Technology and Educational Change

Making the Links

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Abstract

This study investigated teachers' professional learning and pedagogy as they grappled with the challenges and implications of using new information and communications technologies (ICT) in their classrooms. The study's intent was to add to two bodies of literature and research, firstly in relation adult learning, change and teacher professional development, and secondly to understandings about pedagogy and ICT as a catalyst for productive educational change.

Methodologically, two stands of research were conducted. The first involved teams of teachers in a participatory action research (PAR) process where they set the focus for their collective inquiries and learning. The second was interpretive in nature and focused on developing understandings about the way teachers learn and change, their pedagogical interventions, the impact of different professional learning strategies and identification of issues connected with the transition from personal learning to collegial and organizational learning. This strand also identified evidence of change and explicit awareness of the technical, pedagogical, sociocultural, and political dimensions of practice. In particular, the work of Lankshear, Snyder and Green (2000) and Bigum (1995), which argued for an expansion of focus on ICT from technical or operational concerns to the cultural and critical, was a starting point for analysis.

This study combined theory and practice, identifying connections between the grounded experiences of teacher researchers and existing literature and research. Educational practice in terms of four major uses of ICT in classrooms has been described, collaborative analyzed, then linked to the literature and recommendations for future action. These were:

- Digital information resources and new literacy demands: with a particular focus on classroom use of the World Wide Web;
- Collaborative online projects: the human factor in digital communication;
- Innovation, animation and multiliteracies: how teachers introduced and developed the practice of animation in their schools;
- Using ICT in the early years or schooling: in particular, the implications of multiliteracies pedagogy for early years numeracy.

This study identified that teachers have technical/operational and organizational concerns, are influenced by their pedagogical orientation, emphasize both social and cultural concerns, and tend to be critical through localized political concerns more than through broader based consideration of socio-historical or political concerns.

A pedagogical lens, based on six dimensions of pedagogy that were drawn from the literature, was applied to the data generated through the PAR process. This lens helped to delve deeper into what influences teachers' pedagogical decision making. This study identified pedagogical orientation, particularly in terms of whether a teacher was more strongly oriented to the student or to the curriculum, as a major influence on decision making. Teachers craft their educational intentions from different standpoints, which affect the way they interpret student response and how they craft pedagogical action.

A critical lens, based on the work of Smyth (1989), was used to analyze teachers' reflective writing and talk. As a result, it was possible to identify how different data generating approaches produce different emphases in reflective behaviours such as describing, interpreting, confronting and reconstructing.

This study establishes a clear link between the complexity of learning and change that result from professional learning processes that engage teachers-as-researchers, focus more on the pedagogical dimensions of practice than the technical, and raise awareness of the sociocultural and critical through strategic prompts.

Foreword: A Practitioner's Journey

I can trace the serious beginnings of my interest in information and communications technologies (ICT) to 1993 when, as a new teacher at a primary school, my principal asked if I would be interested in becoming Computer Coordinator. Although my computer skills at that time amounted to basic word processing, I was interested and saw the position as an opportunity to expand my existing skills.

When I look back at that year with a somewhat faded memory, I see myself spending large amounts of time addressing technical problems related to hardware and software. I do not particularly remember my technical skills developing to any significant degree but I did become familiar with a range of new software programs. Students in my class took turns playing at the computer, mostly games such as Carmen San Diego, Civilization and Sim City. A copy of Microsoft Publisher was used to develop a regular class newsletter.

The main change that year was in my conceptualization of computer use in the classroom. A conference introduced me to the Internet and possibilities of online communications and projects. Working with the staff to develop a computer policy resulted in my conceptions of computer use changing. I remember developing a simple framework that considered how children would engage with software, ranging from cause and effect responses to more complex thinking. I think this was the moment that I stopped being simply 'socialized'[1] into the use of ICT and started being critical.

It wasn't until I attended the University of Oregon that I really began to explore connections between teaching, learning and ICT and further develop my critical perspective. At the time I met regularly with like minded colleagues, to talk and to write together, and to critique each others' work. When I talked about learning, one colleague was able to point me towards theorists who helped me make better sense of my experiences. During that time I also expanded my technical skills through a range of practical classes. Along with several other colleagues, we decided to run some

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[1] Lankshear et al (1998). Digital Rhetorics: Literacies and Technologies an Education – Current Practices and Future Directions. The authors discuss learning theory in terms of becoming proficient in various social practices. "Acquisition" leads to fluent performance but on its own does not lead to realization of the "cultural and critical dimensions of social practice". They state that a "learning" dimension involving analysis, critique and intervention is necessary if mastery is not to simply become a form of socialization. (p. 46)

professional development sessions that put our beliefs about learning and ways of using ICT into practice. I developed a Web site to support this and consequently improved my understanding of and ability to use the Internet.

At the end of this time, my conceptions of computer use had firmed into a more complex framework than the one that had first developed at the primary school. I could now see software in terms of use as a tutor, an intellectual tool, and a medium for communication and collaboration and I had developed a strong preference for the latter two uses. My views about learning, and adult learning in particular had developed to include dimensions of dialogue, reflection, action and social engagement. A strong influence on my thinking at that time was an international 'Women in Leadership' group which was exploring the concept of 'capacitation' which had been developed in Brazil—evoking capacity within teachers, peeling back layers to reveal understandings and fostering different ways of seeing, so that more confident and informed decisions about practice could be made. Paulo Freire's theories (1973) in relation to literacy learning and 'reading the world' were explored and discussed at length with colleagues.

On my return to Australia, I began working in the area of professional development and ICT. Before long, and despite loftier goals, I found myself entrenched in teaching largely technical skill based programs in a computer lab. One exception was the opportunity to teach an action research based Bachelor of Education degree through a local university. During this course, teachers engaged in more reflective practices and significant changes were noted in terms of their confidence to make decisions about ICT use. Technical skills were developed alongside opportunities to share broader issues that arose in the classroom. A series of professional readings was used as journal and discussion prompts. Connections between theory and practice became more explicit.

This research project was born from a desire to marry the theories that I resonated with to a practical program of professional learning for teachers. It was also born out of a desire to make a difference, and for my work to lead ultimately to productive change in schools and learning experiences for students.

I consider myself fortunate to have had time out from the busy life of teaching to engage in thinking about pedagogy and ICT and the many and varied relationships that can be forged through innovative practice. The reality for many teachers in schools is that they

have no such luxury. Thus this project was also conceived with a goal of providing teachers with a little bit of thinking luxury as well as opportunities to collaborate, learn new skills and be exposed to new ideas and theory.

Section 1: Research and Learning

In this section, I introduce the research project and questions, review the literature and present the methodology. I then report on the first dimension of this research: Teachers' professional learning and change.

Chapter 1: Introduction

As governments have identified a need for a shift in emphasis to 'knowledge-based' economies, they have become increasingly committed to promoting the use of information and communications technologies (ICT) in education (OECD, 1997). This has largely been in response to the pressures that technological change is exerting on labour markets, transforming work practices and creating a need for more highly educated and flexible workforces (Meredyth, Russell, Blackwood, Thomas, & Wise, 1999).

Education must respond not only to labour markets and economic interests however, but also to shifting societal landscapes shaped by globalisation and migration. The development of citizens who are prepared to be active and engaged in their communities, both local and global, and the development of individuals who have a strong sense of their personal identity are also goals (Australian Council of Deans of Education, 2001; Cope & Kalantzis, 2000). New learning for new times has been advocated, with ICT playing a central role and viewed as a catalyst for educational reform (Australian Council of Deans of Education, 2001; Meredyth et al., 1999; Office of Educational Research and Improvement, 1998). In particular, use of ICT has been connected to engagement in authentic, challenging, multidisciplinary tasks; reconstruction of the teacher-learner relationship; and changing the culture of the classroom learning environment (Meredyth et al., 1999).

Within Australia, all states and territories have made the use of ICT in schools a policy imperative and made large investments in infrastructure, both in terms of networking and hardware provision (Meredyth et al., 1999). This in turn has influenced professional development provision for teachers in relation to ICT, with states offering extensive 'train-the-trainer' models of professional development courses together with workshop opportunities, professional networks, conferences, best practice schools and seminars (Education Victoria, 1997; NSW DSE, 1997; Q.D.E., 1997; T.D.E., 1997; W.A.D.E., 1997).

Despite this, significant concerns have been raised in relation to how such technologies are being used in schools and whether they are simply reinforcing old pedagogy better suited for industrial economies (Bigum, 2001; Lankshear et al., 1997; Luke et al., 2000;

Meredyth et al., 1999; Papert, 1997; Yelland, 2001). Innovative use of ICT tends to be limited to individual schools or educational settings where other aspects of schooling are also being challenged (Meredyth et al., 1999; Papert, 1997). This suggests that pedagogical, organizational and curriculum intervention need to be addressed if ICT use is to go beyond adoption and adaptation of the technical.

Thus Silberman's questions (1970) in relation to educational reform and change remain pertinent today:

> *What is education for? What kind of human beings and what kind of society do we want to produce? What methods of instruction and classroom organization as well as subject matter do we need to produce these results? What knowledge is of most worth? (p. 182)*

Similar questions in relation to ICT use also need to be pursued so that technical skilling for its own sake does not hijack the educational agenda. It is important that the sociocultural context of technology use accompanies the development of technical skills and that the medium, the message and the impact on social relations are critiqued (Lankshear, Snyder, & Green, 2000).

Justification for the Project

There have been calls in the literature for professional development programs that are experiential; grounded in inquiry, reflection and experimentation; collaborative and interactional; connected to and derived from teachers' work with their students; sustained, ongoing and intensive; and connected to other aspects of school change (CERI, 1998; Darling-Hammond & McLaughlin, 1995; Hawley & Valli, 1999).

The incorporation of pedagogical skills and understanding of ICT in the classroom has been identified as a priority area for professional development internationally (European Experts' Network for Educational Technology (EENeT), 1998) (Education Victoria, 1998). The emphasis in most European, Australian and USA policy documents is on basic skill development and integration of ICT into the curriculum, rather than questioning the purposes for which ICT is used. In fact, most Australian documents present a strong promotional stance in relation to the use of ICT.

This study has attempted to connect what is known about effective professional development with a critical, pedagogical focus on ICT. The literature clearly reflects a need for critical questioning in relation to ICT use if teachers are to go beyond merely being socialized into its use and move to developing innovations that create new learning opportunities for students (Bigum, 1995; Bigum, 2001; Fullan, 1992; Lankshear et al., 1997; Lankshear et al., 2000; Meredyth et al., 1999; Yelland, 2001).

In addition to researching changes in teacher learning and practice in relation to ICT, the study has also identified changes in the culture, organizational structures and relationships within classrooms that occurred during the research timeframe. The study also demonstrates the depth of change that can occur when a critical, pedagogical perspective guides the professional learning process.

Abi-Raad (1997) has suggested that "there has been relatively little research on how and why Australian teachers use telecommunication technologies" (p. 206). This study has addressed this gap in the research and identified classroom practice, influences and motivations to use ICT with students. At a result of applying a critical perspective to such practice, future recommendations in relation to ICT use in classrooms have been identified through a participatory research process.

Yelland (2001) identified an urgent need for Australian research to inform educational practice in relation to use of ICT, particularly in relation to literacy, numeracy and the concept of multiliteracies. This study has specifically targeted all of these areas.

Research Questions

A challenge for any program related to teachers' professional development and ICT has been how to go beyond the technical and practical. This necessarily involves consideration of pedagogy, organizational structures, sociocultural and critical dimensions of ICT use. With this in mind, initial questions for this research project were:

1. What changes can be identified as a result of teachers engaging in critical reflection and participatory action research as part of the research project?

2. How do teachers link technology use in the classroom and pedagogy?

3. How do teachers articulate the influence of the professional learning strategies on their learning?

4. What changes in the culture of teaching, relationships and organizational structures can be linked with the project experience?

The Project in Outline

In this project, 12 teachers from six different schools collaborated to develop their understandings and practice in relation to ICT use in education. This was the 'sub-text' of the project, which invited teachers to identify either an 'Early Years' or 'Middle Years' educational issue that they wanted to explore in conjunction with their investigation of ICT. Early years teachers initially identified a numeracy and creative thinking focus, which later broadened to address use of ICT across all key learning areas. Middle Years teachers variously focused on literacy, integrated curriculum and the potential of communications technologies to provide new learning opportunities and cross-cultural experiences for students.

The schools invited to participate in the project were all nominated by regional curriculum consultants, who felt that the schools had supportive leadership and a strong interest in developing their practices in relation to the use of ICT. The target schools for the project were also identified as 'disadvantaged', with criteria for selection requiring at least 30% of families to be identified as recipients of the Education Maintenance Allowance, of non-English speaking background, or students qualifying for the Special Learning Needs Index. This requirement was at the request of a Department of Education business partner, as negotiations were in place to later incorporate this professional development program into an 'official' education partnership that was similar to partnerships already established in the USA. The business partner's education initiative was to some degree philanthropic and aimed to increase access to technology in disadvantaged communities and encourage placement of computers in classrooms rather than laboratories. There was also a commitment to supporting teachers to learn from one another by spending time in classrooms rather than artificial workshop situations. At the same time, the business partner hoped to increase their exposure in schools and to trial a particular 'software solution'.

Principals were visited to confirm their interest and were briefed in more detail about the project. They were then asked to nominate teachers who they thought would be interested in participating. These teachers were then visited and provided with an overview of the project and invited to submit an expression of interest.

Of the six schools in the project, two primary schools were located in country or satellite communities within an hour's drive of a capital city. These communities were characterized by low socio-economic status of a high number of families in the area. The other three primary schools were suburban schools characterized by diversity, particularly in terms of ethnicity and socio-economic backgrounds of families. One secondary school participated in the project, and met the disadvantaged criteria as a result of the diversity of socio-economic status of families in the school community.

Teachers in the project varied in age, experience, familiarity and confidence with using ICT. The common link between teachers was a high motivation to improve their confidence and use of ICT in their classrooms and their perceived potential to be leaders and change agents in their school communities. Of the 12 teachers, only three rated their confidence with ICT as medium, with most other teachers describing themselves as novice or beginning users.

The project investigated the process of professional learning and change as well as the learning and change associated with use of ICT in schools. Chapter 2 reviews the literature in this area. Recent views on school change and teacher professional learning are presented, along with key recommendations and justification for particular approaches. As pedagogical intervention was strongly implicated in connection with ICT use in schools, recent research and recommendations in relation to particular pedagogical orientations and approaches are outlined. These have helped to focus the analysis strategy of the research.

Chapter 3 articulates the major issues involved in the choice of research methods. The exploration of themes initiated in Chapter 2 continues—the development of collegial models of professional development that incorporate a teacher-as-researcher role; critical and reflective inquiry; and respect for teachers' concerns and 'ways of knowing' (Cochran-Smith & Lytle, 1999). In this chapter, I conclude that two research strands are necessary to successfully address the research questions and project goals. One strand

involved the project teachers in a participatory research process where they identified the focus of their inquiry and worked in self-selected inquiry teams to implement action research cycles and participate in a range of professional learning strategies. This strand particularly focused on connections between pedagogy, practice and use of ICT.

The second strand of the project consisted of an overarching interpretive study which was designed to support the collective work of the group. In this strand, qualitative methods were used to inquire further into the changes that teachers experienced and facilitated in their classrooms and to identify influences and motivations. Where the participatory strand of the research focused on specific issues of teacher inquiry, the interpretive strand was more wide ranging and designed to address the research questions that were concerned with personal, social and cultural change (Niemi & Kemmis, 1998).

Chapter 4 outlines the various professional learning strategies associated with the project and presents an analysis of their relative effectiveness in relation to change in practice and critical reflection. Teachers' professional learning, change in practice and pedagogy, and the impact and influence of collaboration and collegiality are reported. This chapter also addresses some of the broader issues associated with organizational learning and how individuals approached the task of taking their new learning beyond their own classrooms.

Section 2 (Chapters 5–8) focuses on teachers' use of ICT in their classrooms. Each chapter has been crafted in response to a major investment of time and energy by teachers during the participatory research process. Chapter 5 reports on teachers' use of digital information resources in the classroom, particularly the World Wide Web, and the pedagogical approaches and concerns they grappled with during the course of their inquiries. This is further analysed interpretively and with particular reference to changing conceptions of literacy, such as 'technoliteracy' (Lankshear et al., 2000) and 'multiliteracies' (Cope & Kalantzis, 2000), in order to identify recommendations for future pedagogical approaches and action.

Chapter 6 describes teachers' first forays into online communications projects with their students. Through the participatory research process, they identified key organizational, planning, communication and pedagogical considerations that affected the success of

such projects. Teachers' work in this area is further analysed in light of the pedagogical, sociocultural and critical implications of their practice. Again, further links with the literature are made in order to conclude with recommendations for future action.

Chapter 7 describes the most significant innovation to occur as a result of the participatory research project, where use of ICT was connected to changes in classroom culture, teacher-student roles and relationships, and the development of new literacies and capabilities that were clearly connected with futures oriented education. This chapter describes the impact of teachers' introduction of animation into their classrooms and the fundamental shifts that occurred in pedagogy and practice. It concludes with recommendations for future development and research.

Chapter 8 reports the work of teachers who focused on early numeracy, creative thinking and the use of ICT. Differences in pedagogical orientations are analysed, together with the impact this had on student response. Recommendations for pedagogical approaches and future actions are presented, with reference to the current literature and other recent research in this area. This aspect of the study was able to determine a valuable role for ICT within the early numeracy curriculum, which provided new learning opportunities as long as such experiences were situated within a more complex framework of practice.

In Chapter 9, key issues from the study are revisited from the perspective of the researcher. Written in the first person, this chapter attempts to makes more transparent the impact of the researcher role and issues such as validity, trustworthiness, reflexivity and generalisability. Prior to this chapter, the researcher perspective has been a subtle, yet powerful influence in the crafting of the narratives associated with teachers' professional learning and change.

This final chapter also articulates a way forward, both in terms of teacher professional learning and use of ICT in schools. The implications for teachers, schools and communities are discussed in light of the demands that young people will face in the future.

Chapter 2: Literature Review

This study was informed by research and theorizing in three major areas. Literature related to productive educational change informed the design of the study, which aimed to produce changes in the culture and structures of classrooms and school organization. Together with professional development and adult learning literature, this body of work guided the design of a professional learning program for teachers that aimed to promote productive change through individual, team and whole school learning processes. Specific recommendations in terms of teachers' professional learning and the use of new technologies were also reviewed in terms of both content and process.

This study was also guided by research on successful change initiatives that recommended teacher professional learning programs refocus on pedagogy and teachers' understandings of their own practice, in the context of their beliefs, values, philosophy and theoretical positions. Broad views about pedagogy have been drawn together to provide a lens through which to consider practice and associated theorizing.

Finally, literature related to sustaining change and innovation within organizations is reviewed in order to identify the implications for professional development programs that aim to progress from individual to organizational learning.

Educational Change, Restructuring and Reculturing

Australian government and educational policy in relation to ICT in schools is an example of a major educational change initiative. A significant number of respected researchers have found that the culture of a school is the single most important factor determining the extent to which educational change occurs (Common, 1988; Hargreaves, 1992; Newmann & Wehlage, 1995). Hargreaves (1994) identifies a 'collaborative culture' as being the critical component for sustained educational change. However, he also states that in some cases "it is not possible to establish productive school cultures without some structural changes that increase opportunities for meaningful work relationships and collegial support" (p. 256). Atkin (1991), Newmann and Wehlage (1995), and Hargreaves (1994), all argue that there needs to be a reciprocal relationship operating between restructuring and reculturing for reform programs to achieve positive and long lasting educational change.

What does this mean for those working in schools? Fullan (1993) sees change as starting in the behaviour and culture of teaching and teacher relationships, then spreading and leading to changes in structure. With Stiegelbauer he states:

> *The relationship between changes in behavior on the one hand, and changes in beliefs or understanding on the other requires careful consideration. It seems that most people do not discover new understandings until they have delved into something. In many cases, changes in behavior precede rather than follow changes in belief...We see the relationship between behavioral and belief change is reciprocal and ongoing, with change in doing or behavior a necessary experience on the way to breakthroughs in meaning and understanding.* (Fullan & Stiegelbauer, 1991, p. 91)

Many educational changes occur on a surface level, without real change in school and classroom culture (Cuban, 1988; Sarason, 1990). Elmore (1996) states that it is necessary to change the 'core' of schooling if genuine reform is to be achieved, namely teachers' understanding of the nature of knowledge and students' role in learning, pedagogy and the structural or organizational arrangements of school (p. 2).

Fullan and Stiegelbauer (1991) and Cuban (1988) stress the importance of planning for 'second order changes' which seek to alter the collaborative work cultures of organizations, including new goals, structures and roles. This contrasts with the more common 'first order changes' which improve the efficiency and effectiveness of what is currently done, "without disturbing the basic organizational features" or "substantially altering the way that children and adults perform their roles" (Cuban, 1988, p. 342).

Hargreaves and Dawe (1990) identify two different, contradictory forms of collaboration:

> *In the one, it is a tool of teacher empowerment and professional enhancement, bringing colleagues and their expertise together to generate critical yet also practically-grounded reflection on what they do as a basis for wiser, more skilled action. In the other, the breakdown of teacher isolation is a mechanism designed to facilitate the smooth and uncritical adoption of preferred forms of action (new teaching styles) introduced and imposed by experts from elsewhere, in which teachers become technicians rather than professionals exercising discretionary judgment. (p. 7)*

Newmann and Wehlage (1995) further define what productive collaboration means:

> *When teachers collaborate productively, they participate in reflective dialogue to learn more about professional issues; they observe and react to each others' teaching, curriculum and assessment practices; and they engage in joint planning and curriculum development. (p. 31)*

Neither collaboration nor collegiality alone will promote educational change that produces significant impact on classroom and school culture. Critical reflection is crucial, where teachers "subject their own and their colleagues' practices to critique in light of their social, political and moral implications" (Peters, Dobbins, & Johnson, 1996, p. 60), with a view of creating "a less oppressive, more just, humane, and dignified society" (Smyth, 1987a, p. 4). Such reflection is seen as a vital link if we are to move out of conceptions of schooling that are based on the needs and requirements of the Industrial era and enable teachers to recreate their own work in a form that is suitable for the Information Age (Middleton & Hill, 1996; Smyth, 1989b).

Papert (1997) addresses the issue of school reform from the perspective of re-visioning the learning environment through the use of ICT and argues for broad based change in education that includes:

> *...a different content, different style of learning, different epistemology, and a different medium all matched to one another and to a form of school structured without curriculum or age segregation. (p. 426)*

The issues raised in this section led Fullan and Stiegelbauer (1991) to state:

> *Educational reform will never amount to anything until teachers become simultaneously and seamlessly inquiry oriented, skilled, reflective, and collaborative professionals. (p. 326)*

As a result, Fullan and Stiegelbauer recommend professional development programs aim to bring about change on a multidimensional level if they are to be effective. This clearly has ramifications for the introduction of ICT into schools. Without careful implementation planning, it is quite possible that expensive networks, hardware and software will be used to promulgate only first order changes.

Professional Development and ICT

If professional development programs in the area of ICT are to be multidimensional, they must promote changes in teachers' beliefs, attitudes, theories or pedagogical assumptions; changes in content knowledge; changes in teachers' practices, strategies or approaches; and the possible use of new or revised materials, resources or technologies (Conners, 1991; Fullan & Stiegelbauer, 1991). Peters, Dobbins and Johnson (1996) provide a practical summary of what they see as effective professional development, which leads to a "culture of collective inquiry" (p. 59). They state it is necessary to address:

- *the knowledge, skills and attitudes needed to effectively implement the change in ways that improve learning programs*
- *strategies for coping with the change process*
- *strategies for democratic decision making*
- *the interpersonal skills needed to work collaboratively*
- *skills of critical reflection and collective inquiry.* (p. 64)

Despite such new understandings emerging as to what conditions are likely to lead to educational change, the majority of organized professional development options for teachers are "specific, focused on particular innovations and isolated from each other" (Fullan & Hargreaves, 1996, p. 16).

This is particularly true in relation to use of information and communication technologies where short courses that focus on use of hardware and software are prevalent (Meredyth, Russell, Blackwood, Thomas & Wise, 1999). Meredyth et al. found, in their review of the literature, that in-service training and professional development failed to be integrated into plans for ongoing development of computer use by classroom teachers (p. 17). McLaughlin and Marsh (1978) stress that skill-specific training by itself has only a transient effect because the use of new materials and methods is often mechanical without the underlying ideas becoming assimilated. Similarly, the learning of new skills through demonstration and practice does not necessarily include the learning of the conceptual underpinnings necessary for lasting use (Bussis, Chittenden, & Amarel, 1976; Hall & Loucks, 1978; Joyce & Showers, 1988; McLaughlin & Marsh, 1978 cited in Fullan, 1991 #13, p. 85). Beynon (1993)

stresses that technological literacy for teachers "demands knowing about technology in more than a skills way" (p. 223) and requires both educational and cultural knowledge.

The 1998 European Experts' Network for Educational Technology (EENet) report on ICT in education policy states that teacher professional development is:

> *...one of the most exacting challenges and one which will require government intervention to set frameworks. Pedagogical use of ICTs as well as basic beginner training will be needed...approaches which include the use of peer support, personal access to the technology and the opportunity to learn from more skilled teachers are likely to have the most impact. (p. 16)*

Fullan (1992), in his review of an implementation effort of microcomputers in Canada, states that the use of new hardware and software is the easiest to implement while:

> *The most effective teaching practices in relation to particular pieces of software—and the corresponding conceptual understanding...are (1) not well specified, developed or known; (2) are complex; and (3) are at the heart of successful or unsuccessful implementation. (p. 30)*

Other organizations concur with this concern (EENet, 1998). Jurema (1998) goes further and advocates the development of a political view of technology:

> *A political view of technology should lead to new, previously unasked questions and push beyond simply establishing ties between the technological requirements of larger society and formal institutions of education, or even finding ways to integrate computer technology and curriculum. It is crucial that political, ideological, economic and philosophical issues, which are usually hidden or not well emphasized, are brought into the educational debate. (pp. 142-143)*

Beynon & Mackay (1991) state that there have been few attempts to develop a conception of computer use that goes beyond an emphasis on the technical. Surveys of what teachers themselves request in this area have produced recommendations that are firmly focused on the technical and day-to-day implementation (Conners, 1991; Rowe, 1993).

Two Australian studies, *Real Time* (Meredyth et al., 1999) and *Digital Rhetorics* (Lankshear et al., 1997) identify serious problems with the teacher knowledge and proficiency base around use of new technologies. Meredyth et al. found that, although the majority of teachers possess basic skills and familiarity with computers, there was:

> *...little evidence that teachers are extending these basic skills in ways that are likely to fundamentally change the ways they teach, or in ways that will enable the use of computers as other than relatively low-level educational tools. (p. 263)*

They recommend ICT skills be developed in the context of teaching other useful knowledge or integrated across the curriculum and be accompanied by the development of students' awareness of "when and why they would use the skills, together with a readiness (even a desire) to use that skill" (p. 264). Such levels of awareness would contribute to flexibility, the ability to be autonomous and adapt to change, identified as capacities for life-long learning (Hattie et al., 1996; Warner & Christie, 1998 cited by Meredyth et al., 1999, p. 264 & p. 251). Along with Tully (1997, cited in Meredyth et al.), the *Real Time* study found that informal learning was the primary means of learning ICT skills for both students and teachers. This has implications for the design of learning environments, with opportunities for 'situational learning' within 'experience-rich contexts' recommended (Kirshener et al., 1997).

Meredyth et al. (1999) also identify productive use of ICT, where it has been used as a resource to achieve "fundamental reform in everyday classroom practice" (p. 266). In these instances, ICT was associated more with the development of "competent citizens in this information age" than with skill development (p. 266). They argue strongly that technological competence must be seen as:

> *...not only technical skills, but also understanding of the social and cultural relevance of learning activities, the ability to transfer knowledge and skills to new tasks and situations, and the capacity to think broadly and critically about the impacts of human activities on each other and the environment. (p. 270, also cited AEC and MOVEET 1992, Tinkler et al. 1996)*

Carlson (1994) identifies teachers' beliefs as the most important influence on what they do in the classroom. He suggests that linking beliefs about students, teaching, and

information technology is one of the most critical aspects of professional development in this area. He recommends that professional learning programs:

- assist teachers to uncover their personal beliefs about teaching;
- encourage teachers to describe their experiences with information technology and the assumptions they have about information technology;
- allow time for reflections;
- probe for deeper understanding;
- encourage teachers to go beyond 'fitting in to the curriculum' when they design information technology activities;
- help teachers to identify persistent difficulties within the curriculum, topics with which students consistently have problems. (cited in Meredyth et al., 1999, p. 284)

The *Literate Futures* report (State of Queensland, 2000) identifies multi-mediated communication and multiliteracies, requiring new 'repertoires' of practice, as futures oriented literacy practices. These will require students to develop mastery across oral, print and multimedia communication. The concept of multiliteracies in relation to new communications technologies involves "new blends of skills and practices that engage simultaneous and blended uses of traditional print literacies with designs of visual, aural, aesthetic and other kinds of representations" (The New London Group, 1996 cited in The State of Queensland Literate Futures Report, 2000, p. 19). Despite this, the *Literate Futures* report notes that:

> *The technological upgrading of the teaching force, on the one hand, and the integration of new technologies with print literacy and multiliteracy-focused teaching on the other, have been separated. This is a significant problem because it treats technological competence as 'button pushing' and 'technical know-how', rather than critical pedagogical intervention. (p. 19)*

The report recommends that pedagogical and technical training for teachers should be dealt with in an integrated fashion. Such professional development programs need to address pedagogical support and resources for innovation in engaging with the literacies of new technologies to enhance teacher or student multiliteracies (p. 24). Professional development programs therefore need to encourage teachers to learn how to work with

"the multiliteracies that are increasingly required for work and leisure, citizenship and community participation, personal growth and cultural expression" (p. 24).

Lankshear, Snyder and Green (2000) build on their work from Digital Rhetorics (1997) to also recommend a literacy orientation to the use of ICT in education. They suggest that literacy always involves some kind of technology when literacy is considered as "language made visible" (p. 25). For them, new 'technoliteracies' are a necessary part of becoming multiliterate as print literacy transforms in relation to "new technologies, new cultures, and new forms of life (Durrant & Green 1998, p. 5 cited in Lankshear, Snyder & Green, 2000, p. 27). They argue that all learners must become proficient in three dimensions of literacy and technology: the operational, the cultural and the critical. The operational dimension "is a matter of individuals being able to read and write in a range of contexts, in an appropriate and adequate manner" and includes "competence with the tools, procedures and techniques involved in being able to handle the written language system" (p. 30). The cultural dimension involves being literate with regard to some aspect of knowledge or experience so learners can make and grasp meanings as part of social practice. This means understanding the purpose of particular social and cultural practices and why they are appropriate. The critical dimension goes beyond using and being socialized into a range of literacy and technology practices to attend to "context and its significance in terms of meaning and power" (p. 32). Critical literacy is necessary if individuals are to be able to critique and transform existing literacy and technology practices and actively produce new social practices (p. 31, 46). Thus teacher professional learning programs, which aim to develop teachers' ability to use ICT effectively in educational programs, would benefit from being situated in a broad context of multiliteracies development, with particular consideration of new technoliteracies.

Collins (1991) states that teachers learn best when they can "diagnose their own learning, have the opportunity to try out, discuss, observe others, reflect, evaluate, and rediagnose" (p. 17). Hawley and Valli (1999), Brookfield (1995), Freire (1994) and Horton (1990) however, all caution that teachers' experience should only be a starting point and that it is important that someone asks provocative questions and supplies alternative interpretations or information while maintaining the link to the experiences being analysed. How then, might professional development programs go about developing this critical/political perspective?

Developing a Critical/Political Perspective

Kincheloe (1991) argues for a notion of teachers as 'critical researchers' as the world becomes increasingly marked by "technicalization...(and) a powerful mass communications industry which helps shape human interests and ideological orientations, and an increasing domination of individuals by groups with excessive power" (p. 1). In his view, teachers must subject their own and their schools' practices to "questions of educational purpose or social vision" (p. 15), examine the ways ideology shapes social relations and debate issues of ethics and morality. Cochran-Smith and Lytle (1999) review the teacher research movement and distinguish three interconnected conceptual frameworks: teacher research as social inquiry, teacher research as ways of knowing within communities and teacher research as practical inquiry.

Other writers similarly advocate action research, action learning and critical reflective practice on the basis that they develop teachers' abilities to theorize about practice and to think systematically about what they are doing (Brookfield, 1995; Grundy, 1995; McNiff, 1998). Brookfield (1995) recommends that four different lenses be used in order to become a more critically reflective practitioner. These are (1) our autobiographies as teachers and learners; (2) our students' eyes; (3) our colleagues' experiences and (4) theoretical literature. Use of teachers' writing in the form of journalling (Hogan, 1998), case writing (Cherednichenko, Gay, Hooley, Kruger, & Mulraney, 1998) and analysis of critical incidents (Tripp, 1998) are particular examples of processes that enable teachers to reclaim their professional knowledge (Down, Hogan, & Swan, 1998).

Thus professional learning programs that aim to link technology with educational reform must include a critical, political and moral dimension if we are to avoid what Kincheloe calls "an erosion of competence" and establish instead "communities of competence" in our schools (p. 2). The development of collegial relationships based on 'productive collaboration' (Newmann & Wehlage, 1995), an increase in opportunities for teachers to research and contribute to knowledge about their practice, and changes in school structures and cultures to support these processes are also indicated.

Such programs must also turn this critical view towards rethinking pedagogy; the nature of knowledge, curriculum and assessment; the structures and organization or schooling;

and the nature of the teacher-student and student-student relationships in light of technological and societal change (Australian Council of Deans of Education, 2001; Cuban, 1993; Luke et al., 2000; Meredyth et al., 1999). Pedagogy, relationships and structures within the classroom are within the province of teachers' individual capacities to leverage change and reform.

Pedagogy and Practice

Kruger et al. (2001) argue that, when classroom practice and pedagogy are taken as the starting point for inquiry, teacher and student agency are more openly represented. They recommend that acknowledgement of such agency, in conjunction with the structures that shape the social practices of education, needs to be a part of social research studies in schools (p. 18-19). This section reviews current conceptions of pedagogy and identifies a range of dimensions through which to reflect upon practice. This view of pedagogy is then extended into consideration of recent research on 'productive pedagogies' and links with authentic learning and improved student outcomes. The concept of critical pedagogy, which acknowledges the influences of agency, context, and structures, and the implicit power relations from a political, economic and cultural perspective (Kruger et al., 2001), is also reviewed.

Critical Pedagogy

Kenway and Modra (1992) state that critical pedagogy was a response to conceptions of pedagogy that were blind to the broader social relationships embodied in the teaching and learning process. Referencing the work of Lusted (1986), they state:

> *The concept (of pedagogy) must be concerned with what is taught, how it is taught and how it is learned and, more broadly, with the nature of knowledge and learning...(An) understanding of pedagogy must recognize that knowledge is produced, negotiated, transformed and realized in the interaction between the teacher, the learner and the knowledge itself. (p. 140)*

Lusted's view (1986) of pedagogy addresses "the transformation of consciousness that takes place in the intersection of three agencies—the teacher, the learner and the knowledge they together produce (p.3).

Lather (1992) supports the position of Ellsworth (1992) who offers a critique of critical pedagogy by discussing such issues as empowerment, teacher authority, student voice

and dialogue. Ellsworth notes that strategies such as "student empowerment and dialogue give the illusion of equality while in fact leaving the authoritarian nature of the teacher/student relationship intact" (p. 98).

Smyth (1987a) states that "a truly critical pedagogy involves an examination of existing social relationships at three levels: that of history, of current practice (including its hierarchical bases), and of the potential to transform arrangements in the future" (p. 160). He suggests four forms of critically reflective action that can raise awareness about such relationships and lead to action that produces more socially just and humane educational outcomes: describing, informing, confronting and reconstructing (Smyth, 1989a). This kind of reflection must necessarily go hand in hand with pedagogical development.

Dimensions of Pedagogy

Max van Manen (1991) defines pedagogy as:

> *...the influences that are at the heart of the special interactions, situations, and relations between educators and students... animated by an orientation to the good, to what is good for this child— meaning that this orientation has pedagogical intent. (pp. 16-17)*

Pedagogical influences, in van Manen's view, are context specific and always practical. They are normative to the degree that they indicate a teacher's orientation to children and how they exercise their responsibilities. For van Manen, teachers always stand in pedagogical relationship with children and as a result of pedagogical action are prodded to reflect upon whether such action was the best possible. Pedagogical thoughtfulness and self-reflection are the hallmarks of what he calls "pedagogical tact" or the "practice of being oriented to others" (p. 139), so that situations are considered from the child's point of view and how they experience their world.

The New London Group (2000) define pedagogy in terms of relationship:

> *Pedagogy is a teaching and learning relationship that creates the potential for building learning conditions leading to full and equitable social participation. (p. 9)*

Their multiliteracies pedagogy is based on how the human mind works in society and classrooms and is a complex integration of "situated practice, overt instruction, critical framing and transformed practice" (p. 35). Situated practice involves immersion in a community of learners engaged in authentic versions of practice so that mastery is achieved. They caution that immersion can result in children pursuing "wrong leads" and does not necessarily lead to "conscious control and awareness of what one knows and does" (p. 32). In addition to this, they state that such situated practice does not necessarily create learners who can critique or put their knowledge into action. They draw on the teachings of Vygotsky (1978, 1987 cited in The New London Group, 2000) to recommend that certain forms of overt instruction are needed to support immersion or acquisition if learners are to gain conscious awareness and control of what is acquired. Again they caution that such overt instruction used in conjunction with immersion can lead to uncritical socialization where learners are unaware of the cultural locatedness of various meanings and practices. Critical framing is therefore an important aspect of pedagogy as it allows learners to gain distance from what they have learned so that they can constructively critique it in relation to its context. Transformed practice refers to the ways teachers provide learners with opportunities to "demonstrate how they can design and carry out, in a reflective manner, new practices embedded in their own goals and values" (p. 35).

Although van Manen's (1991) notion of pedagogy as situational, and The New London Group's (1996) situated practice have similarities, they differ fundamentally in that van Manen focuses specifically on the relationship between the teacher and child while The New London Group refers to more complex relationships that may include expert novices within a learning community. Where The New London Group focuses on the opportunities teachers need to provide children, van Manen focuses upon the actual experience of pedagogy in action. He goes beyond defining pedagogy as a relationship between adults and children, or a way of doing, to include what makes "an encounter, a relationship, a situation, or an activity be pedagogical" (p. 31). In particular, he stresses that pedagogy should orient us to the child and the child's growth, not the curriculum and structures of schooling. Central to van Manen's concept of pedagogy is the 'pedagogical moment' which arises out of everyday practice when an adult must act on the spur of the moment and "do something pedagogically right in his or her relation with some child or children" (p. 40). He distinguishes between two kinds of pedagogical

practices—actively living through pedagogical experiences and reflectively talking or writing about these experiences. Both intersect to influence adults in the action they take in pedagogical situations. When teachers act in the pedagogical moment, they draw on their reserves of past experiences, beliefs, philosophy, values, cultural norms, knowledge and relationships to craft a response. This, for van Manen, is the essence of pedagogy.

Van Manen (1991) discusses a range of interconnected aspects of pedagogy:

- Intention: the active and reflective distinctions as to what is good for a child that guide and adjust curriculum planning and the formulation of learning objectives;

- Empirical: ascertaining the 'facts' of a situation, which may involve interpretive or evaluative judgments;

- Ethical-moral: value judgments in terms of what is 'good' for the child, which are often embedded in culture and everyday life;

- Method: skills, techniques, teaching methods and curriculum programs;

- Philosophy: the larger philosophical perspective impacting the child's education, theoretical stance;

- Orientation to the child and their context: the quality of relationship between teacher and child; sensitivity to children's backgrounds, life-histories and individual qualities;

- Tensions and contradictions: contrasting principles that cause us to continually reflect upon and clarify how we should act with children e.g. freedom vs. control; right vs. wrong; security vs. risk; ideal vs. reality etc.

- Pedagogical tact: a mindful orientation to how one is and acts with children.

Kruger et al. (2001), in their discussion of social practice in the classroom, contend that it is important to study "what teachers and students intend, how teachers put their intentions into practice and how students respond in understanding and action" (p. 12). Drawing on the work of Sewell (1992) and Giddens (1984), they note that "to explain social situations is to understand how structures affect people and how people perceive those structures and how they respond to them" (p. 14) where structures are understood as the "'rules' and 'resources' which people, individually and collectively, understand

and mobilize in different ways to express their agency" (p. 14). In order to understand social practice, it is also necessary to try to "understand how teachers and students act on each other, and on schools and systems" (p. 22).

Kruger et al. (2001) go beyond van Manen's (1991) view which focuses on 'pedagogical intention' to recommend consideration of both teacher and student intentions and the structural constrictions they deal with as they engage in social practice. Similarly to van Manen though, Kruger et al. note that teaching is both a technical and philosophical undertaking and that from educational and research standpoints, it "is how practitioners integrate the technical and philosophical in practice, as a reflexive and reflective accomplishment" that is at stake (p. 21).

Kruger et al. (2001) also argue a case for "authentic pedagogy and curriculum" which is "the acknowledgement by a student that learning directly advances personal interests" (p. 148). Findings from their research indicate that teaching practice must enable the "agency-filled activity of students" so that they are engaged in authentic learning with tangible benefits to themselves or their community. Such student agency must go beyond demonstrating learning to teachers to involve working for change and improvement.

Authentic and Productive Pedagogies

Newmann and Wehlage (1995) and Newmann and Associates (1997) identified the following characteristics of "authentic pedagogies" as part of their Center on Organization and Restructuring of Schools (CORS) research in the USA: students are active constructors of knowledge; they engage in disciplined inquiry; and learning has value beyond the school. The CORS research concluded that student learning was enhanced when teachers engaged in such authentic pedagogies. The Queensland School Reform Longitudinal Study (SRLS) (Luke, Ladwig, Lingard, Hayes, & Mills, 1998) built on the CORS research to identify a more complex set of strategies they termed "productive pedagogies". This study classified four categories of such pedagogies: intellectual quality, social support, relevance and recognition of difference. Within these categories they identified 20 strategies (see Table 1).

Table 1: Productive Pedagogies: School Reform Longitudinal Study (1998)

Intellectual quality	Higher-order thinking Deep knowledge Deep understanding Substantive conversation Knowledge seen as problematic Metalanguage
Relevance	Knowledge integration Background knowledge Connectedness to the world Problem-based curriculum
Social Support	Student control Student support Explicit criteria Engagement Self regulation
Recognition of Difference	Cultural knowledges Inclusivity Narrative Group identity Citizenship

Kruger et al. (2001) caution that although the SRLS 1998 study accorded prominence to teacher and student agency, this agency was still limited by the identification of strategies that result in measurable outputs, with particular emphasis on individualized, higher order thinking. They propose that authentic learning is characterized by:

- *A trajectory from conversation to production/publication*
- *Students learning with others and in groups*
- *Active production*
- *Usefulness and meaning for students*
- *Student participation in deciding what should be learned and how. (p. 150)*

Kruger et al. (2001) further address the notion of authentic pedagogy by connecting the following practices to the emergence of authentic learning:

- *Relationships, respect and collaboration—between teachers and students, among staff and between staff and school management*

- *Thoughtful awareness and response*

- *Talk and communication in teaching and learning*

- *Explicitly participatory leadership and educational values*

- *Personal commitment to students and the morale needed to initiate change. (p. 150)*

Authentic pedagogy suggests moral purpose (Hargreaves, 1995) in terms of preparing and encouraging students to act knowledgeably and powerfully in the classroom and beyond.

How can these different but connected views/theories be used to help develop understanding in relation to teachers' practice and pedagogy? For the purpose of this study, they have been amalgamated to the following dimensions of pedagogy, and used as a lens for analysis:

Table 2: Analysing Teachers' Practice

Dimensions of Pedagogy	
Educational intentions:	Intentions of the teacher in terms of what is to be taught and intentions of the student in terms of what will be learned (Kruger et al., 2001; van Manen, 1991).
Influence of context, structures and norms	Cultural norms, rules, resources and socio-historical connections (Giddens, 1984; Kruger et al., 2001).
Philosophical orientation	Beliefs, values, orientation to the child and the child's growth, ethical-moral stance (Kruger et al., 2001; van Manen, 1991).
Strategies, methods and technical knowledge	Actions devised from knowledge of teaching methods, skills and curriculum programs to implement educational intentions. E.g. productive pedagogies, situated practice, overt instruction (Cope & Kalantzis, 2000; Kalantzis & Cope, 2001c; Luke et al., 2000)
Relationships and interactions	Interpersonal, intra-individual and socio-historical orientations (Cope & Kalantzis, 2000; Kalantzis & Cope, 2001c; Kruger et al., 2001; van Manen, 1991)
Thoughtful awareness and response	What is noticed, interpretive and evaluative judgments, recognition of tensions and contradictions, tailored learning opportunities, critical framing in relation to cultural locatedness and context (Cope & Kalantzis, 2000; Kalantzis & Cope, 2001c; Kruger et al., 2001; van Manen, 1991).

These dimensions are interconnected with educational intentions of the teacher often reflecting their philosophical orientation or being impacted by existing structures and norms. Orientation to the child and the curriculum will impact relationships and interactions and the way teachers craft a response to the child. Such response will also be impacted by knowledge about and familiarity with strategies and methods that can be implemented in both a planned and spontaneous interaction with students. Pedagogy not only shapes relationships but affects knowledge transmission and construction through schooling.

Pedagogy and Knowledge

Singh (2001) notes that many radical pedagogies which aim to contest educational disadvantage (critical, feminist, post-structural, post colonial etc.) "focus on the sociology of "knowers and their relationships" (Moore & Muller, 1999, p. 190) at the expense of "analyzing the internal structuring of the specialized forms of knowledge transmitted through schooling" (p. 252). According to Moore and Muller "knowledge forms and knowledge relations are [often] translated as social standpoints and power relations between groups" (p. 190).

In contrast to this position, Bernstein (2001a) wrote extensively about the rules/principles generating the transmission (selection, organization and evaluation) of knowledge through schooling. He proposed that a specialized "pedagogic discourse" transmits two modes of knowledge—knowledge pertaining to abstract concepts/skills and knowledge pertaining to moral conduct. This discourse comprised both instructional components (knowledges/cognitive competencies and their organization and evaluation) and regulative components (principles which guide such selection, organization, pacing, criteria etc. of content; theoretical underpinnings; values, attitudes and socio-affective competencies; and establishment of identity, roles and relationships between teachers and learner (2001a) (Neves & Morais, 2001)). "Recontextualising agents", such as classroom teachers and syllabus writers, select from these discourses in order to enact pedagogic discourse (Singh, 2001, p. 253). Pedagogic discourse embeds the instructional in the regulative and Singh notes that regulative discourses "perform a crucial ideological function because they conceal the relations of power and control generating the arbitrary internal ordering of school knowledge" (p. 254). Bernstein made explicit the dominance of the regulative and theorised "how power relations are transformed into what there is to be known, or discourse, and how access to it is regulated, whether in the family, school or at the knowledge frontier" (Davies, 2000, p. 1).

Bernstein (2001b) also raised concerns about what he saw as the development of a "totally pedagogised society" (p. 380), where pedagogy is viewed as a technology that can be enacted in quite a mechanical way as people "put together a discourse aimed at producing changes in individual experiences, knowledges, and competency" (p. 380). When pedagogy is enacted in this way, it results in a mode of socialization characterised

by "trainability" or the "ability to respond effectively to concurrent, subsequent, or intermittent pedagogies", what Bernstein (2001a) called learning for the "short-term" (2001a, p. 366). Instead, Bernstein (1971)(2001a) advocates a long-term view where pedagogy involves collective and interdependent consideration of curriculum, teaching, evaluation and social relations so that learner identity arises out of reciprocal recognition, support, legitimation, and negotiated collective purpose (Bernstein, 2001a, p. 366). Bernstein's view provides a useful framework for considering the interconnectedness of the dimensions of pedagogy outlined in the previous section.

Bernstein (1975) differentiates between "visible pedagogy" where there is clear differentiation between curriculum areas (classification) and a prescribed "modality of socialization" (framing) and "invisible pedagogy" with "weakened" classifications and framing (pp. 143-144). Moore and Maton (2001) link Bernstein's (1971; 1975; 1990; 1996; 1999) theorizing about pedagogy to the production of knowledge, arguing that this is also characterised by differing principles that regulate the organization and mode of production so that certain things are made "visible and potential objects for knowledge, and other things invisible within its current field of vision" (p. 157). They propose that:

> *The epistemic device is the generative principle for the construction of knowledge, or more precisely, for the distribution, recontextualisation, and evaluation of legitimacy in intellectual fields of knowledge production. That is, the epistemic device regulates who can produce legitimate knowledge, the ways in which antecedent knowledge is selected and transformed in the course of producing new knowledge, and the criteria for adjudicating claims for new knowledge. (p. 176-177)*

Their construction of the "epistemic device" is an analogue to Bernstein's (2001b) "pedagogic device" which aimed to "show how pedagogic discourse was itself constructed" (Bernstein, 2001b, p. 373). Moore and Maton (2001) suggest that it is necessary to consider both pedagogic and epistemic devices to understand the recontextualisation, reproduction and production of knowledge and that they represent two different dimensions of an "overarching knowledge device" (p. 178). In their view, it is through consideration of the nature of relations between the epistemic and pedagogic devices that different knowledge stances that favour either the relationship of

the knower *to* knowledge OR the relationships *within* an intellectual field of knowledge can be understood and ultimately integrated.

The Australian Council of Deans of Education (2001) has produced a charter for new learning and change in education that considers education's role in preparing future workers, fully participating citizens and individuals secure in their identity. In particular, The Council argues that:

> *New learning will be general in its focus, rather than specialised on the particular needs-of-the day. It will be about creating a kind of person, with kinds of dispositions and orientations to the world, rather than simply commanding a body of knowledge. These persons will be able to navigate change and diversity, learn-as-they-go, solve problems, collaborate, and be flexible and creative. Finally, new learning will be increasingly interdisciplinary, requiring deeper engagement with knowledge in all its complexity and ambiguity. (pp. 2-3)*

The Australian Council of Deans of Education (2001) also contends that a "New Basics" is emerging that must be about "promoting capability sets, reflexive and autonomous learning, collaboration, communication, and broadly knowledgeable persons" (p. 3). In theview of the Council, old learning, which focused on fixed content knowledge, is now redundant as it "fosters a rigid way of thinking which will be counterproductive for the workers, citizens and persons of the new future" (p. 61). Instead, the Council argues:

> *The new learning is less about imparting defined knowledge and skills and more about shaping a kind of person: somebody who knows what they don't know; knows how to learn what they need to know; knows how to create knowledge through problem solving; knows how to create knowledge by drawing on informational and human resources around them; knows how to make knowledge collaboratively; knows how to nurture, mentor, and teach others; and knows how to document and pass on personal knowledge. In sum, this kind of person is open to autonomous, assisted and collaborative learning. (p. 61)*

This charter implicates Bernstein's (1975) notions of invisible pedagogy, with implicit hierarchy, sequencing rules and criteria and the underlying rule that "things must be put together" (p. 120). Bernstein sees the locus of social control in invisible pedagogy as

being "vested in the process of interpersonal communication" (p. 135) and, as the outcomes of socialization are less certain, ambiguities are created. Despite such ambiguity, such a move to invisible pedagogy has the potential to make visible "fundamental social contradictions" and, when the implicit is made explicit, such ambiguity has "less disguise" (p. 146).

The issues raised by this charter also implicate Moore and Maton's (2001) epistemic device as the nature and durability of knowledge, valued capacities of individuals and the way knowledge is produced and transformed are called into question. The Australian Council of Deans of Education (2001) point out that knowledge today is highly situated, rapidly changing and diverse, requiring doing things in different ways for different contexts (pp. 85-86). Increasingly, states and territories in Australia are reconceptualizing "the basics" as more general forms of knowledge rather than subject disciplines, and blurring the boundaries between knowledge domains. Brennan (2002) has summarized this as follows:

Table 3: New Basics and New Key or Essential Learnings

Qld	SA	ACT	Tasmania
Life pathways and social futures	Identities	Critical literacies: reading the world	Personal futures
Multiliteracies and communications media	Communications	Community building: learning to live together and with others	Communicating
Active citizenship	Inter-Dependence	Working with cultural, ethical and environmental heritages	Social responsibility
Environments and technology	Futures	Real life research and futures study	World futures
	Thinking		Thinking

(adapted from Brennan, 2000)

Research that aims to identify the success or otherwise of educational change initiatives must therefore consider Bernstein's (1971) long-term view of pedagogy connecting

curriculum, teaching, evaluation and social relations. Values, beliefs, knowledge and understandings about these areas, as well as design and implementation skills, are critically connected. A shift from visible pedagogy and hierarchical and sequential bodies of knowledge or disciplines also has implications for the ways new learning is assessed and monitored, with testing of fixed content knowledge replaced by methods that are more oriented to interpersonal communication (Bernstein, 1975) such as project, performance, group and portfolio assessments (Australian Council of Deans of Education, 2001).

This also suggests identified knowledge or content domains need to be framed within the broader context of pedagogy and indeed may even become redundant or change in a short space of time. For example, the following recommendations on information and communication technology (ICT) skills and knowledge (Cuttance & Stokes, 2000) are mostly concerned with the technical or operational dimension of ICT use (Bigum, 1995; Lankshear et al., 1997; Lankshear et al., 2000):

- Information management skills and knowledge: organization, management, sourcing, storage and transfer of information;

- Understanding social and ethical contexts of information use: ownership, ethics, intellectual property;

- Creation skills: word processing, authoring, multi-media skills (including video, sound, graphics, etc);

- Communication skills: connectivity, group processes;

- Thinking tools: extending personal capacity to enhance one's own knowledge and understandings through analysis, problem solving, simulation, computation, etc;

- Research and information classification skills: representation, synthesis, evaluation, interrogation of information to create knowledge; and

- Creative and design skills and knowledge: using a design/make/evaluate/improve cycle to create information and communication products and models. (p. v)

In contrast, Yelland (2001) calls for the identification of more pertinent research questions that will support the effective use of ICT in schools. She questions the knowledge base in relation to ICT, reflecting, "Are we asking the right questions? And who decides what the right questions should be?" (p. 31). In particular, she stresses the need to "seek new ways to reconceptualize curricula that illustrate the important benefits that ICT can bring to education, rather than continue with our practice of fitting new technologies into old curriculum or within the context of traditional didactic teaching methods", simply as an "add-on" (p. 36). Only then can ICT be linked to productive educational change.

If productive educational change is to go beyond individual classrooms and be sustained within an organization, it is necessary to go beyond pedagogical considerations to address organizational learning.

Organizational Learning

A focus on pedagogy provides a way of talking about the relationship between teaching and student learning, so that as aspects of pedagogy are made explicit, it becomes possible to examine and change practice. Just as an emphasis on pedagogy can help to transform individual classrooms, an emphasis on organizational learning can help to transform a school.

Senge (1990) advocates that all organizations become "learning organizations" characterized as a place:

> *...where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning how to learn together. (Senge, 1990, p. 3)*

and

> *...an organization that is continually expanding its capacity to create its future. (p. 9)*

Central to Senge's notion of a learning organization is the recognition of the interdependence or "connectedness" of factors within an organization. Bivins-Smith (1996) identifies leadership as crucial in relation to the sustainability of innovations and

new perspectives particularly through opportunities for "employees…to connect 'lived experience' to the daily machinations of an organization" (p. 22).

Marsick and Watkins (1996) point out the difference between an "organization of individuals who learn" and "a learning organization". In the latter:

> *Lessons must be captured, shared, and used by the organization so that this collection of people, working together, join in charting the way they respond to challenges within and outside their institutions. Old ways of thinking, socially constructed and maintained, must be questioned. Learning must take place, and be supported, in teams and larger units where individuals can join together to mutually create new knowledge. We define a learning organization as "one that learns continuously and transforms itself". (p. 18)*

They expand on the work of Senge (1990) and suggest six action imperatives for building learning organizations:

- Create continuous learning opportunities
- Promote dialogue and inquiry
- Encourage collaboration and team learning
- Establish systems to capture and share learning
- Empower people toward a collective vision
- Connect the organization to its environment.

Staples (2001) notes that:

> *A learning organization is about more than just helping the individuals to learn within an organizational context. It is also about the collective learning of the organization itself, as individuals build on the learning of others to which they now have access. (p. 41)*

Liebowitz (2000, p. 9) considers "social capital" the most critical element necessary to build knowledge capital and thus organizational intelligence. According to Prusak (1998), cited by Liebowitz, (2000, p. 9) this involves:

- trust
- space (cognitive space—share of mind around knowledge)
- slack (time to reflect on what you know)

- coherence (shared context, shared language, "communities of practice")
- shared vocabulary
- symbols and signals.

Liebowitz (2000) argues that social capital contributes significantly to organizational learning. Essential characteristics of organizational learning include: new skills, attitudes, values, behaviours and products created or acquired over time; what is learned becomes the property of some collective unit; and what is learned remains within the organization or group even if individuals leave. A challenge for organizations is to enable transitions from personal learning to organizational learning so that it becomes possible to create a learning organization or learning community.

Conclusion

This review establishes the need for professional learning programs that develop teachers' skills, understandings and beliefs about ICT within broad pedagogical, sociocultural and critical contexts and with an emphasis on preparing students for the future. Such professional learning programs must "confront the normal" (Dalmau, 2002) in relation to curriculum, assessment practices, teaching and learning, organizational structures, and social relations within classrooms and the larger organization if futures oriented reform is to occur. The literature review suggests that involving teachers as researchers and placing strong emphasis on critical reflection and reconstructing practice are necessary components of successful professional learning programs. Individual professional learning must similarly be connected to sustainable organizational learning if innovation or new teaching and learning practices are to become institutionalised or culturally 'normed'.

This study consists of a design, implementation and evaluation of a professional learning program with such reform and futures oriented intentions, particularly in relation to use of ICT. The literature suggests beginning with an individual learning focus, allowing teachers to set their own goals and to experiment within a supportive, collegial, yet critical environment, then connecting this with team and organizational learning. For this reason, a participatory action research process was selected as a methodological strand.

Pedagogy was also implicated as a starting point for intervention, so this study responds to a gap in the literature in relation to teacher professional development and ICT, taking a strong pedagogical rather than technical focus. This necessitated a second interpretive strand to the methodology that analysed links between ICT use, pedagogy, critical reflection, teacher learning and educational change.

This study therefore addresses calls for professional learning strategies with teachers that aim to produce second order change effects so that roles, relationships and organizational structures and culture are substantially changed. The use of ICT, strongly implicated as both a cause and consequence of futures oriented changes in society and education, provides a focus and catalyst for exploring change and learning with teachers.

Chapter 3: Methodology

Introduction

Two major concerns that guided this research design were consideration of how teachers would directly benefit from engaging in the research and how the design could emphasise research *with* teachers, not *on* them. Thus it was an attempt to avoid the traditional stereotype of a researcher who comes into a setting, gathers as much data and information as possible, then goes away and makes sense of it all back in an office or university. The research process was also designed as a catalyst for change, a process that supported rethinking and new actions for all involved.

Hopkins (1987) argued for a teacher researcher concept on the basis that traditional educational research has been inadequate in terms of helping classroom teachers to improve their practice. This was backed up by Stake (1987) who found that the results of educational research were often too specific or too general and contained few signposts for action. As a consequence, "teachers often regard educational research as something irrelevant to their lives and see little interaction between the world of the educational researcher and the world of the teacher" (Hopkins, 1987, p. 114). This would appear to hold true for Australian teachers who rated participation in academic research projects towards the bottom of a list of preferred methods to gain or improve teaching or administrative skills (Conners, 1991).

The purpose of this research was to go beyond finding out 'what's going on here', to making more informed decisions about actions and practice that grew out of the learning that took place. The research design selected therefore included a co-researcher relationship with the teachers participating in the project. Kruger et al. (2001) point out that one impact of post-modern research has been to separate researchers in universities and practitioners in schools, both discursively and practically. Their study developed a methodology around the notion of 'collaborative practitioner research (CPR)' where teachers and university researchers came to a 'co-learning agreement' (Wagner, 1997). Wagner characterized this relationship as being "reflexive, systematic inquiry, stimulated in part by ongoing collegial communication between researchers and practitioners" (p. 17).

In a similar vein, this methodology was designed around a core strand of action research which was developed with participatory principles and critical theory in mind. A complementary strand of social inquiry was also developed with an aim to be both reflexive and respectful. This strand of the research drew upon the philosophical stances of interpretivism/constructivism (see Carr & Kemmis, 1983; Smith, 1989; Lincoln and Guba, 1994); and critical theory (see Freire, 1970; Habermas, 1972; Horkheimer, 1972; Carr & Kemmis, 1986; Carspecken & Apple, 1992; Carr, 1995; McLaren & Giarelli, 1995; Smyth, 1997; Smyth, Hattam & Shacklock, 1997; Crotty, 1998; Kemmis, 2001). The next section outlines the major methodological considerations and attempts to make underlying assumptions and values transparent in an effort to be methodologically reflexive. The specific methods used in the study are also outlined in detail.

Research Paradigms for Social Inquiry

The Concept of Paradigms

A paradigm, according to Kuhn (1970), provides a way of looking at the world or of perceiving reality. Paradigms develop in response to historical and cultural conditions and provide a conceptual framework for seeing and making sense of the social world we create and live in (Maguire, 1987). Social science research paradigms, which shape the form and purpose of investigating social reality, are based upon "different sets of assumptions about the nature of society, the ways in which society should be investigated, and the kinds of knowledge that it is possible to acquire about the world (Popkewitz, 1984 cited by Maguire 1987).

Thus paradigms shape:

> ...what we look at, how we look at things, what we label as problems, what problems we consider worth investigating and solving, and what methods are preferred for investigation and action...a paradigm influences what we choose not to attend to; (and) what we do not see. (Maguire, 1987, p. 11)

Paradigms also impact what we see as acceptable forms of knowledge and views as to the uses and purposes of knowledge (Kuhn, 1970; Popkewitz, 1984; Fay, 1975 cited in Maguire, 1987).

Crotty (1998) distinguishes four basic elements of any research process which are generally addressed within a paradigm: epistemology (theory of knowledge), theoretical

perspective (philosophical stance), methodology (strategy, action plan, process or design) and methods (techniques or procedures used to gather data). Guba and Lincoln (1994) add a paradigm's ontological position (nature of reality or of being in the world) as another element for consideration. They also stress that, as a paradigm is a human construction, it is subject to change as more informed and sophisticated views emerge for analysis and argument. Thus a paradigm shift occurs periodically within fields of knowledge (Kuhn, 1970).

The Scientific Paradigm

The scientific paradigm has been dominant in Western society and assumes the goal of seeking to discover facts about reality and the laws that guide that reality. It is assumed that clear cause and effect relationships exist in the world and the role of the researcher is to discover the truth about the way things "really are" and "really work" (Guba & Lincoln, 1994, p. 108). This is assessed by how well variables affecting the situation have been controlled and how well predictions and generalizations can be made to other similar situations. The human effect is minimized and the research designs attempt to eliminate bias and the scope for personal judgment in the description and appraisal of a state of affairs (Eisner, 1993). Thus it is assumed that all studies should be 'objective' and value free and that the results of one study add logically to another. This view has become known as 'positivism' (Crotty, 1998; Guba & Lincoln, 1994). Technical knowledge derived as a result of such inquiry is used to expand power and control over people and the environment (Maguire, 1987).

Within the scientific paradigm, the epistemological position of objectivism (meaning resides in the object of study and is there to be discovered) and the theoretical perspective of positivism directly influence the choice of methodology and methods and, in particular, the way that they are developed and applied in line with the above beliefs. The ontological position is that there is a 'real' reality but shifts within the paradigm to 'postpositivisim' suggest that humans can only imperfectly apprehend such reality (Guba & Lincoln, 1994). Either qualitative or quantitative methods can be used within this paradigm to construct a methodology, but there is generally a higher value placed on quantitative methods.

Quantitative methods begin with clear questions and hypotheses backed up by existing theory, utilize design methods which identify variables in the situation and set controls

to minimize these effects, and collect data that can be quantified and represented statistically. Reliability in the use of quantitative methods refers to measures that are free from 'measurement error' while validity refers to the degree to which a measure assesses what it purports to assess (Fink, 1995). The result of such an inquiry is that a single slice of what is occurring may be accurately reported.

Alternative Paradigms

Kuhn (1970) is one of the key theorists who questioned the objectivity and value-free neutrality of scientific discovery that characterizes the dominant scientific paradigm (Crotty, 1998). This has had implications for social science research, which historically has been strongly influenced by empirical positivism (Maguire, 1987). Alternative research paradigms have gained increasing credibility in social inquiry since the 1960s. These paradigms reject the epistemological stance of positivism (objectivism) and propose constructionism and subjectivism as alternatives. More recently, there have been calls for a new paradigm that takes a participatory world view and integrates aspects of positivism and constructionism, acknowledging both a 'real' reality and the paradox of entering the realm of human language and cultural expression as soon as an attempt is made to articulate such reality (Reason & Bradbury, 2001).

Constructionism is defined as the epistemological view that "all knowledge, and therefore all meaningful reality as such, is contingent upon human practices, being constructed in and out of interaction between human beings and their world, and developed and transmitted within an essentially social context.…Meaning is not discovered, but constructed" (Crotty, 1998, p. 42). Crotty contrasts subjectivism (imposing meaning on the object from elsewhere) with positivism (seeing meaning inherent in the object). Constructionism, he states, brings objectivity and subjectivity together in an active relationship.

Moore and Maton (2001) critique the paradigm position and argue that Kuhn's view of incommensurable paradigms (Kuhn, 1970) causes a communication breakdown within intellectual fields of knowledge as "specialised knowers" develop their own "distinctive and incommensurable language or 'voice'" (Moore & Maton, 2001, p. 163). They propose that it is more helpful to describe an intellectual field of knowledge as comprising a range of perspectives, with contributing specialists who employ a "language of mediation between levels and approaches" which results in knowledge

integration (pp. 162-63). Constructionism, by considering objectivity and subjectivity in relationship with each other, attempts such mediation.

This constructionist epistemological position was selected as best suiting the context of the purposes of this inquiry. Two theoretical perspectives, which are informed by constructionism, are discussed further: interpretivism/constructivism and critical inquiry.

Constructivist and Interpretivist Inquiry

Although differing slightly in concept, constructivist and interpretivist inquiry share a basis of common beliefs and goals. In particular, both types of inquiry have the goal of "understanding the complex world of lived experience from the point of view of those who live in it" (Schwandt, 1994, p. 118). The constructivist paradigm, as conceived by Guba and Lincoln (1994), assumes that there are different ways of looking at the world or multiple realities and that it is not possible to understand what is occurring except in the context of webs of social significance (Ferguson, Ferguson, & Taylor, 1992). Inquiry within this paradigm aims to describe, understand and reconstruct what is occurring, with opportunities for "more informed and sophisticated constructions" occurring over time (Guba & Lincoln, 1994, p. 113). The purpose of such inquiry is therefore not to discover the 'truth' but rather to develop shared constructions of reality among the members of a particular group and thus greater understanding of the comprehensive patterns and relationships that exist in a given situation. Although it is acknowledged that a physical reality exists, there is no pure way of gaining access to that reality and thus no one specified way of conducting an inquiry. It is also assumed that an inquiry will be influenced always by context, interpretation and values. The important thing is to be cognizant of these and aware of how they affect the study.

Schwandt (1994) notes that Guba and Lincoln's (1994) constructivist paradigm and the position of 'social constructionism' are examples of constructivist thinking that move away from a focus on individual minds and cognitive processes to "the world of inter-subjectively shared, social constructions of meaning and knowledge" (Schwandt, 1994, p. 127). This position has the focus of the "collective generation of meaning as shaped by conventions of language and other social processes" (p. 127) rather than individual meaning making.

Constructivism draws on the tradition of hermeneutics. According to Crotty (1998), this means that reconstructions tend to consider features such as the intentions and histories of authors, the relationship between author and interpreter and practical relevance for readers. The determination of meaning is "a matter of practical judgment and common sense, not just abstract theorizing" (p. 91). Rundell (1995) notes that, through hermeneutics, "interpretation has become part of our cultural self-understanding that only as historically and culturally located beings can we articulate ourselves in relation to others and the world in general (p. 10). Skilled hermeneutical inquiry is seen as having the potential to uncover hidden meaning and intentions that 'authors' or participants may not have been able to articulate themselves (Crotty, 1998). Crotty suggests three different ways that hermeneutical inquiry can be approached: *empathic*, where we seek to see things from the author's/participant's perspective and understand their standpoint; *interactive*, where the author/participant and interpreter/researcher engage in dialogue about what the author has to say; and *transactional*, where out of engagement comes new insights (p. 109).

In terms of this study, the constructivist position presented as respectful of the world views and experiences that all participants would bring to the study. By sharing multiple perspectives, the study attempted to come to more informed and sophisticated views or insights. The seeking of multiple perspectives was also considered as a strategy to assist in constructing a view of cultural changes that occurred in teachers' workplaces and classrooms.

The constructivist or interpretivist tradition of social inquiry does not, however, seek to change a situation, although it is acknowledged that the very presence of the researcher and researcher actions are likely to impact and cause changes. It would only help to explain 'what is' rather than assisting understanding of 'what might be'. Critical theory, with its emphasis on critique, change and transformation, also informed this study's theoretical position.

Critical Inquiry

Critical inquiry developed from the philosophical position informed by critical theory. Although there is not a unified, agreed upon view as to what critical theory is (Crotty, 1998; Kincheloe & McLaren, 1994), there are a range of beliefs that are generally held in common by critical theorists. Kincheloe and McLaren suggest the following:

- *that all thought is fundamentally mediated by power relations that are social and historically constituted.;*

- *that facts can never be isolated from the domain of values or removed from some form of ideological inscription;*

- *that the relationship between concept and object and between signifier and signified is never stable or fixed and is often mediated by the social relations of capitalist production and consumption;*

- *that language is central to the formation of subjectivity (conscious and unconscious awareness);*

- *that certain groups in any society are privileged over others and, although the reasons for this privileging may vary widely, the oppression that characterizes contemporary societies is most forcefully reproduced when subordinates accept their social status as natural, necessary, or inevitable;*

- *that oppression has many faces and that focusing on only one at the expense of others often elides the interconnections among them;*

- *that mainstream research practices are generally implicated in the reproduction of systems of class, race, and gender oppression.*
  (p. 139-140)

Kincheloe and McLaren (1994) state that critical research is best understood in the context of the empowerment of individuals and as an attempt to confront injustice. They describe this kind of research as 'political' and a transformative endeavour that aims to promote emancipatory consciousness. Critical researchers are clear and unequivocal about their "partisanship in the struggle for a better world" (p. 140). Although they enter into the research situation with their assumptions on the table, Kincheloe and McLaren state that these assumptions may change as they are analysed, particularly if the researcher recognizes that such assumptions are not leading to emancipatory actions. Critical theorists pose the research itself as a set of ideological practices. Smyth, Hattam and Shacklock (1997) state that a study operating from the worldview of critical theory will be about "uncovering undisclosed interests of power that normally remain shrouded and hidden" and "will proceed in ways that work participatively with the researcher participants to uncover the manner in which broader social, economic and political forces operate on them" (p. 21).

Jurgen Habermas, an influential critical theorist whose goal was social critique, proposed an epistemological tenet for the critical inquiry paradigm, that "human beings constitute their reality and organize their experience in terms of cognitive (or 'knowledge-guiding') interests" (Crotty, 1998, p.142). His typology of human knowledge was based on: technical interests which help to predict and control; practical interests which aim to develop mutual understanding in the everyday conduct of life; and critical interests which aim to bring about emancipation from relations of dependence (Kemmis, 2001).

Kemmis (2001) sees the above theory as a promising way through debates about explanation and understanding, the relationship between objective and subjective perspectives, the relationship between the individual and social realms of cognitive and cultural realities, and the relationship between theory and practice (p. 91). In particular, he notes that participants cannot be enlightened or empowered by others as this can only occur in their own terms. Kemmis applies Habermas's theory to the different approaches to research and practice and identifies: i) empirical-analytic (or positivistic) approaches with a technical or means-end interest in getting things done effectively; ii) hermeneutic (or interpretive) approaches with an interest in wise and prudent decision making in practical situations; and iii) critical approaches which are guided by:

> *...an interest in emancipating people from determination by habit, custom, illusion and coercion which sometimes frame and constrain social and educational practice, and which sometimes produce effects contrary to those expected or desired by participants and other parties interested in or affected by particular social or educational practices. (p. 92)*

These interests clearly have implications for methodological design as they relate directly to the purpose or intent of an inquiry and the nature of knowledge that it hopes to generate. These will be taken up later in specific methodological considerations.

Crotty (1998, p. 113) summarizes some of the differences between critical theory and interpretivism, noting the following distinctions:

Table 4: Contrasting Interpretivism and Critical Theory

Interpretivism	Critical theory
Research that:	Research that:
• seeks merely to understand	• challenges
• reads the situation in terms of interaction and community	• reads the situation in terms of conflict and oppression
• accepts the status quo	• seeks to bring about change
• reconstructs 'authentic lived experience'	• interrogates commonly held values and assumptions
• describes social structures from multiple perspectives and seeks consensus	• challenges conventional social structures

(Adapted from Crotty, 1998)

The Participatory Worldview

This emerging perspective attempts to break down some of the polarization between the scientific and alternative paradigms and moves forward informed by both. Reason and Bradbury (2001) state that the participatory worldview:

> *...places human persons and communities as part of their world—both human and more-than-human—embodied in their world, co-creating their world. A participatory perspective asks us to be both situated and reflexive, to be explicit about the perspective from which knowledge is created, to see inquiry as a process of coming to know, serving the democratic, practical ethos of action research ... Any account ... is culturally framed, yet if we approach our inquiry with appropriate critical skills and discipline, our account may provide some perspective on what is universal, and on the knowledge-creating process which frames this account. (p. 7)*

Reason and Bradbury (2001) outline five dimensions of such a participatory view which address techniques, epistemology and ontology (Figure 1):

Figure 1: Dimensions of a Participatory Worldview
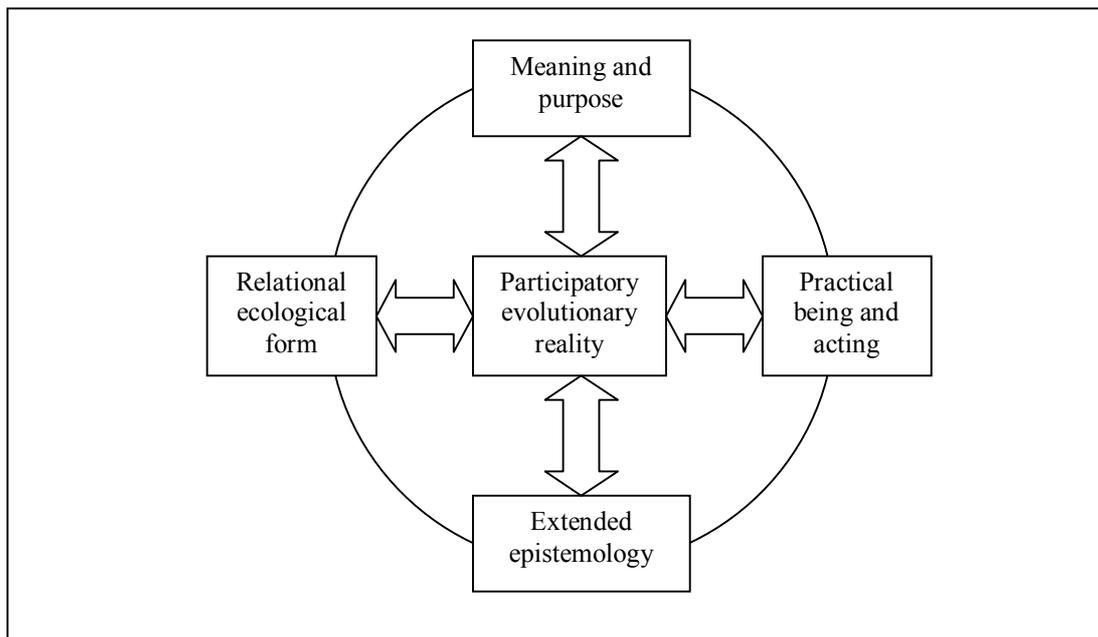
(Reason and Bradbury, 2001)

This view stresses interconnections with an "evolutionary, emergent and reflexive" worldview where reality or "the cosmos" is continually self-ordering and self-creating (Reason & Bradbury, 2001, p. 8). Activity and the practical are seen as the starting point for epistemology, with theory developing to guide and illuminate such action and provide it with meaning. Different ways of knowing are embraced with relational, reflective and representational knowledge all valued (Park, 2001). Representational knowledge aims to provide explanation and identify relationships which enable prediction and control; relational knowledge helps to create other forms of knowledge as it fosters community ties; and reflective knowledge concerns a vision of what ought to be, what is right and wrong (Park, 2001 cited in Reason & Bradbury, 2001, p. 9).

Thus a participatory view is able to draw on various traditions of inquiry, depending upon the purpose and aims of the inquiry. This in turn impacts the design of methodology and selection of methods. This broad based epistemological position was favoured in this study as it not only embraced both constructionist and critical positions, but left open the door to consider new relationships or explanations that might be of use to the broader teaching profession. As previously noted, the methodology of action research, which can be developed out of a range of theoretical positions, sits comfortably within this perspective.

Methodological Choices and Rationale

The philosophical preferences previously outlined influenced the development of two strands of inquiry within this study. One was based on the participatory and democratic principles of action research and critical theory traditions, with a co-researcher relationship with teacher researchers fundamental to the strand.

The second strand of inquiry drew upon interpretivist/constructivist beliefs and critical hermeneutics and was influenced by interest in learning and cultural change. This strand of the research design constructed the researcher role as 'interpreter' and was based on a hermeneutic cycle of seeking empathic understanding, dialogue with participants about issues and seeking new insights into the situation being experienced (Crotty, 1998). This strand was therefore designed as an individualistic inquiry rather than a genuine co-researcher relationship.

Participative Inquiry and Action Research

Participative inquiry has a history of connection to social, political and ecological action with participatory researchers raising concerns about the collapse of positive values and attitudes towards humankind and nature as a consequence of modernization (Fals Borda, 2001; Reason & Bradbury, 2001). The term 'action research' is used to represent the extensive family of approaches to inquiry which draw on different research traditions but are all participative, grounded in experience and action oriented (Reason & Bradbury, 2001). Reason and Bradbury define action research as "a participatory, democratic process concerned with developing practical knowing in the pursuit of worthwhile human purposes" (Reason & Bradbury, 2001, p. 1) Fals Borda (2001) notes three broad challenges that participatory researchers must grapple with in a process of "scientific deconstruction and emancipatory reconstruction": the relations between science, knowledge and reason; the dialectics of theory and practice; and the subject/object tension (p. 28).

Fals Borda (2001) sees the participatory movement as bringing together academic accumulation and people's wisdom in a practical struggle for social transformation. It is a theoretical premise that practice and community are needed "to justify the existence of science and to explain the functions of everyday life" (p. 29). This gives rise to the notion of an ethical dimension to the purpose of pursuing knowledge and, in the case of

social research, examination of the processes of knowledge production in terms of who monopolizes knowledge, resources, techniques and power. Fals Borda notes the need for a more holistic epistemology where science is connected to moral conscience and reason enriched with sentiment and feeling.

The work of Paulo Freire (1970; 1972; 1973; 1976; 1978; 1994), a respected educator and critical theorist from Brazil, has strongly influenced theory/practice debates, particularly in relation to educational inquiry. Freire contemplates the relationship between reflection and action and the Aristotelian notion of praxis, which he concludes is "reflection and action upon the world in order to transform it" (Freire, 1970, p. 33). Freire argues that reflection does not precede action, but takes place at the same time and as such they "constantly and mutually illuminate each other" (Freire, 1976, p. 149). Praxis can lead to "conscientisation" or the awakening of critical consciousness (Freire, 1973, p. 19), which arises from humans simultaneously being engaged in the world and transforming that world, resulting in further informed action (Freire, 1970; Freire, 1973). The pursuit of full humanity cannot be an individualistic pursuit but must take place through dialogue with human beings "united by their action and their reflection upon that action and upon the world" (Freire, 1972, p. 75). This appears particularly apt for the teaching profession.

True dialogue, argues Freire, cannot exist without critical thinking; yet only dialogue is capable of generating critical thinking (Freire, 1970, pp. 73-74). Freire's concept of education—dialogical education—is premised on the following:

> *The teacher is no longer merely the one who teaches, for the teacher is also taught in dialogue with the students. And the students, while being taught, also teach. In this way, teacher and students become jointly responsible for a process in which all of them grow. (Freire, 1972, p. 53)*

Freire's views led to calls for combining research and teaching (Kincheloe, 1991; Stenhouse, 1976) in order to transcend pedagogical routines (Fals Borda, 2001). The notion of 'capacitation' emerged from the Brazilian education system, as a way of working with teachers that opens spaces for reflection, dialogue, and reinvention of actions leading to better educational practices (Weber, 1992 cited in Jurema, 1998). This is similar to Kemmis's conceptualization of action research as a process that "*brings people together around shared topical concerns, problems and issues … in a*

way that will permit people to achieve mutual understanding and consensus about what to do" (2001, p. 100; original emphasis). The knowledge creation process in this sense is firmly grounded in experience with theorizing connected to sense-making and action planning within the group rather than being imposed arbitrarily in a disconnected manner from outside. As a result of this, the notion of increasing people's self-reliance and empowerment are cited as genuine achievements of participatory research (Fals Borda, 2001; Heron & Reason, 2001; Kemmis, 2001).

Kemmis (1995) notes that, in contrast to Freire's views, theorizing about education is "something that occurs away from practice" for most teachers (p. 13). He suggests a new way of approaching debate about the relationship between theory and practice, illustrated by four elements of the theory/practice discourse:

Table 5: Theorists' and Practitioners' Theories and Practices

	Theory	*Practice*
Theorists	(1) Theorists' theories	(2) Theorists' practices, especially their research practices.
Practitioners	(3) Practitioners' theories	(4) Practitioners' practices

(Adapted from Kemmis, 2001, p. 3).

Kemmis (2001) raises a concern that practitioners' theories and theorists' research practices are often relatively unexamined in research literature. Instead, theorists' theories have generally been used to "describe, interpret and (perhaps) explain practitioners' practices" (p. 3). At the same time, researchers have been relatively quiet about their own research practices which, he states, were often underpinned with methodological assumptions that could not be justified. Kemmis suggests a view where practitioners should be regarded "as people who are able to do their own theorizing for themselves, without the intervention of the social scientist as the mediator of what is to count as social reality" (p. 3). The role of the external researcher needed to shift to one where they could "engage in, or facilitate, or cooperate with, or collaborate with, or at least support practitioners researching their own practice" (p. 4).

Participative inquiry in the form of action research calls for new relationships between the traditional subject/object dichotomy of researcher and researched, academics and community members, or 'outsiders' and 'insiders'. Maguire (2001) notes a number of feminist influences at the heart of action research which also address power relations: the effort to flatten power by promoting the approach of co-researchers; the notion of 'reflexivity', where researchers critique and change their own research practices in response to identifying power differentials; attempts to make visible and rework the conditions of knowledge production; and clear location of researchers and their biases, feelings, choices and multiple identities within the research process (p. 65). Gaventa and Cornwall (2001) look at power and knowledge in the participatory relationship and propose a different form of knowledge that can emerge through participatory action research. Citing Hall (1992) and Selener (1997), they note the following:

- *Those who are directly affected by the research problem at hand must participate in the research process, thus democratizing or recovering the power of experts.*

- *Knowledge is socially constructed and embedded, and therefore research approaches that 'allow for social, group, or collective analysis of life experiences of power and knowledge are most appropriate (Hall, 1992, p. 22).*

- *Participatory action research recognizes different forms of knowing … and that feeling and action are as important as cognition and rationality in the knowledge creation process. (p. 74)*

Existing power relations can be challenged when change in the dimensions of knowledge (as a resource that affects decisions), action (which looks at who is involved in the production of such knowledge) and consciousness (which looks at how the production of knowledge changes the awareness or world view of those involved) are all addressed within the participatory research process (Gaventa & Cornwall, 2001, p. 74). The production of new forms of knowledge as a result of more open and democratic power relations, which is then used to make more informed decisions for action, can lead to a greater likelihood of liberation and social transformation. Gaventa and Cornwall note that 'participatory' knowledge can also be problematic: it can disguise difference; consensus can masquerade as common vision and purpose blotting out the possibility of more pluralist and equitable solutions; reification of local knowledge may simply replicate dominant discourses rather than challenging them; and

the powerless or 'oppressed' may have internalised dominant views or values and present a less than authentic reality. The solution they present to these concerns is that participatory research "must encourage mobilization and action over time in a way that reinforces the alternative forms and categories of knowledge which might not have been produced" (p. 75) … "with knowledge embedded in cycles of action-reflection" (p. 76). Participatory researchers can also utilize a critical hermeneutic cycle to reflect upon the possibility of such issues emerging.

Participatory Action Research (PAR)

The initial methodological design for this study included an inquiry strand that was constructed with the tradition of participatory action research in mind. This is elaborated here to clearly outline the intent and starting points of this strand of the research.

Smith (1997) describes PAR as a process where a "group of people collectively enters into a living process, examining their reality by asking penetrating questions, mulling over assumptions related to their everyday problems and circumstances, deliberating alternatives for change, and taking meaningful actions. The group has ownership over what questions are pursued and how" (p. 173). PAR is also about the "personal and social transformation for the liberation of oppressed people" (p. 177). While teachers may not consider themselves as 'oppressed', they do work within bureaucratic structures where there are power differentials. The drive to use technology in education is not only a grass roots movement, but dictated by those who are in positions of power within the political, economic and educational systems. As such, PAR can be a process through which teachers decide some of the questions that need to be pursued in relation to ICT in education and contribute to the broader educational agenda.

Wadsworth (1998), places PAR in the context of post-positivism and makes the following important distinctions:

- *PAR is not simply an exotic variant of consultation but instead aims to be active co-research, by and for those helped.*

- *PAR cannot be used by one group of people to get another group of people to do what is thought best for them.*

- *PAR is a genuinely democratic or non-coercive process whereby those to be helped determine the purposes of their own inquiry.*

- *PAR is research which involves all relevant parties in actively examining together current action (which they experience as problematic) in order to change and improve it. They do this by critically reflecting on the historical, political, cultural, economic, geographic and other contexts which make sense of it. (p. 11)*

The following diagram has been adapted from Smith's original framework for PAR praxiology (Smith, 1997, p. 198) and guided the development of a range of experiences that aimed to move the group through the illustrated spirals:

Figure 2: PAR Praxiology
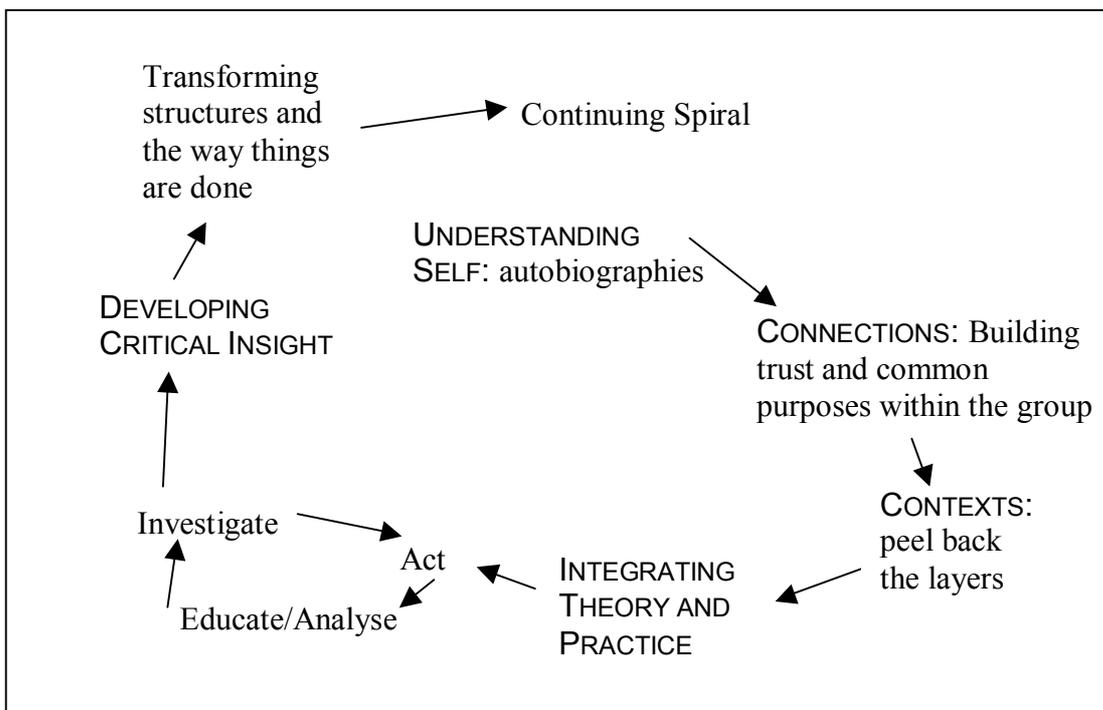
(Adapted from Smith, 1997, p. 198)

PAR sees research as a process of reflection, learning and development of critical consciousness which places the greatest emphasis on "the value of the social learning that can occur by oppressed groups through the investigation process" (Gaventa & Cornwall, 2001, p. 76). Thus action on reality and analyses of that learning can lead to changing awareness of the nature of the problems (p. 76). Authentic alternative knowledge arises out of action upon such awareness and self-critical investigation and analysis of participants' own reality.

In recent years in education, there has been an emphasis on 'teacher-proofing' delivery of curriculum, so that the lowest common denominator is gradually raised. The State Department of Education has been strongly instrumental in promoting particular ideologies, and teachers are often expected to implement without questioning below the surface. The rationale behind such initiatives has sometimes been developed in ways that are outside the day-to-day experience of teachers. When practitioners are precluded from researcher roles, valuable knowledge creation and teacher theorizing are lost, along with the potential for increasing practitioners' capacity for creativity and productive change. The PAR process was selected because of its potential to benefit both practitioners and the system in terms of knowledge creation and teacher capacitation (Weber, 1992 cited in Jurema, 1998).

Interpretive Strand of Inquiry

This strand of the inquiry was conducted in a less participative manner than the PAR strand but was designed to support the collective work of the group. It was informed by the theoretical positions of critical ethnography (Carspecken, 1996) and interpretive hermeneutics (Gadamer, 1976). In this inquiry strand, qualitative methods were used to inquire further into the changes that teachers were experiencing and facilitating in their classrooms and schools. Where the PAR strand of the research focused on specific issues of inquiry, the interpretive strand was more wide ranging and designed to address the research questions that were concerned with personal, social and cultural change (Niemi & Kemmis, 1998).

Dunkin (1999, p. 76) used the following guide (adapted from Fielding Institute, 1992, and Marton & Booth, 1997) to highlight the particular uses and purposes of these two theoretical positions:

Table 6: Assessment of Potential Methods

	Hermeneutics	**Ethnography**
Focus of interest	Understand context	Understand culture of groups
Use when	Understanding of context to a phenomenon will shape interpretation of it.	Explanation of group behaviours and patterns of thinking
Purpose	Describe and interpret	Describe, interpret and explain
Raw data	Historical records, stories	Stories, observations
Role of researcher	Use foreknowledge and prejudices of researcher to interpret	Recorder and interpreter
Discipline Base	History	Anthropology

Both of these positions informed this strand, as context (or structure) and culture had been identified in the literature on school reform as being interconnected determinants of productive educational change.

Data Collection and Generation Methods

Scope of the Project

This project involved 6 schools (4 primary, 1 secondary and 1 central (P-8) school). It operated over an 18 month period, with twelve teachers (2 from each school) involved in a Participatory Action Research strand of the research. A second interpretive strand of inquiry was developed that also involved these teachers, with three selected for a more in-depth study. Colleagues and principals of these teachers were also involved in this strand.

Participants

Schools considered for the project were nominated by regional curriculum consultants on the basis of supportive leadership, high motivation to develop ICT use across the curriculum, and degrees of disadvantage. The initial participants were identified as 'early adopters' by principals in the 6 targeted schools. Twelve teachers who had demonstrated leadership and innovation in their practice, and who had already acquired

some ICT skills were involved. There is significant evidence indicating that early adopters with strong social connections within schools are the key people to facilitate technological change and innovation at an organizational level(Rogers, 1995).

Three of the original group of teachers from three different schools were invited to participate in a more in-depth study which was part of the interpretive strand of the study. They were selected on the basis of representing Early Years, Middle Years (Primary) and Middle Years (Secondary) sectors and their high levels of commitment and participation in the project. In order to gain a better understanding of the impact of the project on school culture, principals and one colleague of each of these three teachers were interviewed. In total, 18 participants were interviewed.

Table 7: Summary of Research Participants

Teacher Researchers	Principals	School Colleagues	Schools
12 teachers involved in Participatory Action Research and group interviews.			6 schools
3 teachers from above group will participate in an in-depth study	Principals of the in-depth study teachers will be interviewed. (Total participants =3)	A colleague of the in-depth study teachers will be interviewed. (Total participants =3)	3 of the above schools

The Two Inquiry Strands

As previously outlined, two inquiry strands were utilized in this study—a PAR strand which was developed around teachers' research interests and an interpretive strand that further probed connections between pedagogy, practice and teacher theorizing; change, particularly in relation to organizational structures, culture and relationships in classrooms and schools; teacher professional learning; and use of ICT. This is further elaborated here with reference to the work of Kemmis (2001), who identified the key issues in the theory/practice debate. His original table has been adapted to structure the elaboration of method. Terminology has been changed to further reduce the theory/practice divide:

<div align="center">**Table 8: Researcher Roles**</div>

	Academic researcher	Teacher researcher
Practices	The specific research practices engaged in by the academic researcher to support/facilitate the collective work of the group	The specific research practices engaged in by the teacher researchers to further illuminate teaching
Theorizing	How the academic researcher engages in collective/collaborative theory building with the group	How the teacher researchers engage in individual/collective/collaborative theory building with the group.

<div align="center">(Adapted from Kemmis, 2001, p. 3)</div>

A broad range of data gathering techniques was used and the methodology aimed to be reflexive without becoming a burden to the teachers (Figure 3).

Figure 3: Overview of Data Generation and Analysis Process

Data Gathering/Generation

Teacher Researchers

- Expressions of Interest
- Reading Responses
- Action Research Reports
- School Visit Observations
- Journals
- Emails
- Case Writing
- Snapshots
- Curriculum Planning Docs
- Commentary Writing
- Student work samples, surveys and interviews
- Professional Learning Evaluations

Facilitating Researcher

- PAR Structures
- Reading Responses
- Project plans, guidelines etc.
- School visit observations
- Journal
- Emails
- Interviews
- Summary Reports
- Commentaries

Data Generated

- Shared with group
- WebBoard
- Inquiry team or partner

Sample Threading
- By author
- By Fac researcher
- By another teacher researcher

Sample commentary
- By author
- By Fac researcher
- By another teacher researcher

Stage 2 Interviews

- Themes
- Theory
- Categories

Hermeneutic cycle

Links to literature

Sorting by facilitating researcher

Simple themes and categories

Compare with literature and teacher analysis – refine categories, themes theory

Check emerging theory with group

1. PAR Inquiry Strand

A. Academic Researcher practices

In this strand of the research, I adopted the twin roles of project coordinator and facilitating researcher (see p. 63 for extended discussion) and although theoretically different, the boundaries at times were blurred. Professional learning activities that aimed to address professional development and school change were conducted over two and a half days at the beginning of the project in order to address the early stages of Smith's (1997) PAR praxiology. In particular, these activities provided time for teachers to reflect upon themselves and identify issues they felt passionate about in education. Time was also provided for teachers to engage in conversations with other members of the group in order to begin establishing connections and to identify others with similar interests. As the facilitating researcher, I also presented an overview of the participatory action research process to the group and developed a planning proforma for them to use to develop their own inquiries (Appendix 1).

As a member of the PAR team, I generated similar documentation to that produced by the teacher researchers, with some differences prescribed by my role (see Figure 3). My aim was to contribute to the intellectual life of the group through this contribution, and to place similar demands on myself compared to those that teachers were prepared to accept. My contribution to theory building in this strand was in the form of informal email responses to teachers' shared documentation, facilitation of discussion and dialogue during network and inquiry team meetings, and online reflections.

It should be noted that, while teacher researchers had full control over the data gathering techniques they used in their particular inquiries, the overall framework within which they planned their inquiries and made their understandings explicit were mostly imposed as part of the project design. Some collaboration in relation to this occurred early in 2001, when a planning group consisting of 4 teachers was established and met to discuss the type and frequency of documentation. This group recommended that each teacher keep a weekly journal and post monthly journal summaries on the online forum. They also recommended that a monthly professional reading and online reflection take place with deadlines set for the group. The initial journal prompts that teachers were provided with were also changed during the course of the project in response to teacher feedback and analysis of the types of reflection that they were generating. Thus there

was some consultation and reflexivity in relation to the PAR framework, but teachers generally agreed to go along with suggestions for general documentation that I put forward as facilitating researcher.

B. Teacher Researcher Practices

All members of the project group planned and engaged in a PAR process that focused on broad curriculum issues and use of ICT in their classrooms. Early in the project, the group self sorted into three project teams based on common interests: an Early Years group (Yrs. P-4) and two Middle Years groups. One Middle Years group consisted of two primary schools and year 5/6 classes while the other group consisted of the secondary and central school teachers (Yrs. 5-9). Each inquiry team consisted of 3-5 members from 2-4 different schools.

In November 1999, inquiry teams developed an initial action research proposal which addressed broad areas of interest/concern, current contexts, constraints, possibilities and necessary resources. This was reviewed in Feb 2000, when teachers refined their initial proposal. Broad areas of interest were refined to open-ended questions as a result of further discussions within the teams. Planning around specific issues, such as what kind of data they would collect/generate, how they would use this and timelines, were also further developed.

Teachers met once each term during 2000, both in the whole group and in inquiry teams, to discuss progress in relation to the inquiries and to engage in discussion about broader pedagogical issues. These broader issues were identified as a result of discussion, readings and system initiatives.

As part of the action research cycle, teachers conducted before-and-after surveys of student skills and attitudes towards ICT, interviewed students and collected samples of student work that were generated in response to new practices.

In addition to the specific data collection connected with their classroom research, teachers also generated numerous reflective and summary/analysis documents that were associated with the PAR process (see Figure 3 and extended discussion in Chapter 4).

During the course of their inquiries, teachers identified specific professional learning needs and professional development sessions were developed in response to these.

These sessions provided further opportunities for reflection and the integration of theory and practice.

C. Data Analysis: Academic Researcher and Practitioner Theorizing

The volume of documentation generated presented as a methodological issue in terms of how best to involve teachers in meaning construction so that it was not an onerous, time-consuming task, and that they derived benefit from such participation. A second consideration was how best to arrive at new knowledge that would hold up in light of trustworthiness and validity issues and that identified 'signposts for action' that practitioners regarded as relevant and accessible (Anderson & Heer, 1999; Conners, 1991; Erlandson, Harris, Skipper, & Allen, 1993; Hopkins, 1987; Stake, 1987).

In the PAR strand of the inquiry, teachers synthesized the documentation they produced, their learning from actions taken during their inquiries, and student artefacts that were the result of the action research process, to produce monthly journal summaries, mid-year and end-of-year reports. These were the main strategies used by the teacher researchers to move beyond description of practice into analysis, interpretation and theorizing. Some collaborative analysis and interpretation was encouraged at the end of the first year of the study between teachers in each inquiry team when they were asked to produce a joint report about their common inquiry focus. Insights from the teacher researcher findings were compiled into one response, which was returned to the teachers for 'member checking' (Erlandson et al., 1993).

A concern that emerged was that a process for systematic interpretation, analysis and theory building had not been well established by the end of 2000, with the reports performing more of an evaluative and summarizing function.

In 2001, another strategy was added to the PAR analysis phase in order to engage in a more dialogic process of analysis and move on from individual reflection and insight. This particular strategy—sketch of practice, thread and commentary—was adapted from Kruger et al's (2001) longitudinal study. This presented as a way of increasing genuine collaborative validation between all researchers (teacher and university) and of encouraging more focused theorising by teacher researchers.

The revised analysis strategy proceeded as follows:

- A small group of teacher researchers engaged in sketch, thread and commentary writing with three self-selected documents from the beginning, middle and latter part of the study.
- This sample of teacher researchers shared their writing with the main group of teacher researchers, who used the commentaries to identify key words and threads from their own perspective. They added a new commentary.
- A small number of threads and commentaries was shared.
- The in-depth study teachers engaged in dialogue to achieve collaborative validation of explanatory themes and to put forward tentative research propositions.

In retrospect, this process of sketch, thread and collaborative validation would have been a better process to use during the first year of the study, replacing monthly journal summaries. Use of the strategy in the second year indicated that earlier use may have encouraged more ongoing interpretation and theorising of the practices that had been described and reflected upon. Earlier use of this strategy would also have provided more of a basis to engage teacher researchers in debate about themes and tentative research propositions, thus strengthening claims for validity and trustworthiness.

2. Interpretive Strand

All schools were involved in this strand of the study, which was structured along the lines of a social inquiry that considered change in pedagogy, technology use, culture and teacher learning. Three schools participated in a more in-depth study with additional interviews and observations. At times, the methods of data generation/collection were intertwined with the PAR strand of the study, with much of the documentation used in this strand generated during the PAR strand. Analysis during this strand of the research was less collaborative but still verified by the participants in the study.

A. Academic Researcher Practices

Carspecken and Apple (1992) identify social action, subjective experience, and their conditions as being the three principal items investigated in all social research. They recommended collecting information on the following to assist such investigations:

- social routines

- the distribution of routines across related social sites
- constraints and resources affecting social routines
- cultural forms associated with social routines
- subjective experiences
- life history narratives (total or partial)

The study design was also influenced by Wolcott (1992) who proposed that the full range of data-gathering techniques employed in qualitative study fall into three categories:

> *Experiencing, with emphasis on sensory data, particularly watching and listening; enquiring, in which the researcher's role becomes more intrusive than that of a 'mere observer'; and examining, in which the research makes use of materials prepared by others. (p. 19)*

Experiencing

i) Participant Observation

An extended amount of time (fortnightly visits over 2 months) was spent in the three schools selected for the in-depth study. Each of the other schools was visited three times (Terms 1 and 4, 2000 and Term 1 or 2, 2001) to observe the culture of the classroom and to generate thick descriptions (Geertz, 1973 cited in Eisner, 1979) related to observed elements of classroom, team and school culture. This was an important source of information about social routines.

As well as noting social routines, elements of pedagogy that were in evidence in the classroom and specific interactions that occurred at the computers were also recorded. During literacy sessions, many of the teachers employed a strategy called 'Guided reading and writing' which required them to work only with a specific reading or writing group.

Enquiring

i) Reflections

All participants in the PAR process posted online reflections. These reflections focused on readings that promoted discussion about pedagogy and use of ICT in education. Teacher researchers also provided regular reports in relation to action research.

All participants in the study kept a journal which was designed to provide another lens into the social routines operating in classrooms and to provide opportunities to map the distribution of routines across related social sites. The journals also provided opportunities for teachers to identify other constraints and resources affecting social routines and were one of the main ways that subjective experiences were recorded.

ii) Group Interviews

Group interviews were conducted with the 12 teachers selected for the research project. These were conducted with teams of approximately 4 teachers, with 1 interview per team (a total of 3 group interviews). Open-ended interviewing was used to explore the teachers' learning processes, gain feedback re their specific inquiries and how these were impacting professional learning, and discuss change. All group interviews were recorded and transcribed.

iii) Individual Interviews

Individual interviews with three of the initial group of project teachers were conducted to take a deeper look at the learning processes used and changes in workplace culture. Two interviews, with each of the three teachers, were conducted over an 18-month period in order to identify whether a more critical view of technology was emerging. Individuals were provided with transcripts of each interview. The principal and one colleague of each of these 3 teachers were interviewed once after 18 months operation of the project. In all, 12 individual interviews were conducted.

iv) Critical Reference Group

A critical reference group of professionals from outside the study was established. These were members of the research community, school community and teacher educators. Interpretations of events and emerging constructs were tested with this group. This group was also a resource in terms of selecting appropriate literature for group discussion.

Examining
i) Snapshots
Each participant in the study was asked to provide both an initial and final snapshot of their work culture. This focused on the norms, procedures, values and relationships that were apparent in the way they worked with both students and colleagues. A list of guiding questions was used to assist this process (Appendix 1).

ii) Project group (network) and inquiry team reflections

Reflections of project group and inquiry team meetings were recorded and used as part of the research analysis.

iii) Literature

Literature related to educational reform, innovation and change, and technology use in education was used to inform and triangulate the study. Selection of such literature was guided by recommendations from the group, critical reference group members, and issues arising from group discussion. Research findings from other studies were included as part of this literature.

iv) School and Department of Education Documentation

Documentation such as school charters, learning technology plans and curriculum documents was also used to inform the study. In particular, teacher's curriculum planning documents were collected at six month intervals to analyse for evidence of impact and change.

Table 10 clarifies how data was generated and/or its purpose for collection.

Table 10: Clarification of purposes for data generation/collection

Research Questions	Data Collection			Data Analysis and interpretation
	Project Data generated as a result of structures in the project design	**PAR Strand** Data generated as a result of facilitating the PAR process	**Interpretive Strand** Data generated through research with individuals	A detailed outline of data analysis techniques is found on pps. 59-67.
Q1 Q3 Q4	Minutes of Network Meetings	Online reflections in relation to reading and PAR process	Participant Observations in Classrooms	Includes joint analysis of PAR data with PAR co-researchers and individual analysis across full range of data collected. Changes in pedagogy, practice in relation to ICT use and learning were a focus for this analysis, together with change in classroom and school culture and structures.
Q1 Q3	Required processes/structures	Journals	Personal journal	
Q1-4	Literature related to the project operation, roles, requirements of participants	Inquiries conducted by inquiry teams	Interviews with selected individual teachers (3 project members, their principals and 2 colleagues at each of their schools).	
Q1 Q2 Q4	Readings selected for group	Collaborative analysis of group	Group Interviews with each inquiry team	Includes both collaborative and individual analysis. Links between dialogue and readings and evidence of change in teachers consciousness were analysed together with the curriculum decisions teachers made in their classrooms and schools.
Q1 Q4		Minutes of inquiry team meetings	Collection of Dept of Education, School and Curriculum documentation	Focus was changes in classroom structures and curriculum planning that could be linked to the project experiences.
Q1 Q2		Publication/showcasing of PAR projects	Collection of classroom artefacts	Examined to see how they expressed pedagogy.
Q1 Q2 Q4		Teacher generated drawings, diagrams and descriptions of their classrooms and workplace environments	Snapshots of classroom and workplace culture at six month intervals (3 target project teachers)	Used to identify changes that occurred over time in teachers pedagogy and use of ICT in their classrooms
Q1-4			Critical reference group comments.	The critical reference group was asked to comment on emerging themes and constructs generated from ongoing analysis
Summary of Facilitating Researcher Role	• Design of project • Formulation of structures and processes based on current review of literature and research	• Design of PAR process • Facilitation of group meetings • Co-researcher • Critical friend	• Ongoing analysis • Observation and interview data collected at 6 month intervals • Compilation of cultural snapshots • Member checking • Critical reference group checking	
Who is involved	• 12 project teachers from 6 schools	• 12 project teachers from 6 schools	• 12 project teachers from 6 different schools (one for each teacher).	12 project teachers from 6 different schools; 3 principals, and 3 colleagues of the in-depth study teachers

B. Data Analysis and Theorizing

Ely et al. (1991) emphasize that data analysis should be continuous and progressive from the beginning of data collection. Data analysis took place in two different phases based on this recommendation. The first phase, initiated at the beginning of the data collection period, was used to "focus and refocus observational and/or interview lenses, to phrase and rephrase research questions, to establish and check emergent hunches, trends, insights, ideas, (and) to face oneself as research instrument" (p. 140). The final phase took place after leaving the field and focused on making sense of the data that had been gathered and telling the story of what had been learned.

Initial analysis of this strand began by coding the data that had been generated/collected using qualitative research software. Webb and Glesne (1992) summarize the analytical process as an initial disassembling through coding, then a reassembling as descriptive findings or theories. First order constructs must be transformed through coding and further analysis into second-order constructs. Hammersley and Atkinson (1995) stress it is important to devise ways of developing and testing the ideas that emerge from the analysis. Data that appear to be most central to the analysis need to be worked on with a view to clarifying meaning and exploring their relations with other categories (p. 209). The "constant comparative method" (Glasser and Strauss, 1967, cited in Hammersley and Atkinson, p. 209) involves examination of each item of data coded in terms of a particular category with similarities and differences noted. Hammersley and Atkinson state that mutual relationships and internal structures of categories are more clearly displayed through the process of systematic sifting and comparison.

Coding was based on general categories suggested by the data, but which were also prompted to some extent by the design of the proformas used by the teachers for generating their documentation. General codes identified teachers' feelings and beliefs, use of ICT and impact on students, classroom and school culture, motivation, vision and problems and constraints. The first three months of data generated by the teachers was summarized under the general categories that emerged and returned to the teachers for member checking and verification. This was termed 'baseline data' and designed to capture starting points.

Categories were built by sorting and theorizing to make sense of the data gathered. Ely et al. (1991) suggested starting questions such as: "What is the smallest meaningful chunk of log narrative that I will call a category? What concept does it imply? What categories will help me to organize the essential aspects of what is written here?" (p. 145).

Reflections on this analysis strategy resulted in some dissatisfaction. Fine coding resulted in losing a sense of the whole, and losing teachers' voices in summaries. Feedback from a critical reference group suggested keeping teachers' writing intact as much as possible during the analysis. The fine coding strategy was very much an isolated event in terms of the teachers' work, and the codes used were determined by my world view and interests as a researcher. Working out ways to involve teachers in this aspect of the analysis was problematic, as was ensuring that such a process would not be onerous for them, given the time and effort they were already putting in as part of the PAR strand of the research.

Kruger et al's (2001) threading and commentary strategy was adapted at this stage as a reflexive attempt to stay much closer to teachers' original narrative writing and avoid submitting the data to overly reductionist analysis. Building on the PAR strand of the analysis, the following strategies were utilized:

- Teacher researcher generated keywords, themes and propositions were used as a guide for further analysis of all data through threading and commentary; vignette and commentary; matrix/tables and classification; links with literature and other research findings (Bringing together of PAR and Interpretive strands)
- A second stage of reflexive discussion was employed with the in-depth study teachers to validate reconstruction of insights and findings

Thus this study involved some collaborative analysis and validation with the teacher researchers as well as individual analysis. The overall analysis was 'member checked' by the teacher researchers (Lincoln & Guba, 1985). Compared to analysis using qualitative software, the threading strategy enabled a more holistic picture within both individual and successive narratives to be kept in focus. This technique was used as part of a suite of analysis strategies that was applied to the data, and was used selectively

depending on whether it appeared to be the best method to represent particular relationships and connections.

The thread and commentary strategy was not enough on its own to pursue the notion of critical pedagogy. In order to do this, several analytical schemes were applied to the data. In particular, questions posed by Simon (1984, cited in Smyth, 1987) which addressed critical action, were used as a guide (see Table 11).

Table 11: Questions Leading to Critical Action

Why are things the way they are?	How did they get that way?	What set of conditions are supporting the processes that maintain them?	What is the potential for action that is embedded in actual relationships?

Teachers' reflections and journals were analysed as to whether they were attempting to address such questions. Smyth (1987) adds some further categories to this set of questions that "seek to unravel the social, cultural and political forces that have shaped our teaching" (p. 158). They have been adapted to a set of descriptive categories:

Table 12: Categories for Examining Evidence of Critical Pedagogy

Reflection on historical connections of teaching/learning ideas	Reflection on appropriation of ideas	Reflection on social and cultural conditions causing endorsement of teaching/learning ideas	Reflection on whose interests are being served by ideas.
Reflection on power relationships expressed in teaching practices	Reflection on how practices accommodate to the dominant ideology	Reflection on encouraging resistance of others who are oppressed	Reflection on grounds for radically changing teaching.

Smyth (1987) states that "a truly critical pedagogy involves an examination of existing social relationships at three levels: that of history, of current practice (including its hierarchical bases), and of the potential to transform arrangements in the future" (p. 160).

In order to stay close to teachers' narratives, vignettes were also distilled from the data to present "in miniature the essence of what the researcher has seen and heard over time…They are devices that are established through analysis and offered to provide meaning, cohesion, and colour to the presentation" (Ely et al., 1991, p. 154). These were selected at a later stage as emerging themes and propositions became apparent.

Ely et al. (1991) define a theme as "the researcher's inferred statement that highlights explicit or implied attitudes toward life, behaviour, or understandings of a person,

persons, or culture" (p. 150). Themes are customarily expressed in the form of statements. Themes did not become apparent till later in the analysis strategy and were constructed by drawing on both the PAR and Interpretive strands of the study.

A challenge for the research design was how to ensure that emerging themes and constructs were a genuine exploration of the theory/practice relationship and themes and insights emerging from the study. The following analytical scheme was applied to the keyword-thread-commentary data that had been generated by the in-depth study teachers. These have been informed by the Kruger et al. (2001) study, which suggested the categories *practice described, interpreted, theorised and changed*, as useful ways of exploring the theory/practice relationship (see Table 13).

Table 13: Categories for Exploring the Theory/Practice Divide

Change	Learning	Practice/ Pedagogy	ICT	Practice Described (D); Interpreted (I); Theorised (T); Changed (C)

Phrases such as 'I came to realise…', 'I find…', 'Obviously this …' were taken as indicators of theorising. The four categories of Change, Learning, Practice/Pedagogy and ICT were selected on the basis that they related most closely to the research questions and purpose of the study.

From here, tentative research propositions were initially built from teacher theorizing around these broad issues of change, learning, practice/pedagogy and ICT. My role was to build a synthesised map of these connections, which were returned to the teacher researchers for further debate and validation. Connections with the literature were also incorporated at this stage.

Role Issues

It is important at this stage to be clear about my dual researcher/ coordinator role within the project. As the project coordinator, I was in a position to shape the experiences of the teachers (and therefore in a position of power). I had a clear agenda for the project to promote the development of a critical perspective among the teachers. My facilitating researcher role involved designing the research guidelines that were used throughout the project. The two roles are distinguished in Table 14.

Table 14: Role Clarification

Project Co-ordinator Role	Facilitating Researcher Role
Co-ordination of professional learning program for teachers.	Designing of professional learning processes based on review of literature and research. Analysis of online reflections and teacher journals related to impact of these experiences on teachers
Organization of network meetings	Analysing minutes and personal journal of network meetings
Inviting speakers, including people who have engaged in participatory action research, to network meetings with teachers.	Participating fully in the participatory action research process as a critical friend. Sharing with group ideas re methodology and process
Requesting participants to post at least 4 online reflections about their inquiry progress and readings each term	Posting of online reflections re participation in participatory action research process. Analysing content of reflections with group
Requesting teachers to maintain a journal and minutes of inquiry team meetings	Analysing teacher journals and minutes of inquiry team meetings. Maintenance of own journal
Visits to classrooms to discuss issues, problems or concerns with teachers related to practical implementation of action research	Visiting classrooms to observe class in action
Engaging in regular email contact with participants re organization and administration issues	Participating in online reflections as co-researcher with participatory action research group. Critical friend role
Advising participants of ongoing professional development opportunities	Analysing participants' reflections about their professional learning
Monitoring online contributions and progress of the project	Analysing online contributions and changes that occurred in teacher attitudes, beliefs and practices
Reporting regularly to stakeholders in project (corporate partner, Dept of Education) on activities undertaken and future action planning.	Providing Dept of Education with copy of final dissertation and summary report. Providing each participating school with a summary report of research
Planning and conducting showcase of projects at the end of each semester	Submitting research papers to educational journals and conferences. Writing with teachers about the participatory action research process
Maintain a database in relation to administration of the project	Maintaining personal reflections in relation to participation in the project

In ethnographic and hermeneutic traditions, researchers' judgments are an integral part of the interpretive work presented and attract different tests of rigor (Dunkin, 1999). As previously argued, social research cannot be value-free, with the values of the researcher and cultural group influencing and shaping the development of the research (Parsons, 1951) and the building of theories (Reed, 1996). As Dunkin asserts, all

researchers engage in their own sense-making at each stage of their research processes, and that includes both academic and teacher researchers (p. 70).

Validity, Trustworthiness, Reflexivity and Generalisability

The scientific or positivistic paradigm assumes that the only way to generate valid information is through the application of a rigorous methodology that follows a strict set of established rules and procedures (Kincheloe & McLaren, 1994). Lather (1986) suggests that paradigmatic uncertainty is leading to a reconceptualization of validity and suggests that "vigorous self-reflexivity" is crucial (p. 270). She suggests the following categories of validity as appropriate for critical inquiry:

- Triangulation: multiple measures, multiple data sources, methods and theoretical schemes. Seeking counterpatterns as well as convergence.

- Construct validity: guarding against theoretical imposition and critiquing the theoretical tradition within which the study is aligned. Systematized reflexivity that reveals how a priori theory has been changed by the logic of the data.

- Face validity: recycling description, emerging analysis, and conclusions back through at least a sub-sample of the participants.

- Catalytic validity: the degree to which the research process reorients, focuses, and energizes participants toward knowing reality in order to transform it. (Lather, 1991, p. 65-69)

It has also been argued that trustworthiness is a more appropriate concept (than validity), particularly in the context of critical research (Anderson, 1989; Kincheloe & McLaren, 1994; Lincoln & Guba, 1985; Reinhartz, 1979). Kincheloe and McLaren acknowledge Lather's (1986) validity descriptions but add the following criteria as being more suitable measures of critical trustworthiness:

- Credibility: the constructions are plausible to those who constructed them.

- Anticipatory accommodations: accommodation of unique aspects of what has been perceived in new contexts.

Anderson and Heer (1999, p. 16) suggest five tests of validity for practitioner research:

Outcome validity:	*the extent to which action proposed in the research leads to a resolution of the problem that led to the study*
Process validity:	*the extent to which problems are framed and solved in a manner that permits ongoing learning by the individual or system*
Democratic validity:	*the extent to which research is done in collaboration with all parties who have a stake in the problem under investigation*
Catalytic validity:	*the extent to which the research enables the participants to understand reality so as to transform it (Lather, 1991) and*
Dialogic validity:	*the support for the findings accorded by a 'peer review' of colleague practitioners.*

These criteria were selected as being particularly relevant to this study and applied as part of the methodological analysis.

Reflexivity was an important element of the methodology which resulted in changes being made during the struggle to recognise and transform the constraints implicit in the research process (Shacklock & Smyth, 1998). It was necessary to critique and problem solve around issues of democracy and degrees of genuine collaboration from both ideological and methodological stances.

Reflexivity also resulted in validity concerns emerging which were addressed through limited application of the collaborative validation and theory building processes previously cited. This sampling provided a stronger base upon which to claim validity by connecting collaborative research propositions to those that were independently constructed.

Trustworthiness considerations related to both the usefulness and accuracy of the tentative research findings for the teacher researchers. The further testing of findings involving additional cycles of collaborative validation and theory building went beyond the time frame of the current study but would have strengthened trustworthiness claims.

The notion of 'fuzzy prediction' or 'fuzzy generalisations' (Bassey, 2001) was explored as it appeared to sit within the participatory worldview. One of the purposes of this

research was to make a contribution to the teaching profession in terms of knowledge creation and Bassey offers fuzzy generalizations as being of potential use to both practitioners and policy-makers in education. In particular, he notes that teachers generally seek "practical guidance based on credible evidence" as opposed to the sociologist who seeks "theoretical insight based on methodological probity" (p. 17). A fuzzy prediction, according to Bassey, can be a form of practical guidance, provided the context and related evidence is clearly enunciated. It can also contribute to theory building.

Bassey (2001) distinguishes fuzzy generalizations as being of the form that "particular events *may* lead to particular consequences" in contrast to scientific certainty that "particular events *do* lead to particular consequences" (p. 6, emphasis added). His position contrasts with the interpretive world view that dismisses the notion of universal laws in relation to social phenomena, as prediction and control are not goals of such research.

Bassey (2001), however, suggests that prediction in educational and social research is possible, provided there is a "rethink of the concept of generalization" (p. 8) where the notion of fuzziness refers to everything being a matter of degree. Thus a fuzzy generalization is 'neither likely to be true in every case, nor likely to be untrue in every case: it is something that *may* be true" (p. 10). In order for a researcher to propose a fuzzy generalization, the conditions under which it may or may not be true must also be explored. He cites Schofield (1990) who suggests 'three useful targets for generalisation' as being '*what is*, *what may be* and *what could be*" (p. 8).

Bassey's (2001) suggestion that the use of fuzzy prediction and generalization could provide a powerful tool for researchers to communicate with potential users of research at the same time as contributing to the creation of educational theory presented as a worthwhile consideration in terms of the goals of this study. It will be explored further following the overall analysis of the data and methodology.

Conclusion

This chapter has explored the basic assumptions and principles involved in selecting a research method. It provides an overview of competing paradigms and perspectives and the various theoretical positions that have informed the methodology. The research

purpose, goals and questions were used as starting points to design an appropriate methodology, which in turn indicated the methods most appropriate for data collection and generation. Thus two strands of inquiry were developed, one based on participatory inquiry and the other drawing on interpretive approaches to research, with particular emphasis on critical ethnography and hermeneutics. The latter sections of the chapter have described the participants, the type of data that was collected and the role of the researcher.

This research had several purposes. Firstly, it aimed to support and facilitate teacher learning and the development of critical pedagogy as they explored the possibilities of using ICT to achieve productive educational change and expand learning opportunities for students. The participatory inquiry strand was designed to address this aim. Secondly, it aimed to explore how the notion of 'teacher as researcher' could be employed in professional development programs and provide some "fuzzy generalizations and predictions" for policy makers and practitioners. Both strands of the research informed this aim. Thirdly, cultural and structural change at both a classroom and school level were explored in relation to the project experiences. The interpretive strand of the research informed this aim.

Issues in relation to trustworthiness, validity, reflexivity, predictions and generalizations have all been raised and addressed in the context of this research. The next chapters, which address the analysis issues that emerged from the data and research cycles will address these further.

Chapter 4: Professional Learning Experiences and Change

The focus of this chapter is the development of critical reflection, teacher learning processes and levels of change. In particular, this chapter reports on the impact of the professional learning strategies utilized during the project. As 'critical' reflection was identified in the literature as necessary for productive educational change to take place (Hargreaves & Dawe, 1990; Peters et al., 1996; Smyth, 1987a), this concept is further defined and discussed in light of the type of reflection that teachers did engage in. Building on the work of Smyth (1989a), teachers' reflections (written and oral) were coded in order to identify trends in the type of reflective action that different activities elicited.

Although original research questions focused on exploring "what changes could be identified as a result of teachers engaging in critical reflection and participatory action research", the analysis phase of this research went beyond identification of general changes (theoretical and practical) to focus more strongly on the different kinds of teacher theorizing, questioning and problematizing that took place. This enabled clearer links to be made between the development of a critical perspective and the reconstruction of practical action.

As chapters 5-8 provide specific examples of teachers' learning and pedagogical change, this chapter is more concerned with the learning process and making links with the literature in order to discuss whether second order changes, cultural change and productive collaboration occurred (Cuban, 1988; Cuban, 1993; Fullan, 1992; Fullan, 1993; Fullan & Stiegelbauer, 1991; Hargreaves, 1992; Hargreaves & Dawe, 1990).

Pedagogical Intentions and Philosophical Orientation

The design of the professional learning strategies developed in conjunction with this research drew on the work of Fullan (1993), who placed school-based professional development through collaborative inquiry at the heart of educational reform. Central to the intention of the project was the notion of teachers as researchers who contributed to their own professional knowledge as a result of systematic and collaborative inquiry (Cochran-Smith & Lytle, 1999; Fullan & Stiegelbauer, 1991; Kincheloe, 1991). The

concept of the project was also shaped by research and literature that recommended the formation of 'communities of practice' (Lave & Wenger, 1991), 'learning communities' (Cranton, 1994; Jalongo, 1991; Shaw, 1998) and 'learning organizations' (Conzemius & Conzemius, 1996; Marsick & Watkins, 1996; Senge, 1990; Watkins & Marsick, 1993) where research, rethinking and renewal were regarded as normal and essential work practices.

The project design was also constructed in response to calls for a greater emphasis on pedagogy and ICT, rather than a singular focus on technical skills (European Experts' Network for Educational Technology (EENeT), 1998; Fullan, 1992; Fullan & Stiegelbauer, 1991; Jurema, 1998). In addition to this, the work of Fullan (1991) and Conners (1991) was acknowledged so that professional learning activities aimed to encourage changes in teacher beliefs, assumptions, content knowledge, practices and use of materials as they related to curriculum decisions and ICT use. These dimensions of learning were identified as necessary if productive educational change were to occur (see Chapter 2).

Thus the key strategies developed to promote and support teachers' professional learning were:
- development of a culture of inquiry through engagement in a participatory action research process

- critically reflective practices, with an emphasis on pedagogy

- establishing a support network or learning community

- productive collaboration and sharing with other colleagues.

Professional Learning Strategies

This section outlines the professional learning strategies associated with this research. These strategies were analysed for indicators of critical reflection, which enabled recommendations about the strengths and application of particular strategies to be made. The impact of teacher collaboration and the development of a learning community are then discussed, together with the implications for school-based learning and collaboration.

Developing a Culture of Reflection through Participatory Action Research

Overview

Smith's framework for participatory action research praxiology (1997, p. 198; see also Chapter 3, pp. 49-50 for detailed description) guided the selection and development of a range of professional interactions and reflective practices, specifically:

- *Understanding self*: Teachers engaged in conversations and written reflections to make explicit some of their values and beliefs about teaching and ICT (Walk and Talk, Snapshot, Journal Proformas: see Appendix 2).

- *Making connections, developing trust within the group*: At the beginning of the project, teachers spent several days together to share stories and experiences, examine values, articulate interests, listen to each other and make personal connections. After these initial interactions, teachers self-selected themselves into inquiry teams based on common interests. At least one day each term was provided for them to come together as a group for network and inquiry team meetings.

- *Contexts*: Teachers wrote about their own contexts and practices as well as visiting at least two other teachers' classrooms and writing a response to their experience (Snapshot, School Visit Reflections: see Appendix 2). When teachers visited each other, they were encouraged to actively plan for and participate in the visit, set a focus for such participation, clarify roles and responsibilities and clearly delineate expectations and follow-up.

- *Integrating theory and practice*: As part of their induction into the program, teachers were provided with a workshop on the action research process. Time was then provided for teachers to come together regularly (at least once per term, usually 2-3 times) to discuss the issues they were working on, questions arising and how they might proceed in action. Weekly journal writing and online posting of summaries each term contributed to communication process between teachers. As well as analysing issues directly arising from their action research, teachers also read related articles that were selected to support and challenge their theoretical and philosophical positions. Once a term, they posted a reading response on the online forum.

- *Developing critical insight*: Teachers were encouraged to share summaries of their reflective journals online and to write their final reports collaboratively, encouraging the development of common understandings and analyses. The group acted as 'critical friends' to one another, responding to online postings and email communications.

- *Investigate/act/educate/analyse*: Teachers worked through several research cycles in relation to their action research projects. At two six-month intervals, teachers wrote an extensive account of their research issue and the understandings they had developed. Teachers also conducted a professional learning evaluation to identify their own professional change and learning (Appendix 3).

- *Transforming structures and cultures*: Teachers identified changes to support their research, including: planning and curriculum structures; classroom organization; timetables; teaching strategies; beliefs and values; learning theories; and collaborative relationships with students and other staff.

At the beginning of the project, teachers were asked to frame a problem or question related to teaching and learning. A sub-thread of investigating ways that ICT could support student learning in relation to the focus area of their inquiries was also planned.

Teachers' orientation as researchers within the PAR process is first examined, followed by an analysis of the impact of the professional learning strategies that were utilized.

Orientation within the PAR process
Interest in the area of teacher research or practitioner inquiry has been steadily building for well over a decade (Anderson, Herr, & Nihlem, 1994; Cochran-Smith & Lytle, 1999; Hollingsworth & Socket, 1994; Kemmis, 2000; Kincheloe, 1991; Noffke & Stevenson, 1995; Schon, 1983; Stenhouse, 1985; Whitehead, 1999). Two conceptual frameworks are used to discuss the practitioner research that was conducted as a part of this project.

Kemmis (2001) builds on the work of Habermas (1972) to suggest that practitioner research can be characterized by three areas of interest: *technical interests* in getting things done more effectively, achieving a defined goal or solving a particular problem;

practical interests in improving practice, informing practical decision-making and increasing self-understanding in context; and *emancipatory interests* in arriving at a critique of work and work settings, connecting the personal and political, and "developing an understanding of the way people and settings are shaped and re-shaped discursively, culturally, socially and historically" (p. 92). He warns that participatory action research should be a response to questions, dissatisfactions or injustices that already exist as a result of the life experiences of a group or else it runs the risk of becoming a "solution looking for problems". Kemmis's framework was used to analyse teachers' action research interests, which were characterised by either technical or practical interests. Those that began with a singular technical interest (e.g. developing a web site) shifted to include more practical interests as the year progressed.

Teachers who designed their initial action research project as a technical endeavour, with a specific goal or problem to be solved, expressed concerns about "lack of progress" and "not getting to the research" midway through the year. This was despite the fact that they had addressed a range of broader teaching and learning issues and made significant changes in their classrooms and school structures (meeting times, opportunities to collaborate with other staff). Reflection about what they were doing and what they saw as important resulted in a shift to more practical and broader pedagogical interests. This resulted in teachers changing the focus of their action research to a more general change and learning endeavour. This does not mean that action research projects initiated by technical interests are inadequate, but that there needs to be a process and opportunity for such projects to broaden their focus as teachers increase their understandings of their inquiry focus.

Like Kemmis (2001), Cochran-Smith and Lytle (1999) also distinguish between three broad conceptions of teacher research: teacher research as "practical inquiry"; teacher research as "ways of knowing within communities"; and teacher research as "social inquiry" (p. 17). They caution that such conceptions are also interrelated and not separated by exclusive distinctions. While similar in underlying concepts to Kemmis's (2001) view, they suggest a further sophistication and complexity, both in terms of the interrelationships between the different conceptions and opening up possibilities for a continuum of development within each strand.

Cochran-Smith and Lytle's (1999) conceptualization of teacher research as *practical inquiry* is couched in open terms, focusing on the generation of practical knowledge rather than achieving defined goals and solutions. Teachers' practical knowledge is assumed to be "some of the most essential knowledge for teaching", with such knowledge developing from "reflection in and on practice" (p. 19). The practical knowledge generated by such inquiry is variously described as 'craft' knowledge generated when teachers use their professional judgments to bring many different knowledge bases and pedagogical positions to bear on their teaching. This conception of teacher research is characterized by 'immediacy' and a response to the everyday knowledge needs of teachers that give rise to a need for classroom change. All teachers in this research project were concerned with the generation of practical knowledge at some level, even when their concerns shifted to a focus on their own teaching and learning role within the classroom. As can be seen from their action research projects (see Chapters 5-8), practical concerns were always strongly represented in the issues they chose to write and reflect upon, particularly teaching strategies and classroom organization.

Considering teacher research as *ways of knowing in communities* includes, but goes beyond, Kemmis's (2001) characterization of practical interests. Rather than only focus on 'self-understanding', they embrace the broader perspective of collective inquiry that includes a critical dimension:

> *...teachers generate local knowledge of teaching, learning, and schooling when they make classrooms and schools sites for research, work collaboratively in inquiry communities, and take critical perspectives on the theory and research of others. (Cochran-Smith & Lytle, 1999, p. 18)*

Teacher practice is conceptualized as a "critical and theory-building process" guided by the larger goal of creating rich learning opportunities for students that increase their life chances (Cochran-Smith & Lytle, 1999, p.18). This type of teacher research addresses a range of pedagogical dimensions, including the impact of relationships, capacity for responsive action and formulation of new questions for inquiry and future learning (p. 18). Regardless of whether teachers began with a focus on *practical interests* or *ways of knowing*, all action research projects eventually broadened to encompass the latter:

Initially I planned to explore how to integrate ICT more effectively into the Scientists in Schools program. However I have found that as part of my own reflection on how to achieve my goals I have diverted some issues. …Thus I have reformulated my major issue into creating a teaching and learning environment within my class and how, through changing my approaches to teaching and learning, the students are more engaged in learning as well as in the SIS Project.

(Muriel, 6 month Professional Learning Evaluation, Aug 2000)

Cochran-Smith and Lytle's (1999) third conception of teacher research as *social inquiry* is similar to Kemmis's (2001) characterization of *emancipatory interests* where "the emphasis is on transforming educational theory and practice toward emancipatory ends and thus raising fundamental questions about curriculum, teachers' roles, and the ends as well as the means of schooling" (Cochran-Smith & Lytle, 1999, p. 18). Emancipatory interests were not stated up front as a specific focus of teacher inquiry but particular readings and speakers during the project resulted in some teachers questioning curriculum and the nature of schooling. Grappling with emancipatory concerns tended to be something that ebbed and flowed in the course of reflective practices or as a part of theorizing about practice and purpose. Identifying a strong political perspective was problematic, as captured in the following journal entry:

I started with such high ideals about the project developing a critical/political and sociocultural perspective but I'm not really sure how to facilitate this. If I'm working with the group in the spirit of PAR then it doesn't feel right for me to bring issues to the group that I think would be 'good' for them. At the moment their concerns are practical and it seems that teachers want to focus in on what they think they can realistically change and impact. If you don't see yourself as operating politically, why expend energy trying to change the broader political system in which you work? Teachers rail against the political and the 'powers that be' or 'leadership'. Perhaps the first step is to develop self-understanding and clarity of values and beliefs before our vision can go beyond? Or perhaps I'm missing something more subtle in the reflections of the teachers as they worry about their ESL kids or assessment or having to measure outcomes at the expense of teaching well? Can the political be brought to the group or must it

emerge from already felt discord or dissonance? What does 'political' look like at a local level or in the eyes of teachers?

Emancipatory interests can be connected to values, ideals and vision. In a small way, taking action to enact such beliefs rather than simply espouse them could be taken as a step towards emancipatory action.

The action research process resulted in a range of different kinds of questions being posed by teacher researchers, with a shift in emphasis noticeable as the year progressed. Questions were coded into the following categories:

- What to teach: content and skills students need to develop, what's important and worthwhile?
- How to teach: effective strategies and approaches, engaging students?
- How to effectively organize for teaching?
- What works: what has been the impact of teaching, changed practices, and use of new resources?
- How best to communicate and share with other staff?
- Confronting the legitimacy of particular practices—is this good for students?
- Equity of access to resources by students—what are the implications of inequity?
- How am I doing as a teacher: my role, knowledge, strategies and impact on students?
- How to change school structures and timetables?
- How to maintain personal motivation and direction: where to from here?

Although teachers' questions were strongly weighted towards the technical or practical, they also illustrated a concern with understanding and improving their own practices and the impact they had on their students. Many 'what' and 'how' questions focused on what to do or teach, but some confronted what students were being asked to do and reflected on personal effectiveness. Where questions asked early in the action research cycle focused mainly on issues of practice, pedagogy, resources and evaluation, later questions also addressed communicating and sharing with staff and beyond the school, changing school structures, maintaining personal motivation and direction and future

planning and development. Thus teachers' concerns changed over time and broadened from the immediate demands of knowing what to do to embrace a sense of themselves as learners who had worthwhile contributions to make in their professional community.

At the very least, the action research project was a catalyst for more systematic and ongoing reflection about particular teaching and learning issues. It provided a focus for implementing change and mirrored the contradictions raised by Kemmis (2000) as to what actually happens when teachers become researchers — do they investigate their reality in order to transform it (Fals Borda, 1979) or transform their reality in order to investigate it (Kemmis, 2000. p. 8)? Both appeared to occur in dialogical relationship with one another. For example, teachers surveyed, interviewed and reflected with students to find out their opinions about use of ICT, which in turn introduced a new dynamic into the relationship between teacher and student.

At its strongest, the participatory research project led teachers into new areas of reflection and theorizing and developed a strong sense of professionalism, confidence, morale and motivation for some of the participants:

> *I would like to publicly thank the Department of Education for allowing me to participate in this wonderful, meaningful and thought provoking project…I have never worked so hard in my life. I have never wanted to work as hard as I now want to work.*
>
> *(Nina, 6 month Professional Learning Evaluation, August 2000)*

> *It was a very exciting time for me because it is the first time I have been acknowledged, by my school, as being part of the project. I had the honour of presenting numeracy at my school. I felt very comfortable and confident talking about how we teach mathematics and my part in the project. The other staff and quite a few of the parents gave me heaps of positive feedback and were very interested in my approach. It is always a boost to the confidence and ego to be given such encouraging feedback. This was undoubtedly the highlight to my week.*
>
> *(Robin, Journal, May 2000)*

Power and influence

Several influences impacted the questions/issues that teachers decided to pursue for their participatory research. One external constraint was a Department of Education requirement that teachers' concerns link in some way with technology use in the classroom and that they address either Early Years or Middle Years initiatives. This constraint was not viewed as problematic to teachers and actually helped to provide some initial focus and structure. It also linked their action research to initiatives that they saw themselves as needing to incorporate into their practice.

An internal influence was the strong desire of the teachers to work together in small groups. During the initial group formation and community building phase, teachers were asked to identify the big issues that mattered most to them in children's education. Such issues included tackling racism, the development of creative thinking, student engagement and the development of intercultural understandings. The teachers who had initially raised the issues of racism and creative thinking ended up forming a group with other Early Years teachers who wanted to tackle the issue of integrating ICT into the numeracy program, soon to be mandated by the Department of Education. The development of creative thinking was added to the ICT/ early numeracy agenda but the concern about tackling racism was dropped from the potential research agenda (although was still pursued informally by the teacher concerned). In this case, the priorities of the Department of Education took precedence when teachers weighed up the issues they would ultimately pursue.

A power dynamic that was not analysed in great detail by the teacher researchers was the influence of the Department of Education. Although they frequently mentioned the Department, it was mostly in the context of 'imposition' of system initiatives, particularly accountability measures, but also particular strategies that were recommended as a part of such initiatives e.g. the Early Years Project. One teacher went so far as to say, "The Department doesn't really influence my practice at all". When questioned further, she noticed that she attributed most 'impositions' and outside influences as coming from her own school leadership, and had not previously considered the 'reach' of the system influences.

Power and 'the political' were mostly discussed by the teacher researchers in terms of imposition and powerlessness, of structures and initiatives that were imposed and which

they railed against and either adapted to or succumbed. 'Leadership' (meaning the principal, assistant principal and senior leading teachers) was more frequently railed against than the Department of Education, which suggests that there is little stimulus for teachers to consider the broader political context of their work.

Personal power was identified as a strong motivator for teachers, particularly when they perceived they had the freedom to make choices about what, how and when changes would take place:

> *What motivated me was that I could see first hand the benefits of utilizing these practices and wanted to adopt these approaches. The ideas, practices and organization inspired me to do the same. The changes I wanted to make were changes that I was ready for, in my own time and relevant to where I am at in my teaching. The changes were something that I had control over and could trial in the comfort of my own classroom. I could take these ideas away and use them if I wanted, rather than being told it was something I had to do.*
>
> *(Maryann, 6 month Professional Learning Evaluation, Aug 2000)*

The action research process appeared to result in teachers changing the power dynamic that had previously existed in their classrooms. The process stimulated teachers to collect data and hold conversations about learning and student response to teaching practice. Teachers introduced feedback mechanisms and student surveys to gain additional perspectives about the focus of their research. Students were given voice and this in turn informed teaching practice, personal theorizing and future directions.

Strengthening the Action Research Process

The action research process provided teachers with a focus for moving forward in understanding a particular area of their practice. In reality, the learning process went beyond this initial focus, with teachers at times ranging widely into reflection about different pedagogical issues. The action research process did provide teachers with a point of common interest to begin discussions about their work and to try particular innovations and new practices. The process of documentation and collection of data also provided a record of change and learning over time.

What was missing in the first year of the project was a process to elicit deeper cyclical analysis. Although teachers synthesised a monthly journal, which was posted online in

the closed discussion forum, these were often cut and paste edits of previously written journals. In retrospect, a process similar to that advocated by Kruger et al. (2001) involving sketching, threading and commentary proved to be a more effective strategy for moving beyond description, reporting and summarizing to genuine participatory analysis. If this had been used from the beginning of the project, rather than introduced towards the end of the study with a limited number of teachers, a more proactive and collaborative approach to analysis would have taken place. This may have avoided teacher researchers sometimes being overwhelmed by data and led to more in-depth thinking and dialogue about issues at an earlier stage of the project.

Critically Reflective Practices

In this section, the impact of each of the reflection strategies utilised during the project is discussed with a view to analysing how each contributed to teachers' professional learning. Smyth (1989a) and Emery (1996) recommend using a construct based on four levels of reflective behaviour, which are indicators of critical reflection: describing, informing, confronting and reconstructing. This construct was used as a basis to examine teachers' reflective writing, talk and dialogue. Smyth's original constructs have been adapted to more accurately represent teachers' reflections in this study:

Describing: Smyth (1989a) and Emery (1996) categorise *describing* as when teachers ask, "what do I do?" and write a narrative of the events of teaching. In this study, teachers also described what students do, what other teachers do and how they feel about the events of teaching. All of these types of reflections were coded as "describing".

Informing: Smyth (1989a) and Emery (1996) used *informing* to represent when teachers ask themselves, "What does this mean?" and "What are the pedagogical principles behind what I do?" (Emery, p. 110). These explanations are worked out either alone or with other teachers. In this study, when teachers theorized about or interpreted what they had done, seen or felt, it was coded as "informing".

Confronting: When teachers engage in *confronting* to reflect upon their work, they present strong evidence of critical pedagogy as defined by Smyth (1989a). This type of reflective action addresses such questions as: "How did I come to be like this?…What are my assumptions, values, and beliefs about teaching? Where did these ideas come

from? What causes me to maintain this theory? Whose interests seem to be served by my practice?" (Emery, 1996, p. 110). Emery summarizes confronting action as when teachers "subject the principles and theories developed in the informing stage to an investigation of their sources, situating theories in the larger social, cultural, and political contexts" (p. 110). Smyth (1989a) adds that there is also some reflection on power relationships that are expressed in teaching practices.

Confronting reflections were more difficult to code in the context of this study. Teachers did attribute sources and influences to some of their beliefs and theories and this was coded as confronting. Sometimes they made strong and absolute statements about what they believed and valued which was not connected to ruminating about a particular observation or experience. This was also coded as confronting, where they had accepted and rejected particular views of the world and used these as a basis for constructing action and moving forward. When teachers confronted a problem, weighed up options and engaged in more critical theorizing (in contrast to informed theorizing directly connected to practice), statements were coded as confronting.

When teachers confronted the social, historical, political and cultural implications of their practice, they situated their reflections in local contexts or concerns. For example, social reflections considered ways of working with other colleagues in their own schools or local community; historical reflections identified people and educational initiatives that had influenced them; cultural reflections thought about how well their practices were preparing students for a changed society and future challenges students would face; and political reflections tended to rail against what they saw as oppressive structures and requirements that prevented them from teaching in a manner that they felt most benefited students. Political reflections also considered democracy in the classroom, degrees of decision-making afforded to students, equity of opportunity for students and what to do about the 'strugglers'.

The research framework also prompted teachers to confront what they did not know and what they needed to find out during their reflections. Although different from what Smyth (1987a) originally intended, confronting was also coded when teachers appeared to be making critical assessments about themselves.

Reconstructing: When teachers' reflection is typified by *reconstructing* they ask and answer the question, "How might I do things differently?" (Emery, 1996, p. 110) and examine the potential to transform existing relationships and practices for the future (Smyth, 1987, p. 160). In this study, evidence of teachers reconceptualizing or modifying their theoretical stances, and articulation of changed practice and new learning were coded as reconstructing.

The next section applies Smyth's (1989a) construct to each of the following reflective practices:

- Snapshot
- Journal writing
- Professional reading responses
- Classroom visit reflections
- Case, thread and commentary writing
- Action research reports
- Professional learning evaluations
- Dialogue and interviews

Implications for the development of critical reflection are then presented. The recorded reflections of the three teachers in the in-depth study plus at least one other teacher were coded for each of the different forms of reflection. Where a clear trend did not emerge from the four teachers, additional reflections were coded until a trend emerged. A single coded unit of meaning ranged from single statements to paragraphs describing a particular practice. The total number of units of meaning for each form of reflection was then calculated as a percentage of the total coded responses for each individual.

Snapshots

At the beginning of the project, teachers were asked to reflect upon their current practice and classroom organization by writing a 'snapshot' (Appendix 2). As well as providing a form of baseline data from which to track change over time, it was also an opportunity to make current beliefs and pedagogy explicit. The snapshots were successful in eliciting a high level of confronting reflections (see Figure 4):

Figure 4: Forms of Reflection in Snapshots
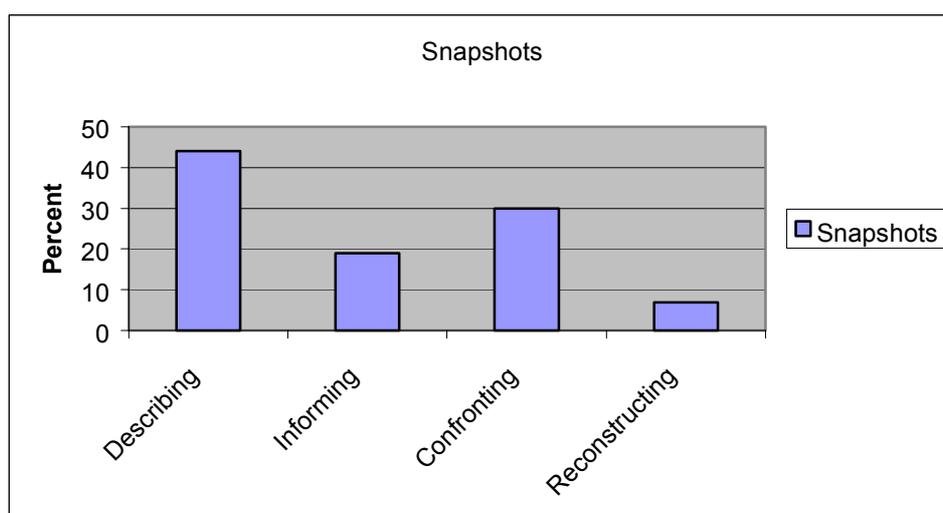
The framing of the snapshot questions would appear to be the most significant prompt for this type of reflection, with teachers directly asked about their feelings, influences on their practice, reasons for wanting to change what they currently did and visions for the future. Reflections that characterized the critical and emancipatory concerns of Smyth (1989a), Emery (1996), Kemmis (2001) and Cochran-Smith and Lytle (1999) emerged in the snapshots:

> *I do believe that ICT is a form of elitism due to the expense of setting up systems for schools. Many schools around the world do not and will not have the resources to set up ICT.*
>
> *(Nina, Snapshot, Feb 2000)*

The snapshots were also effective in eliciting strong statements of belief about the role of ICT in the teaching and learning process:

> *I believe that ICT should be used only to enhance student learning and not as a "busy" tool. ICT tools will not always be a better and/or quicker way of learning. We need to help students to further their own thinking and decision-making skills so they can make calculated judgments as to when ICT will make the task easier.*
>
> *(Phase 2 Teacher, Snapshot, March 2001)*

> *I really want students to use computers more cooperatively so that they can share the learning and research they are involved in. Rather than being passive*

users of the Internet, I want students to be more proactive explorers of how
computers can work for them.

<div align="right">*(Donna, Snapshot, Feb 2000)*</div>

Snapshots prompted self-reflection, particularly in terms of areas for change:

I want to change, as I really don't feel that I successfully engage all students in
the learning process. I really want to make a difference in how students learn
and how they view the whole education 'system'. I feel my time is wasted in the
classroom and in planning and correcting students' work if it has not real
meaning for students. We really work in a vacuum in the school and don't work
together with other staff to share our experiences and learning in a systematic
way.

<div align="right">*(Donna, Snapshot, Feb 2000)*</div>

I want to grow and improve in teaching. I want to feel more sure of myself. I
want to support the learning of my students and to help them deal with the
changes that they will experience in their lives.

<div align="right">*(Nina, Snapshot, Feb 2000)*</div>

Thus one of the most powerful aspects of the snapshot was that, in addition to
contributing to the stage of the action research cycle of 'understanding self' (Smith,
1997), it provided teachers with the opportunity to confront themselves as professionals
and engage in visioning for the future. The snapshots prompted teachers to examine
their existing beliefs in relation to student learning in general and, more specifically, the
use and potential of ICT in the classroom.

Journal Writing

Journal writing was a particular challenge for teachers to maintain as a regular
discipline within busy working lives, with even the most enthusiastic advocates of the
practice citing time factors as problematic. All teachers saw merit in keeping a journal,
variously describing it as "a place to organize and vocalize thinking and teaching", a
practice which "made me become more critical and to question what I am teaching and
how I am teaching it" and "helps to keep you on track and be accountable". One teacher
noted that he was initially intimidated by the practice because "it required me to take a
good, hard look at myself". Another teacher noted that the act of sitting down to write

often elicited thoughts and feelings about a topic that she was not aware she had until that moment. Several teachers cited their reflective writing as a catalyst for making changes in their practice as they engaged in analysis, self-critique, questioning and identification of areas for action:

> *I am keeping a detailed journal, which is helping me learn and practise reflection as a technique for deeper understanding of my own work, my own practice and my own belief system. I am finding out what does and does not work. I am able to begin using metalanguage myself, to talk about my own thinking.*
>
> *(Nina, 6 month Professional Learning Evaluation, Aug 2000)*

> *I find that having to reflect on what happened in my classroom over the week allows me to re-evaluate the direction I am taking with thematic work and the project and to make necessary changes when needed.*
>
> *(Gerry, 6 month Professional Learning Evaluation, 2000)*

Reflections on the act of journal writing were almost always couched in both positive and negative terms, with the benefits contrasted with the struggle to actually write it. Variously described as "a burden" and a "a pain in the neck", one teacher captured the dichotomy as follows:

> *The journal is*
> *A chore, but useful*
> *Tedious, but reflective*
> *Confronting, but analytical and thought provoking!*
> *Time consuming, but worth it*
> *Different, in an interesting way.*
>
> *(Maryann, Journal, Aug 2000)*

Half the group managed to be regular weekly writers, while others were more spasmodic. Two teachers stated that talking with colleagues was a preferred mode of reflection for them rather than writing. One teacher felt that she had too many similar types of reflective activity and would have preferred to hand write rather than type and share her journal, particularly as she did not have email access at home. Overall,

however, the group agreed that a different type of thinking occurred in the writing process compared to dialogue.

Even when teachers were overwhelmingly supportive of the value of reflective writing such as journals, the culture within schools discouraged such reflection. Teachers' lives were extremely busy, taken up with more 'doing' than 'thinking'. Several principals in the project tried to address this problem of legitimate reflection time for teachers by providing a half hour of journal release time each week. While this was enormously appreciated by the teachers, both in terms of having their principals acknowledge the importance of their work in the project and seeing principals in their classrooms each week, the release strategy proved difficult to sustain. Principals also have busy working lives with many random demands made on their time, so that they were not always able to provide the release time as they planned. Several teachers stated that they found journal writing at school difficult, citing too many distractions as problematic. Most teachers chose to do their main reflections for the project at weekends or evenings, where they could create a quiet, calm and focused space.

This study suggests that journal writing is difficult to sustain in school environments as they are currently structured. This kind of regular reflective practice would need to be built into the normal work practices of teachers for it to become self-sustainable, rather than something required by an outsider. This requires a commitment and understanding of its purpose and value by school leadership and the central Department of Education. Figure 5 presents trends in the forms of reflection engaged in by teachers in their journal writing:

Figure 5: Forms of Reflection in Practitioner Journals
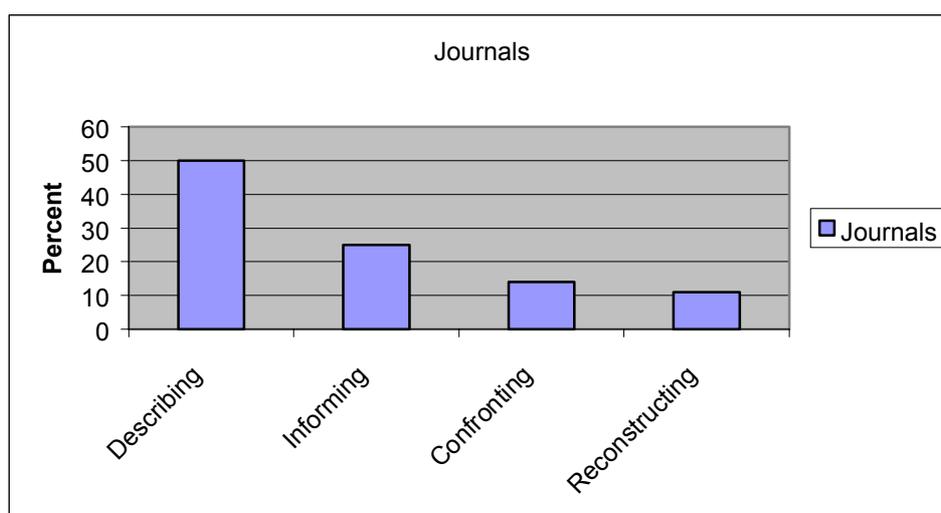
This data suggests trends only, and to some degree reflects the prompts that teachers used to guide their journal writing (Appendix 2). The first prompts were based on the work of Brookfield (1995) and characterized by questions that asked teachers 'what', which mainly led to describing, with only one question prompting reconstructing. An alternative structure of 'what, so what, now what' was introduced in order to shift reflections to incorporate more analysis and theorizing. This was effective in eliciting *describing, informing* and *reconstructing* forms of reflection.

Some teachers chose not to use a particular structure and instead wrote a more natural flow. All four forms of reflection were still in evidence, although unstructured journals at the beginning of the year favoured describing significantly more than the other forms of reflection. Analysis of journal data suggests that simple prompts are best for teachers (easily memorized and used routinely) and that critical reflection is more likely to be elicited with clear intentional prompts. Journal prompts would benefit from being explicitly structured to elicit the four forms of critical reflection e.g. describing (what did you do, what did you observe, what did you feel); informing (what does this mean, how do you understand what occurred); confronting (why did you do things that way, what is influencing you, what dilemmas, problems or conflicts of interest arise for you, what do you believe and value most strongly, who benefited most from the way you did things); and reconstructing (how might you do things differently).

Journal writing was particularly effective in prompting articulations that made tacit practice explicit and the development of what Whitehead (1999) calls 'living theories':

Individuals necessarily create their own living curriculum theories as they describe and explain their own learning…The living theories emerge from the educative relationships of professional educators and their engagement with propositional theories as they become an integral part of moving their curricular enquiries forward. The theories are living in the sense that a present practice is understood in terms of an evaluation of past actions and an intention to create something better in the future. (Whitehead, 1999, p. 5)

Professional Reading Responses

Early data collection and conversations with teachers guided the selection of a range of professional readings. Selection was also influenced by the desire for the project to have a pedagogical focus rather than a technical, and a desire to be provocative. A list of professional readings shared by the group is presented in Appendix 4. Responses to professional readings were shared by the group in an online discussion forum.

Professional reading responses were strongly characterized by critical reflection, particularly confronting:

Figure 6: Forms of Reflection in Professional Reading Responses
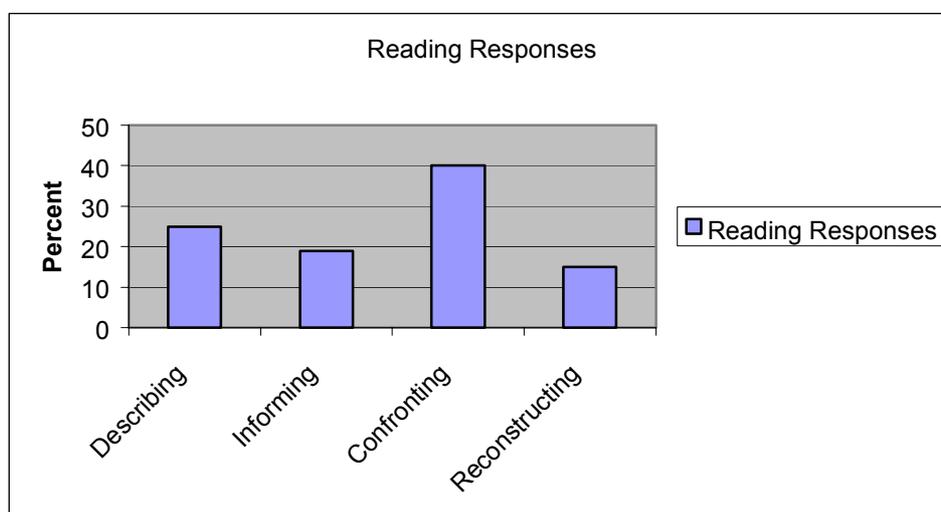
The opportunity to respond to alternative views in the online forum appears to have contributed to the large number of confronting reflections that were evident in reading responses. Although teachers rarely directly confronted or contradicted what their colleagues had written, they would post a strong articulation of their own beliefs and struggle with why this was so. One reading, *The Trouble with Checklists* (Davis, 2000),

was particularly successful in provoking critical reflection of a confronting nature. Most of the teachers had used checklists for different purposes and the article caused them to agree, disagree and interrogate the value of their own practice in this area.

Readings also provided new content knowledge. In particular, readings that addressed questioning skills and creative/critical thinking strongly influenced decisions teachers made about the way they used ICT in classrooms:

> *This section of the article gave me good ideas for stimulating the creative thinking skills of fluency, flexibility, originality, and elaboration.*
>
> *(Nina, Online Reading Response, May 2000)*

Numerous references to professional readings about thinking, questioning and multiple intelligences were made throughout teachers' journals. These references were usually made in connection with teachers grappling with changes in practice and thus significantly impacted teachers' reconstruction of practice and theory:

> *As part of the project we were asked to read an article "Improving our Questioning Skills" and a guide to strategic questioning. I have completely changed my attitude to questioning and to listening to students' answers.*
>
> *(Nina, 6 month Professional Learning Evaluation, 2000)*

Professional reading responses were an effective way of raising consciousness about particular issues and provided teachers with an easily accessible stimulus for trying new pedagogical practices. They successfully stimulated self-confrontation, resulting in references to past practices and action, articulation of current beliefs and practices and the struggle to define directions for future practices.

Classroom Visit Reflections

> *One of the most significant parts of this professional development has been the opportunity to visit other teachers' classrooms and to watch them teach and to talk to their students. Unlike other classroom observations that I have made in the distant past, I was asked by our project facilitator to prepare for my visits. I wrote plans, which I submitted to the teacher I was visiting. I then wrote reflections of my visits, which helped me to dig deeper and think about what I had learnt. The reflections took much longer than the visits and were demanding*

on a personal level. The reflections took me to a higher plane of thinking about my own teaching, my own classroom and how I might improve.

(Nina, Professional Learning Evaluation, Aug 2000)

The active engagement by visiting teachers during the classroom visits shifted the dynamics from passive observation to a two-way flow of learning. Teachers always reported getting lots of ideas, and particularly focused their reflections on classroom management and organization, room displays, the relationship the host teacher had with the class, strategies observed and the activities students were engaged in. Visiting teachers were also able to contribute to the class, through providing the host teacher with a reflection on similarities and differences in the way they did things in their own classrooms and through direct interaction with students:

Zoe tried a new activity this week too. When I was in her grade she had one group of children writing 'at' words on the computer. She didn't realize that the children could have them read back to them so I showed a couple of children how to do this. She emailed me and said how the children in her grade think that the talking computer is great.

(Robin, Journal, Aug 2000)

Classroom visit reflections were shaped by a common proforma that teachers used to send a reflection to their host teacher (Appendix 2). The prompts for observations and reflections/questions were expected to elicit describing, informing and confronting forms of reflection, while 'implications for practice' should have led to some reconstructing types of reflection. Trends in the school visit reflections are presented below:

Figure 7: Forms of Reflection in Practitioners' Classroom Visit Reflections
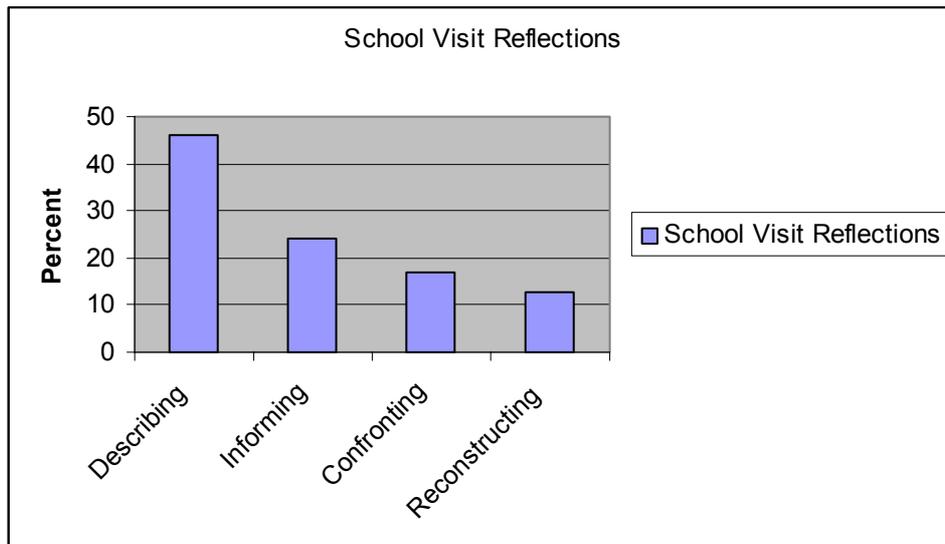
As expected and encouraged by the structure of the proforma, a significant amount of teachers' writing was describing. The informing and confronting responses prompted by the school visits varied in the degrees to which they teased out underlying pedagogical principles. Reflections that were notable because of the degrees of informing and confronting utilized a feedback strategy from the Australian National Schools Network Protocols (Australian National Schools Network in partnership with the Coalition of Essential Schools (USA), 2000). Not only did teachers look at their own beliefs and values when they engaged in this type of reflection, they were also prepared to ask questions which challenged their colleagues' practices:

> *Writing my reflection of my visit to Zoe and responding to her reflection gave me great food for thought. Today I have worked for several hours, probably 5 hours, thinking, typing emails and questioning my work and Zoe's work in our own classrooms. I used the article "Improving Our Questioning Skills" to try and write some cool feedback and some thought provoking questions to Zoe. Just phrasing the questions was insightful for me.*

> *I didn't compare myself and my work to Zoe too many times. However there was the odd twinge I had while thinking, 'I wish I did it that way, or don't the students and Zoe have a warm, supportive relationship'. I thought long and hard and wondered what Zoe had done to build such a positive, respectful, calm and productive environment. It made me realize how different classrooms are from*

each other and how it is so much due to the teaching style of the teacher, the personality of the teacher and the tenor, ambience, and structures of a school and team.

It is difficult to come up with some cool reflections, but I'll try to meet the challenge. I watched the student pairs struggling with the challenge of being the 'tutor' or the 'student' and wondered about it. In what ways could it be more advantageous or productive or enjoyable to share the roles? In what way could the roles be shared during one learning time? What are your reasons for doing it this way Zoe? What other ways are there to approach the learning/working partnership? What could you do that you are not yet doing?

(Nina, School Visit Reflection, Journal, March 2000)

Not all classroom visit reflections were as confronting as Nina's example, with some focusing more on questions that dealt with practical/technical concerns (what do you do and how do you do it). These generally drew describing responses from the host teacher. 'How to' and practical organizational knowledge always seemed to concern teachers, drawing significant investment of thought and energy. The classroom visit reflections strengthened ties within the inquiry teams, setting up a dynamic of contribution rather than passive reflection. The nature of the collaboration was both practical, in terms of sharing new strategies, and pedagogical, as inquiry team members asked each other questions that probed the underlying beliefs and assumptions behind particular practices.

### *Case, Thread and Commentary Writing*

A variation on case, sketch, thread and commentary writing (Kruger et al., 2001) was introduced towards the end of the first year of the project. This was in response to concern about the lack of genuinely collaborative analysis and a preponderance of description and summarizing as the main forms of data synthesis. Teachers either wrote a case about a critical incident in their classroom or used earlier journal entries to create a thread of practice. For example, one thread was created from journal entries to represent changes in practice from the beginning of the project. This is illustrated in Figure 8:

Figure 8: Thread of Practice

THE BEGINNING / THE CHANGES

Exploration

Small group rotations

Open-ended, creative, challenging type activities

Less teaching of specific skills

Reflection time
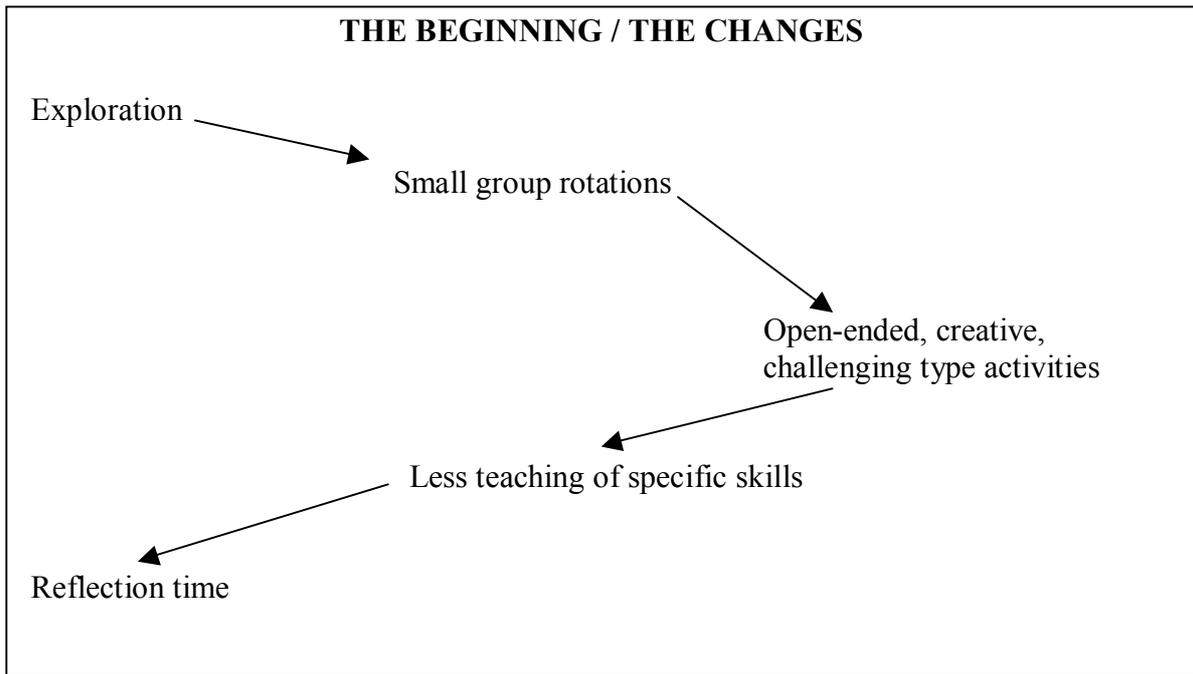
Case writing alone prompted large amounts of description with some theorizing taking place. When teachers wrote a case they described their work, their thinking, prior knowledge and how they worked through a problem. Statements of belief and pedagogical understandings were woven into the case as part of the explanation. When case and commentary writing were coded together the following trends emerged:

Figure 9: Forms of Reflection in Case and Commentary Writing

Case and commentary writing
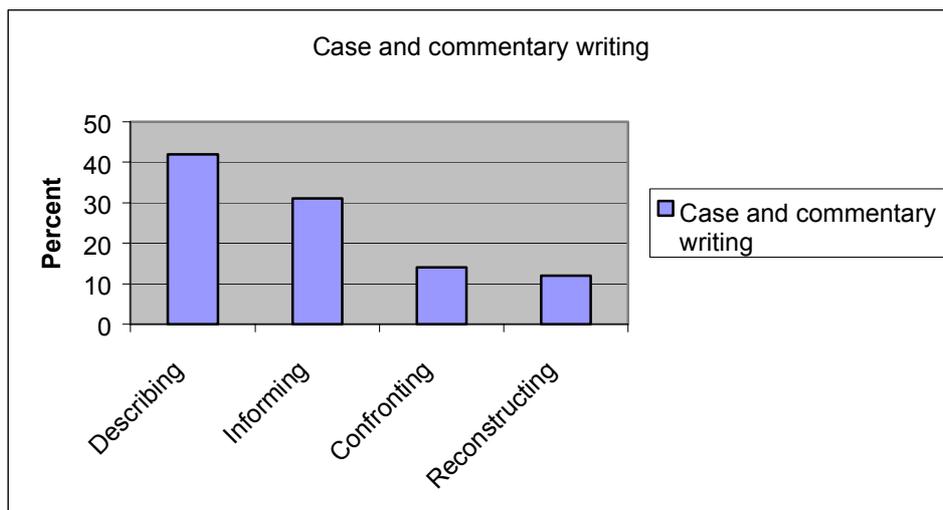
The high level of theorizing as 'informing' or 'confronting' warranted further investigation. It was noted that commentary writing was the form of reflection that

prompted high levels of theorizing, regardless of whether the commentary was in response to earlier journals or a new case. After teachers 'threaded' key ideas from a series of journal entries or a freshly written case, they wrote a stream of consciousness commentary. The following figure shows the difference in one teacher's reflective writing when she simply wrote a case, compared to when she constructed a thread and wrote a commentary:

Figure 10: Comparison of Forms of Reflection in Case and Commentary Writing
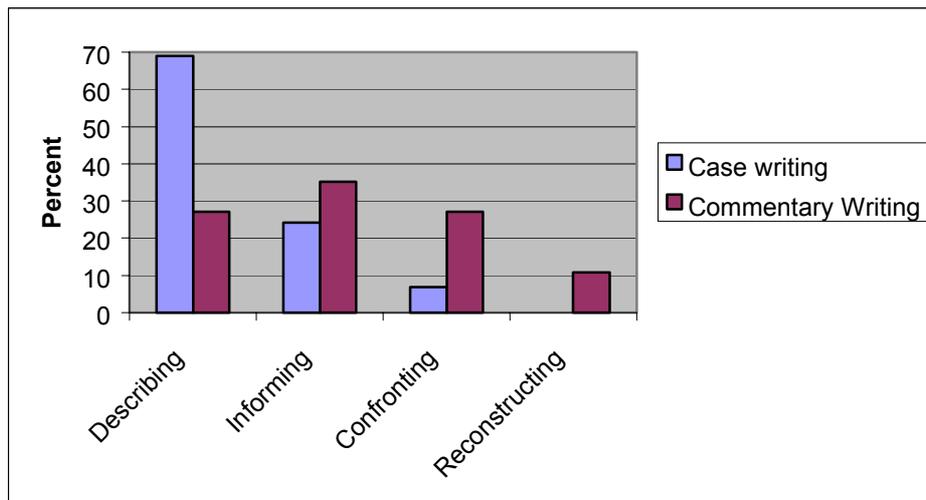
Teachers were more likely to make strong statements about their beliefs, realizations and findings in reflections that took the form of commentaries. They made explicit their construction of living theories (Whitehead, 1999) as they reflected by informing, confronting and reconstructing:

> *One of the greatest fears in the beginning, regarding computer usage in my classroom, was the fact that I felt I didn't know enough to be able to teach my pupils how to use them. I came to realise that I didn't have to be an expert for computers to be used as a teaching tool within my grade.*

> *I had to change my perception about what I thought a 'good' computer task was. I was too hung up on how a particular piece of work should look upon completion. I soon discovered that the end product was not all that important but in fact the process the child has gone through to solve the problem or complete the task was often the most important thing. After a short time it became easy to think of new ways the children could use the computer to extend their knowledge.*

In the early stages I felt I needed to teach the children specific skills. I now believe that these skills should not be taught in isolation. My ICT activities come from a pedagogy focus rather than a technology focus. I found the best time to teach a technical skill is when the need arises. Students need a reason or purpose to learn ICT technical skills. If taught in context the children will retain this knowledge much more easily than if taught in isolation…I have now come to the realisation that open-ended, problem solving type activities require children to use more thinking skills but believe computer programs that allow for rehearsal and practice are valid if they are combined with open-ended activities that require higher order thinking.

(Robin, Thread and Commentary, Mar 2001)

Commentary writing was characterized by statements beginning with comments such as "I came to realize", "I believe", "I find", "I think" and "I have discovered". In terms of a strategy for developing critical reflection, it proved to be extremely effective in moving reflection along from describing to informing and confronting.

Action Research Reports

Teachers wrote a report about their action research at two six-month intervals. The structure of the report (Appendix 1) was designed to prompt analysis and the different stages of the action research process. The reports were effective in describing changes that had occurred over time and prompting theorizing about what was happening as a result of the interventions and innovations that teachers had initiated. These reports were particularly successful in prompting reflection that focused on reconstructing (see Figure 11):

Figure 11: Forms of Teacher Reflection in Action Research Reports
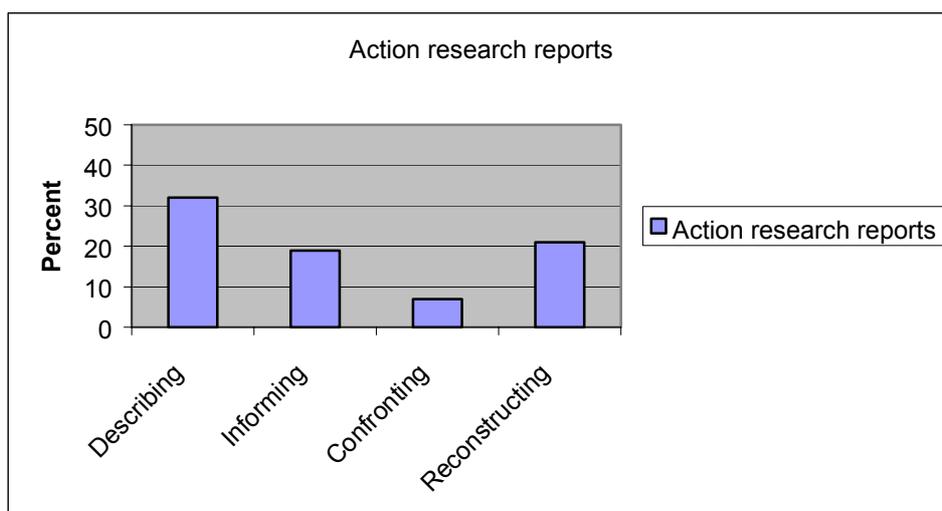
Although successful in refocusing and adjusting teacher research and action in readiness for a new cycle of inquiry, the format was less successful in encouraging confronting reflections except when reports were jointly authored by the inquiry team. Teachers then teased out similarities and differences and moved to making strong statements about new beliefs and understandings. This collaborative opportunity to explore difference as part of a respectful collaborative process was therefore instrumental in prompting all four forms of teacher reflection. Confronting reflections in action research reports were mostly about pedagogy, particularly beliefs, values and influences on practice:

> We have found this project to be an enormous journey of change for all three of us. We started working on how ICT can enhance the learning outcomes for children in the area of mathematics. Later we expanded this across all KLA areas as it felt constraining just working in one curriculum area.

> We went back to our classes and experimented with many programs and activities and found that many were just as beneficial to children as hard copy. In some instances the technology proved to be a disadvantage. We questioned what activities were best for the children and worked from there. We discovered activities using Paint, Kidpix and animation software that enhanced the thinking skills of the children. After several readings and seeing what works best on the computer we decided to include higher order thinking skills as part of the

project. We also felt that our ICT activities should come from a pedagogy focus rather than a technology focus. Robin joined the team at this stage and even though she was not with us at the planning stage, she took on board where we were at and became part of the team.

All three of us continued the cycle of planning, acting, reflecting and refining the use of ICT in the classroom, keeping in mind the need for higher order thinking as part of the process. Open-ended activities were easier to plan and invent as our professional development has allowed us to recognise the potential of ICT across the curriculum. This is as result of our professional reading, our Early Years team meetings, workshops and reflecting on our own teaching.

We found that we became much more critical about the activities and programs we chose for the children. We now rely on the children articulating their thinking to add depth to the assessment and evaluation of the student's learning outcomes and our planning.

(Early Years Action Research Report, Nov 2000)

Professional Learning Evaluations

The format of the professional learning evaluation was designed to prompt teacher reflection about change, learning, collaboration and influences (Appendix 3). Although a significant amount of theorizing took place, the report format meant that teachers mostly wrote about such changes in a way that summarized and described rather than interrogated. They talked about what they had tried, problem solved and found successful. Their evaluations were strongly characterized by descriptions of new practices:

Figure 12: Forms of Reflection in Professional Learning Evaluations
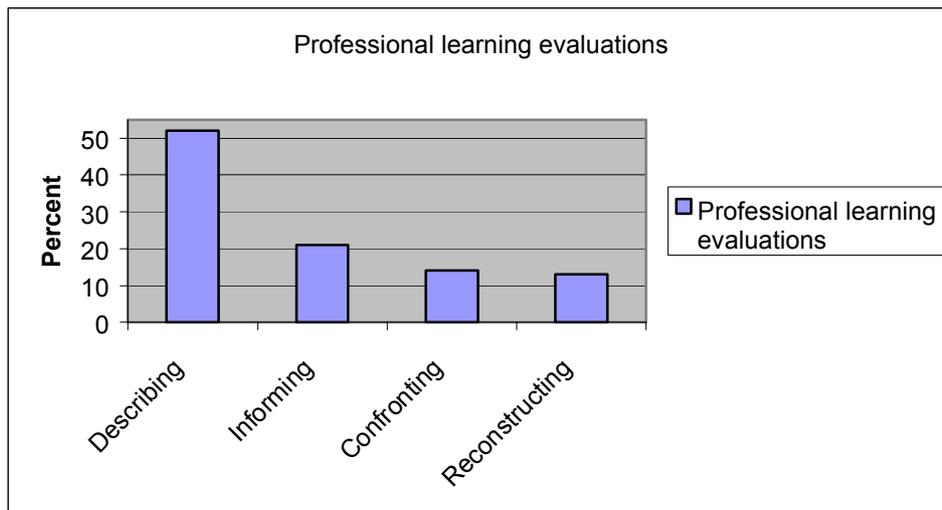
The professional learning evaluations tracked the kinds of changes that Fullan (1992; 1993; 1999; 1991) states lead to productive educational change, in particular teachers' content knowledge, classroom management and organization, teaching strategies, activity structures and use of new resources. This evaluation also tracked changes in roles and responsibilities, types of collaboration and sharing, and structural changes within the school organization.

In particular, teachers' content knowledge about use of ICT in the classroom and the development of children's thinking, planning and organization skills were all reported as changing or developing. Classroom management and organization shifted to include more group and partner work, with greater emphasis on students supporting each other and providing 'expert' or 'tutorial' advice. Teachers incorporated more open-ended tasks and strategic questioning in their practice and consciously increased their planning and use of ICT across the curriculum. All teachers in the project took on new leadership roles within the school, as 'leading teachers' or chairing various ICT-related curriculum or policy committees within the school. Every teacher reported reaching out to other colleagues and organizing technical workshops or offering to share examples of activities. Many presented sessions related to their action research at both school and regional levels, demonstrating initiative in terms of making a broader contribution to the teaching profession. Some structural changes took place at a school level, with one school making timetable changes in response to a problem identified as a result of one teacher's action research and another developing new meeting structure to enable interdisciplinary collaboration. Cultural changes were mostly reported in relation to

classroom change (rather than school change), with new routines, norms and ways of relating between and with students reported.

What was missing from the professional learning evaluations was an interrogation of the cultural and structural changes that had taken place. This may be because of the way prompts were framed, mostly asking 'what' types of questions. In retrospect, if critical reflection is to occur on a broader social, cultural and political level, then the framing of questions needs to pose a challenge that goes beyond reporting changes that connect directly to practice and local action. Such questions may be better asked as part of group dialogue rather than pursued in individual written reflections.

Dialogues and Interviews

When teachers talked about their work, particularly in the latter part of the project, they strongly theorized and interrogated their pedagogy. This was more apparent in a teacher dialogue situation (2-3 teachers discussing their work) and structured use of ANSN protocols (Appendix 5) than in 1-1 interviews. Dialogues that took place early in the year had lower incidences of theorizing and nearly always turned to technical difficulties and the practicalities of engaging in the project. Mid-year, teachers were more likely to explore their beliefs and pedagogy, describing their own practices but also confronting what was influencing them to do things they way they did, particularly the impact of some of the Department of Education initiatives:

> *I always thought of myself as very flexible but after talking to others on Friday I realised just how much Early Years has made me inflexible. I am still flexible in the way I plan Early Years and do not always follow the "suggested" way exactly. But I realised that I am fairly inflexible when it comes to adding things into my planner in the spur of the moment. I have been very conscious of that this week and have noticed a few changes for the better. One day a child bought in a witchetty grub and in the middle of the reading and writing block we talked about it, had a look and then we wrote about the grub instead of the writing activity I had planned. The kids loved it and I found I got a lot out of the children.*

> *(Robin, Journal, Nov 2000)*

Dialogues towards the end of the year were characterized by problematizing practice and recommendations for improvement or 'where to go from here', thus incorporating the reconstructing form of reflection.

Reflections which confronted personal practice occurred most frequently during the structured ANSN protocols which required teachers to ask "probing" questions and give each other "warm", "cool" and "hard" feedback. A fifteen minute section of the protocol required non-presenting teachers to engage in a dialogue about issues raised by the presenting teacher and a sample of work he/she had shared. This kind of teacher talk was strong in the areas of informing and confronting, and addressed possible action for the future. Trends in teacher talk through interviews and dialogue and are presented in Figure 13:

Figure 13: Forms of Reflection in Teacher Talk
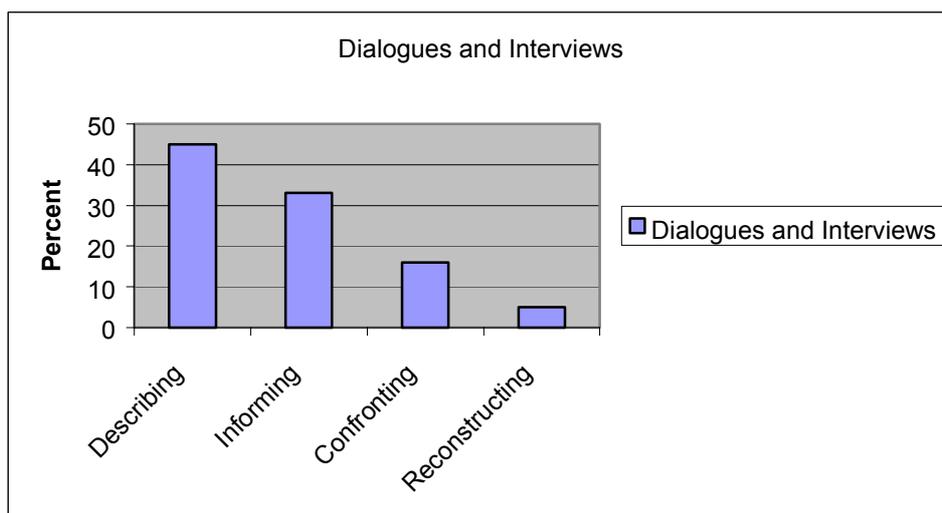
Theorizing was particularly prevalent in teachers' talk. This might be attributed to a range of different factors. Importantly, the group built a strong level of rapport and trust over the 18 months that they participated in this study. Strategies of feedback and questioning were legitimized through such processes as the ANSN protocols (Australian National Schools Network in partnership with the Coalition of Essential Schools (USA), 2000) so that they were sometimes used in other reflective practices.

Learning from use of reflective practices

This study has identified the relative strengths of particular reflective practices to elicit the four forms of critical reflection (describing, informing, confronting and

reconstructing) suggested by Smyth (1989a). The following recommendations are offered to further inform use of such strategies so that it is possible to strategically support the development of teachers' reflections from *describing* to theorizing (*informing* and *confronting*) and *reconstructing* of their practice.

Describing was a natural starting place and foundation for theorizing. All the professional learning strategies previously described effectively elicited describing reflections.

Informing was connected to descriptions of practice, which grounded thinking about the meaning behind what had occurred in the classroom and led to consideration of aspects of pedagogy. Teacher talk/dialogue, journal writing, classroom visit reflections and case/commentary writing were all effective in eliciting informing reflections. Teacher talk/dialogue which took place in structured protocols or small group discussion within inquiry teams led to the greatest instances of informing. Shared experiences, which formed the basis of describing reflections, led to teachers sharing possible theoretical meanings behind such experiences.

Strong differences in the proportion of *confronting* reflections indicated that some strategies were more effective than others. Commentary writing, in the form of reading responses, responses to critical incidents in cases or journals and classroom visit reflections, and snapshots, which asked teachers to articulate beliefs, values and reasons for wanting to change were the most effective strategies to elicit confronting reflections. Journal writing could have been more effective if changes had been made to the writing prompts at an earlier stage in the research and the initial prompts analysed for their intentions. Teachers reported that they valued the experiences that enabled them to confront their existing beliefs and incidences of confronting reflections increased as teachers developed skills in questioning each other and trust developed within the group. Teachers were more comfortable confronting themselves than directly confronting each other. Sometimes they confronted a colleague's behaviour in their private journals but their concerns were rarely raised in later face-to-face discussions. As well as confronting themselves, teachers also confronted political concerns in the form of equity issues, such as access to ICT and issues affecting "the strugglers" in their classrooms.

Action research reports were the most effective strategy for eliciting *reconstructing* style reflections, with less frequent but regular reconstructing also observed in journals and commentary writing. Reconstructing is different from simply modifying practice based on experiences, which teachers felt they did constantly. For reflections to be coded as reconstructing, there also needed to be evidence of connected theorizing and new learning. The action research report structure provided prompts that asked teachers to connect their future planning to observational and generated data, theorizing and problematizing.

Thus the provision of prompts, although not initially geared to specifically prompt *describing*, *informing*, *confronting* and *reconstructing*, did cover all of these bases and has ultimately provided useful comparative data. The implication for future professional learning programs is to use strategic planning to ensure that a range of prompts results in teacher reflections across all four areas of critically reflective action.

Another benefit of the reflective processes was that they enabled incidences of teacher theorizing to be made explicit. Such theorizing ranged over the following areas, which are illustrated with an example from teacher researcher documentation:

i) What teachers need to do:

> *I now understand and believe that in order to support all students, the most important thing we, as educators, can do is to emphasize and develop the intellectual quality of our practice. We must include higher-order thinking, deep knowledge, substantive conversation and deep understanding. We must teach children to think about thinking and to be able to discuss thinking.*
>
> *(Nina, 6 month Professional Learning Evaluation, Aug 2000)*

> *Rather than concentrating on discrete skills, teachers need to focus on planning a meaningful framework of work that can develop concepts, skills, knowledge and attitudes all at the same time, rather than planning to do each separately.*
>
> *(Gerry, Reading Response, Jun 2000)*

ii) What students need:

I have always believed that children learn best in a happy and secure environment. They need to feel respected in order to respect back and need tools to help them think and challenges to put their thinking into action.

(Muriel, Snapshot, Feb 2000)

iii) What teachers want to improve: strategies

My listening, questioning and reflection time need to be sharpened. I now believe that this is the essence to teaching. This is the biggest change in my pedagogy.

(Nina, Professional Learning Evaluation, Aug 2000)

iv) Personal beliefs and understandings: theorizing about what matters:

I believe that students need to begin to take some control of their learning and to become problem solvers rather than having everything 'handed to them on a silver platter.' I believe that while teachers can teach, it is only when a student wants to learn that real learning takes place. Students also need to see the relevance for their learning and to feel engaged in order to gain a deeper understanding.

(Gerry, Professional Learning Evaluation, Aug 2000)

I still believe you have to teach. Discovery and learning are all very warm, comfortable terms, but there are definitely times when good, old fashioned "teaching", OK, modelling is very important for many teachers and children. Different individuals learn in a variety of ways.

(Julian, Reading Response, Jun 2000)

v) Improving learning for students:

I think that teaching and learning in my school could become more exciting, interesting and perhaps more relevant for the future. Students are going to need to know how to think and not to memorise content areas. We as teachers are well aware that jobs of the future are going to be very different than those that exist now. We need to teach children how to be creative, lateral thinkers to solve the problems of the world and the future.

(Nina, Action Research Planner, Oct 1999)

Teachers' theorizing can be seen to range over the dimensions of pedagogy outlined in Chapter 2 (pp.17-28), with second order changes either observed or reported. In particular, teachers clarified what they believed was important to teach, their beliefs and values, and particular strategies that they thought would benefit students. As a result of observing and interacting with students, teachers were continuously interpreting and problematizing their observations and making connections with their future planning. Over the course of time, theorizing about the way teachers interacted with students emerged, particularly in relation to teachers' attempts to democratise their classroom culture. The influence of some contexts and structures was described by teachers, and prompted theorizing when discrepancies existed between what teachers wanted to do with their students and what they were required to do. A great deal of theorizing about context and structures was about the impact on students and their learning. Theorizing about contexts and structures focused mainly on the classroom and school, sometimes went as far as Department of Education initiatives, and less frequently focused on the broader social and political influences on teaching and learning.

As teachers increased the reflective processes they engaged in during their own working lives, they increased the opportunities for their students to engage in reflection:

> *I have found that serious, meaningful reflection is a challenge for me in several ways. Firstly, it is a time issue, secondly, it is a deeply intellectual challenge for me to learn to ask the right questions and thirdly, it is a challenge to engage, support and teach the skill of reflection to my students…If I made time for sharing ideas and reflections the students took more ownership, showed more interest and gained deeper understandings of the concepts that I was attempting to teach.*

> *(Nina, Professional Learning Evaluation, Aug 2000)*

All of the reflective processes undertaken during the project were extraneous to the normal working practices of the teachers involved. Although teachers engaged in dialogue with others in the normal course of their work, it was rarely with the purpose of both sharing and interrogating their practice. Time and the way schools are organized were the two most significant constraints to such processes becoming the norm, despite commitment and good intentions on the part of leadership in the schools and the teacher researchers.

A culture of critical reflection did develop within the interschool network, both as a result of the professional learning activities and the value teachers ascribed to reflective practice. As time progressed and trust developed within the group, teachers regularly confronted themselves and occasionally confronted each other in relation to pedagogy and practice. Respectfully confronting colleagues was challenging for individuals within the group, but the explicit use of feedback strategies and discussion protocols helped to develop new norms that enabled such confronting and subsequent reconstructing to take place. Analysis of the interschool network offers some insight into the components necessary to establish a similar culture within schools that would support the development of critically reflective action and pedagogical development.

Establishing a Support Network or Learning Community

The establishment of a teacher researcher network, with regular scheduled meetings, was important in establishing a group identity and sense of belonging to a 'learning community' (Cranton, 1994; Jalongo, 1991; Shaw, 1998). Teachers reported that they particularly valued opportunities for support, sharing, camaraderie and bonding; stimulation; exposure to new ideas and different ways of thinking; and time out to think. They developed strong feelings about the group and particularly valued opportunities to reflect and collaborate with their colleagues in ways that were not available during the normal course of their work:

> *The highlight of the week was the network meeting for the project. This was great because Bart and I were able to do our 6 month review of the project. This was a very powerful reflection and buoyed us both. It made sure that we looked back over so much that we'd done and also meant that Bart and I had the opportunity to reflect as a team; a thing we've been talking about doing for ages! It's not until you properly reflect that you begin to see the big picture. It also served to highlight the need for both of us to sort out some sort of efficient monitoring / evaluation process; a process we're both finding it difficult to manage with normal teaching loads.*
>
> *(Gerry, Journal, August 2000)*

In this case, the two teachers concerned worked across a corridor from one another, but had struggled to find time and space that allowed them to reflect together at a satisfactory level. Teachers also reported that the regular network meetings resulted in

sharing of ideas, refining of plans and clarification of issues ranging from technical queries to discussions about pedagogy.

Participation in the project and the network led to increases in self-confidence, motivation, morale and initiative. These gains were further enhanced by the fact that teachers felt they were part of something important—teachers reported that they felt "excited", "proud" and "valued" when school leaders acknowledged their efforts and asked them to talk about their project at staff or school council meetings and parent information nights. Most principals championed the teacher researchers, positioning them on key committees, highlighting their work and innovation through the normal communication channels of the school, and acknowledging increased workloads.

Teachers identified understanding and support by school leaders as a crucial form of support. At one school, changes in the leadership caused one of the most passionate teacher researchers to withdraw, citing the new leadership view that teachers needed to stay in front of their own class and not be out on professional development during class time, as a huge disincentive to continuing with her project:

> *I am having a bit of trouble with my new principal. I was stopped in the hallway the other day and told that the project was taking teachers out of school too much, that it was jumping into bed with a major corporation, that it cost the kids too much. She told me that we should be on about giving the students a good, solid, basic education and not this program offering goodies. I was shocked, dumbfounded and had my feelings hurt by the exchange…I told her that PD was supposed to be about changing and growing in one's practice and that this project was changing my practice and me more than any other PD I'd ever done. It gave me food for thought, it got me into other classrooms and that had to happen during the day. I really did feel upset because I'm learning, my unit is benefiting, my students are benefiting and she canned what I'm doing like it was nothing, superfluous, unimportant and in fact damaging to the school.*
>
> *(Teacher researcher, Journal, Jun 2000)*

Active and public support by school leaders was therefore crucial for teachers to develop their own leadership roles within their schools. Teachers in the project took on a range of such roles within their school organization.

Opportunities to engage in face-to-face collaboration and dialogue were rated higher by teachers than the online opportunities for networking and dialogue. Commitments to make online contributions were negotiated with a planning group at the beginning of the year and the setting of deadlines was important in obtaining regular contributions from the group. This may be why online contributions appeared to be more of an obligation or duty whereas real time dialogue was viewed as motivating and sustaining. Only four spontaneous postings were made by teachers during the year, with the rest (219 postings in total) a response to direct facilitation or a response to another teacher (27 postings). The busy lives of teachers and home access to the Internet also influenced the amount of effort they were willing to expend in the online community.

The teacher network and learning community culture proved fluid when three teachers moved on to different roles or transferred to another school. Surprisingly, the new teachers were quickly accepted into the group and evidence of learning from existing group members was almost immediate in the form of changes to their practices and classroom organization. The original group members attributed this easy integration to the culture of sharing and community that was operating in the group and the fact that supporting newcomers prepared them to work with staff at their own school.

Although the network was open to newcomers who were teachers, it was far less receptive to department bureaucrats who were invited to participate in network meetings. They were viewed as disconnected from and extraneous to the work of the group, as captured in the following reflection:

> *There is one part of the project that I would like to see changed. I believe that (the bureaucrats) who have visited us for the last few sessions have interfered with our learning…They get in the way of our learning as a group. They take over. I don't care to hear what they know; I am there to discover myself with my network. They tend to steal our thinking time; they just don't stop talking. Even when it was pointed out to them that they talk too much, they just kept talking. They didn't follow protocol during our session even when they were reminded to do so. We don't need them because we are well and truly on the road to discovery without them.*
>
> *(Teacher Researcher, Professional Learning Evaluation, Aug 2000)*

This comment reflects the nature of group dynamics to some extent, but also the danger of a participatory research process that does not genuinely include all stakeholders, including system bureaucrats and support personnel, school leadership, parents and students. The above response was largely a reaction to outsiders who were not sensitive to the norms of the community but could also be taken as an example of empowerment, as this teacher clearly viewed herself has being able to move forward without the support of Department of Education bureaucrats. The differences between bureaucrats' modes of operation and teachers' modes in the network meetings was an unresolved problem. System bureaucrats held position power (Yukl, 1989), particularly in relation to control over resources. Ultimately they were in a position to make decisions that resulted in the external learning community breaking down before processes were adequately transitioned to the local context (see Chapter 9).

Thus the teacher network effectively created a valued learning community for the individuals involved and contributed to teachers' motivation, morale and sense of professionalism. The network supported the PAR process and meetings created the space and time for critical reflection and planning. A study by Rosenholtz (1989) also found that teachers became more confident when they engaged in 'learning enriched' habits. The increases in motivation, morale and sense of professionalism could be considered as evidence of teachers feeling empowerment and capacitation, the increased capacity to make wiser and more informed decisions and action.

The development of 'social connectedness' (Waldon, 2002) also characterized the interschool network to the point where teachers willingly came to out of hours network meetings followed by an evening meal together. Waldon similarly found that the development of relevant community structures and supportive environments enhanced both participation and social connectedness. Teachers in this study stated that their lives in schools were so busy that there were less opportunities for social contact with other staff members, compared to the past.

What didn't occur during the time of this study was a recreation of such a learning community back in teachers' local schools settings. While a 'new' interschool community enabled a new culture of sharing, reflection and collaboration to be established, the existing culture, structures and demands on teachers' time in schools appeared to be too strong a barrier to easily transfer the new cultural norms to the local

level. This raised questions about the sustainability of such a culture unless a whole school approach to change was involved and both cultural and structural changes implemented (see also Peters, Dobbins & Johnson, 1996). Teachers' attempts to recreate the sharing, collaboration and critically reflective practices back in their own schools provides a basis for understanding some of the challenges inherent in this process.

Sharing and Productive Collaboration

The collaboration engaged in by the teacher researchers in the interschool network brought about new opportunities for "meaningful work relationships and collegial support" and was illustrative of "productive collaboration" as defined by Hargreaves and Dawe (1990, p. 7). The participatory action research process that guided this study included an expectation that teachers in the interschool network would in time expand their focus from personal learning and develop ways to share and collaborate with colleagues at their own schools.

Principals, teacher researchers and their colleagues all agreed that sharing between classrooms and staff members had increased as a result of the project. In particular, beginning teachers, who worked in teacher researchers' area teams, reported gaining support and new ideas from the teacher researchers. The teacher researchers were keen to share their new learning, with one teacher volunteering to present to a local group of schools after only one term with the project:

> *I am going to take this opportunity to show (local schools cluster) some simple, non-threatening open-ended activities that I have tried. I am really looking forward to the day in two weeks time. Hopefully I will get the same keen response that I have got from the other ...teachers at my school.*
>
> *(Robin, Journal, Jun 2000)*

Teacher researchers viewed the sharing process as contributing to their own learning, putting enormous effort into formal presentations and appreciating feedback from other teachers:

> *I planned a session called "Think Maths" for my festival activity. I have worked for hours preparing for this thing and it has paid off today. My participants were really excited about what we did. I got excellent feedback from them and delighted responses to our room, our plans, my handouts, my speech, the*

classroom observations, the displays, etc. I love sharing what I am learning and in organising one's thoughts one learns more and more and more.

<div align="right">

(Nina, Journal entry, May 2000)

</div>

When teachers thought about sharing with their colleagues, they thought beyond simply introducing new activities into the classroom:

For a teacher to really be able to implement ICT successfully into their Maths program it is not just about getting a few new ideas but changing their whole class structure, their thinking and having the confidence to trial something a bit different and new. I hope I will have the opportunity to be able to share my enthusiasm and excitement, as well as my expertise, to help teachers, from my school and other schools within my cluster make these changes.

<div align="right">

(Robin, Professional Learning Evaluation, Aug 2000)

</div>

The act of sharing with colleagues, although valued by the teacher researchers and consciously addressed, was sometimes viewed as problematic by principals and colleagues. One principal thought that a teacher researcher did not share her new learning and ideas as much as she could have. This resulted in another member of her area team complaining that the teacher researcher had become so focused on her own class and what she was doing with her action research that she no longer seemed interested in collaborating for the overall benefit of the team. Another explanation suggested by the principal was that the teacher researcher initially had low levels of confidence in her own technical skills and perhaps had needed time to experiment on her own.

Another principal reported that colleagues were becoming resistant to the ideas being promoted by one of the teacher researchers because of the way the ideas were being shared. In this case, the teacher's high levels of enthusiasm to share and talk about what she was doing were interpreted as "pushy" and "ram down the throat" (Principal interview, May 2001). In this case, the teacher's constant exhortations to colleagues to "come and see what my kids have done" were viewed as lacking in modesty and the principal noted that:

Everyone got sick of hearing about her grade…and it often turned people off even though they liked what she was doing…It was very sad because the children had come a long way and some of those children bloomed.

(Principal Interview, May 2001)

In contrast, another teacher researcher at the same school was perceived as working "quietly and effectively" with the staff as she "shared in a more modest manner". This teacher was more likely to "quietly take people aside", answer questions one-on-one, or simply make an offer to the staff that she would be available in the lab one night after school if anyone wanted to come and do something.

This theme of cultural constraint on 'how' to share was also picked up by another school. They reported that what they perceived as a more subtle approach had been successful and that some of the biggest changes were perceived to have happened "totally by osmosis". One teacher at this school had even changed her more direct approach to sharing—bringing ideas for using ICT to team planning meetings each week—to one where she simply maintained an open door policy to other staff:

I don't have to say this is what I have done and here's my stuff. They are coming in and looking for themselves. Especially two of them. Julie is new to this area so if she comes in I'll say to her 'Oh, do you know how to do this?' And if she says no I just take her aside and show her. She's asking a lot more too. So they come into the room and they see things up on the computer that the kids have done and say 'how have you done that?' Mary is the big one. She was like, 'I hate computers, I don't want to do it' and now she says, 'That works so well' and she is really excited about things. She has come a long way this year.

(Teacher Researcher, Interview, Nov 2001)

Some teachers went to great pains not to 'big-note' themselves or present themselves as experts. One teacher noted that she always tried to present her struggles as well as her learning journey. She did not want to present herself as a 'computer expert' but rather "a teacher trying to meet the challenges of new technologies and the future". It seemed important to this teacher to communicate 'I'm just like you' or 'you too can do this'.

The original teacher researchers at this school were successful in implementing a series of 'Teckie Breckies', half hour breakfast meetings held for any interested staff to provide instruction and support in relation to using particular software applications.

This shift back to the technical at the school level was common, particularly at primary schools. Technical sharing was mainly characterized by "show and tell" and informal workshops involving both teacher researchers and other skilled colleagues who demonstrated software applications and provided ideas for curriculum integration. This technical starting point was usually in response to some form of needs analysis or a response to requests from novice users. It might also reflect a shift back to the mainstream cultural expectations that ICT is first and foremost about the technical, or that until teachers have an understanding of the technical possibilities, it is difficult to turn attention to considerations about pedagogy.

The secondary school in the project stood out from the primary schools because their initial focus on sharing and collaboration was not technical. Secondary teachers noted that they had encouraged colleagues to take a more collaborative approach to their teaching and it had been beneficial to introduce opportunities for colleagues to actively explore teaching strategies and student learning together. As one focus of their action research project was to develop integrated curriculum for Year 9 students, they began by organizing new meeting structures that enabled cross curriculum teams to meet and plan together. Although they later reported that their collaboration had resulted more in "parallel" curriculum being developed, they also noted that:

> *Teachers talk more pedagogy with each other— more about what they are doing in classrooms and the impact on students—a culture of sharing curriculum ideas is being strengthened.*
>
> *(Liz, 12 month Action Research Report, Nov 2000)*

This shift in terms of what teachers talked about is an indicator of the type of changes necessary for a school to become a learning community. The reason why the secondary school was more successful in engaging other teachers in pedagogical discussions about curriculum may have been because they linked their action research project to other major initiatives in the school and to current research that encouraged teachers to address student engagement.

Curriculum change in schools was often attempted by mandating changes to planning requirements and providing modelling and support for this to take place. Sharing was more common than genuine collaboration, e.g. teachers in one school all developed individual planners, which they swapped each month. An ICT committee at one school introduced a requirement that all year levels develop "rich tasks" that involved ICT and a particular key learning area. Teachers in the school were provided with a proforma and examples of rich tasks, accompanied by prerequisite step-by-step instructions for using a particular software application. A teacher researcher on the ICT committee noted that committee members had to 'chase the tasks up' and that they had decided to be quite prescriptive in what was required of other teachers. She also noted that other teachers did not seem to "want to think about their own rich tasks much" (Interview Nov 2001) and often the designated team member with expertise was relied upon for ideas. Colleagues in this school did not report the same feelings of confidence or motivation that the teacher researchers exhibited.

Few opportunities to engage in collaborative critical reflection and theorizing were reported as occurring in the normal context of schoolwork. This was despite the fact that teachers began the second year of the project with good intentions to continue using reflective practices with their local colleagues. In one school, expansion of the school-based teacher research group to include new teachers began with all teachers completing a snapshot and deciding to maintain a journal. Although the snapshots were shared and discussed, the journals did not continue. Another school, with strong leadership commitment and support to the professional learning processes, began the year by forming inquiry teams and requesting that all teachers choose an area they wanted to explore as a focus for their professional development. The principal at this school believed that all teachers were at different stages in the way they worked and wanted to link professional development needs to the teacher review process "so they actually had a purpose to what they were doing and had a purpose to the conversation they were having with me" (Interview, March 2001). The review process would then become an opportunity to demonstrate progress in relation to the professional learning goals set at the beginning of the year. This principal requested that all teachers in the school meet every two weeks and built in a requirement that teams would use some of the professional learning strategies from the interschool project:

I have told them that once a semester they should use a protocol with a piece of student work and they need to do some data observation. They also need to write two commentaries, which are case studies, and they need to talk about two readings that they have had. Also to then look at what they are doing in relation to the teacher competencies and reflect on it myself.

(Principal Interview, Mar 2001)

Despite this, interviews later in the year reported that the professional learning processes had not been implemented as planned. This was largely due to meeting times being cancelled due to unexpected commitments and interruptions, or the focus of meetings being changed to cope with the demands of putting on a school production or organizing camps. It may also have been because the processes were imposed from an authority figure rather than collaboratively decided upon.

Teacher researchers needed the support and assistance of principals to make structural changes in the school organization, and this occurred on several occasions in direct response to issues arising from the action research e.g. timetable changes, new meeting structures and authorized planning requirements. Such changes were also attempted within existing structures (meetings, committees, accountability measures) with the goal of raising awareness of ICT issues so that colleagues at least became socialized into technology use.

Teamwork at the local school level was, in actuality, more characterized by Hargreaves's (1990) notion of 'contrived collegiality' than engagement in 'productive collaboration', as experienced by the teachers in the interschool network. The PAR focus that characterized the interschool network was not successfully implemented at a school level, nor were the reflective processes. The most significant structural change that occurred in primary schools was the formalizing of planning documents and sharing of these either within or across teams. In the secondary sector, new meeting structures to enable communication and collaboration were the most significant changes that led to new forms of teacher interaction.

The creation of an external network and reflective learning community culture would appear to have had limitations. Although individuals were able to demonstrate new learning and second order changes in their classroom culture and pedagogy,

organizational changes were first order and mostly in relation to planning requirements, meeting structures and providing professional support to other colleagues. The PAR process and engagement in critically reflective practices was not continued or sustained at the local organizational level without additional external facilitation (see Chapter 9). It would appear that some kind of legitimisation of these practices as part of the normal work of teachers is the only way that such practices are likely to become sustainable.

Future Directions

Teachers identified a number of directions they perceived as important for future development:

- to involve school communities in a more formal way, both through meetings and working with colleagues in the classroom;
- to spend more time sharing what had been learned and inspiring others to "have a go";
- to build up knowledge of productive pedagogy and include this in planning;
- to ensure that student outcomes assisted students to prepare for changes in society;
- to continue professional development activities and experiences in the use of ICT;
- to continue with a focus on identifying which outcomes were best met with technology and which were best without;
- to learn more about teaching thinking and how best to support students to develop metalanguage;
- to disseminate data related to the project to other staff;
- to further development multi-media design briefs;
- to refine evaluation processes.

Organizational learning strategies were identified as needing further development, together with strategies for teachers to continue their own professional learning, with technical, cultural and critical interests all represented in their recommendations.

Conclusion

The participatory action research process provided teachers with time for their professional learning interests to form, develop and change. Together with talk,

productive collaboration, strategic prompts and critical questioning/reflection, this time, space and structure provided teachers with learning opportunities not available in the normal course of their work.

This study does not purport to provide a blueprint for all professional learning programs, as teachers at different times and stages of their careers have different learning needs. Teachers in this study were identified by their principals as existing or potential leaders and were characterised by high motivation to learn and be involved in the project. The PAR process enabled these teachers to feel some control or 'personal power' over the development and implementation of changes at the local level, particularly in their own classrooms. 'Power' and 'the political' appear to be experienced by teachers as local concerns, with more limited references to the broader societal "conditions that shape our pedagogical experiences" (van Manen, 1991, p. 99). Teachers take action at levels that they feel they can successfully influence. Thus it may be more helpful for future studies to broaden the definition of 'emancipatory' to account for the localized concerns that teachers themselves raise during critical reflection. For teachers, local action is very much a real possibility whereas broader based social, cultural and political change is more nebulous. Also, the current culture of schooling does not support, promote or allow space for broader sociocultural and political considerations, with teachers' lives often overwhelmed by the practical.

This problem becomes further exacerbated if new curriculum initiatives are implemented in a 'technicalised' fashion where teachers are socialised into using recommended practices and implementing policy and curriculum, rather than encouraged to think critically about their broader ramifications. Unless the normal life of schools creates space for teachers to engage in genuine reflection and discussion about their work, they are likely to become increasingly distanced from the 'internalisation' of pedagogy. When this is the case, teachers are unlikely to develop the motivation, confidence and initiative to forge forward with new ideas and commitment. This project has demonstrated that teacher motivation, initiative, confidence and sense of professionalism can be linked to opportunities to reflect and discuss beliefs, practices and new ideas and to the recognition of this effort by school leadership.

The development of critically reflective action, and the effectiveness of processes to achieve such action, can be informed by this study. In particular, time, space/place, talk

and strategic prompts were instrumental in the development of the four dimensions of critical reflection—describing, informing, confronting and reconstructing. Professional learning programs must explicitly and strategically prompt these dimensions of reflection. Thus, this study has addressed a gap in the literature identified by Hatton and Smith (1995), who state that despite the wide variety of approaches employed to foster reflection:

> *...there is little research evidence to show that this [reflection] is actually being achieved. It is necessary to move beyond self reports to the identification of ways in which reflective processes can be evidenced. It is not sufficient to assert that reflection is encouraged by a procedure or technique, rather means must be specified to demonstrate that particular kinds of reflecting are taking place.*
> *(p. 5)*

This study found that most forms of teacher talk and writing successfully elicited *describing*. Detailed written descriptions of practice (journals, case writing, snapshots and shared experiences) with strategic prompts such as 'what did you do, observe or feel' were effective prompts for *describing,* which can be considered as a starting point for the theorizing process. *Informing* directly connected practice to theorizing and problematizing, where teachers tried to develop deeper understanding of the meaning behind their experiences or observations. Teacher talk/dialogue, journal writing, classroom visit reflections and case/commentary writing were all strongly indicated for prompting *informing*. *Confronting* was less likely to occur without strategic prompts, with commentary writing, reading responses, snapshots and journals all effective once the appropriate prompts were identified. These prompts needed to interrogate (why did you do things that way, what is influencing you, what dilemmas, problems or conflicts of interest arise for you, what do you believe and value most strongly, who benefits most from the way you did things) and go further than straightforward reflections about the meaning of practice. *Confronting* prompts presented a stimulus to look at the self and peel back the layers of why and how we become the teachers we are. This 'grounding' of why teachers do what they do enabled a critical perspective to develop based on explicit articulation of beliefs, practices and rationale for practice. Confronting the practices of others also triggered self-confrontation, but teachers were wary of directly confronting the practice of other except within legitimised protocol or feedback processes. These processes are strongly recommended as successful prompts for

establishing new norms for dialogue and conversation about pedagogy between teachers.

The PAR process successfully engaged teachers in *reconstructing* their practice as they referred to their observations and data, discussed meaning with inquiry team colleagues, and confronted themselves and their beliefs, values and understandings. The reconstructing phases were characterized by assimilation of new theorizing and ways of thinking that developed as a result of the wide range of stimuli experienced, from systematically investigating practice to inspirational readings and speakers. Reinforcement through readings, observation of others and evidence from their own action research enabled them to move forward with confidence, stronger in their ability to change and justify their teaching practices. When teachers reach this point of conscientization (Freire, 1973), they have also moved through a process of capacitation (Weber, 1992 cited in Jurema, 1998).

Teachers' theorizing indicates the development of understandings about the conceptual underpinnings of practice (Bussis et al., 1976; Hall & Loucks, 1978; Joyce & Showers, 1988; McLaughlin & Marsh, 1978 cited in Fullan, 1991 #13, p. 85), a vital component of teacher capacitation. This kind of theorizing, while prevalent in members of the external interschool network, was not common with other colleagues at the local school level. Teachers' interventions at a school level focused more on " guiding the practice of teaching" than increasing "one's understanding of what one does and what one has done" (van Manen, 1991, p. 45).

The challenge of creating spaces and opportunities for teachers to engage in critical reflection is a "professional political issue" (van Manen, 1991, p. 99) as:

> *...the daily life of dealing with children is such that there seems little opportunity for reflection—and that this is not the fault of teachers or anyone else. Rather, it is a feature of living together in constant interaction which prevents teachers from critically reflecting on what they are doing while teaching. But more problematic is that there is little opportunity to reflect thoughtfully with colleagues about the practice and meaning of pedagogical experiences. (p. 99)*

Even when teachers valued the opportunity to reflect critically on their own and each others' practice, they were not successful in transferring these processes to their normal school lives without additional support. Despite good intentions, instead of creating reflective spaces for colleagues in their own schools, they tended towards more prescriptive and technical interventions, which resulted in colleagues being socialized into particular practices that the teacher researchers had found worthwhile, without having the same opportunities to "reflect on the meaning, purpose, and significance of the educational experiences of students whom the school and the curriculum are supposed to serve" (van Manen, 1991, p. 99).

The professional learning process associated with this study needs to be considered as stage one of a change process. It was successful in harnessing and growing energy, commitment and momentum around teacher identified areas for improvement (see Lambert, 1998). Hargreaves (1995) identifies "desire" as pivotal in any teacher development initiative. In addition to the technical and political, he recommends integration of the dimensions of "moral purpose" and "emotional attachment and engagement" to professional learning initiatives if sustainable change is the goal. Emotional attachment and engagement can be shored up in environments of "continuous learning and working with 'critical friends'" (p. 27) while consciousness of moral purpose (such as preparing generations for the future and the pedagogical implications of interactions with students) optimises pedagogical decision making in terms of distinguishing between "better or worse courses of action" (p. 15):

> *By reflecting on their own practice, observing and analysing other teachers' practice, or studying case examples of practice, teachers can clarify the dilemmas they face and develop principled, practical, and increasingly skilful and thoughtful ways of dealing with them (Groundwater-Smith, 1993). This approach to teacher development elevates the principles of thoughtful, practical judgment above personal prejudice, misleading moral absolutes, or the false certainties of science as a guide to action and improvement (Louden, 1991). (Hargreaves, 1995, p. 16)*

The professional learning process was also successful in developing 'skilful teacher leaders' who had developed their capacity to incorporate reflection, inquiry, conversations and focused action into their daily work—key conditions for self-

renewing schools (Lambert, 1998, pp. 3-4). A second stage, planned but not implemented due to changes in the administration of the project (see Chapter 9), was necessary for teachers' personal professional learning to be translated into whole school development of a self-renewing learning community. While teachers clearly demonstrated willingness to take on new leadership roles and responsibilities, they would have benefited from continued support to develop their new roles as leaders and change agents in their own schools. This second stage required planning, critical reflection/dialogue and implementation support, similar to that which was provided for the personal learning process focused on classroom change. It also required sensitivity and the capacity to draw in colleagues in such a manner that they experienced ownership of and commitment to the new ideas and directions.

One barrier to this was the perceived 'special treatment' of the original project teachers—extra resources, extra time release, specialized professional development opportunities. Although this special treatment was effective in supporting change and learning, it becomes problematic unless the 'special' becomes the 'normal' and opportunities extended to all colleagues. This would appear to be one of the most serious challenges facing leaders in schools. While some colleagues may prefer to stay on the periphery of a serious learning initiative and delay availing themselves of such opportunities, others will be ready to take on the challenge as soon as it is offered. It is important that both the formal and informal school leaders join together at this stage and, where appropriate, involve other stakeholders such as parents and students. Productive collaboration requires democratisation and the sharing of power in order to create a genuine learning community within the school. Fluid boundaries and distributed leadership are indicated in order to match the reality of complex change. Valuing the learning process enough to make time to observe, share, discuss, collaboratively design future action and critically confront problems and meanings is more important than quick implementation or socialisation. Creating a climate where people *want* to 'buy into' a change initiative or new learning is far more likely to create a sustainable learning community than coercion to adopt new ideas. This means an emphasis on relationships and reculturing (Fullan, 2001).

Reculturing in classrooms was relatively easy to achieve with committed and enthusiastic teachers. The greater challenge in terms of professional learning is reculturing schools and the education system in ways that shift the power and

relationship dynamics and increase opportunities for critical reflection/dialogue and new roles and relationships. Only when such reculturing is valued right across the education system and schools create spaces for regular engagement in critically reflective practices as a part of normal working lives, will pedagogical thoughtfulness overtake the prevalence of socialization into particular teaching practices.

Section 2: Teachers' Action Research and Use of ICT

Sure, the computer promises to provide my students with an endless supply of information, but what good will that do if they can't make sense of it? It promises to help my students express their ideas better, but what good will that do if they don't have any ideas to express? It promises to help them develop marketable skills for a technological society, but how valuable is that if they have never developed the good judgment needed to give direction to that society, or their own lives? The key question for me was this: How is computer technology going to help my students develop those inner qualities, such as insight, creativity, and good judgment, which education at its best has always sought to inspire? (Burniske & Monke, 2001, p. 19)

Section Overview

The purpose of this section is to present teachers' articulations of pedagogy and practice as they developed their use of ICT in the classroom, explore the indicators and influences of different dimensions of pedagogy and finally to build upon teacher theorizing and the relevant literature to identify a practical way forward in terms of teachers' professional learning and ICT.

This discussion of teachers' use of ICT focuses on four issues that teachers explored in their action research projects. Although not representative of all the ways teachers used ICT in their practice, these issues were explored in depth by a number of teachers either within or across inquiry teams. A range of practices in relation to each issue is described and connected to teachers' interpretations and theorizing about practice. Teachers' theorizing in relation to their practice is then connected to the relevant literature to conclude with indicators for practical action in terms of teachers' professional learning. This section also responds to calls for rethinking literacy pedagogy in light of increasing global connectedness, local diversity and the nature of new information and communications technologies (Kalantzis & Cope, 2001a).

Chapter 5 looks at teachers' pedagogy, practice and theorizing in relation to use of the Internet and CD ROMs as an information resource. Chapter 6 explores the development of teachers' understandings as they engaged in online collaborative projects and new learnings that emerged. The *Real Time* project (Meredyth et al., 1999) found very little

use of ICT by teachers and students to communicate with others. Numerous examples of such use are presented and analysed with recommendations for future action.

Chapter 7 illustrates innovative use of ICT as teachers across inquiry teams introduced their students to animation, and analyses how the group developed new pedagogy around its use. This aspect of the teacher research is also a strong response to Meredyth et al's (1999) recommendation that students should be undertaking more creative work with technology as "research consistently indicates that excellence in creative content is the key to effective engagements with technologies in business, education and the cultural industries" (p. 273, also cited Coopers & Lybrand, 1995; Cutler and Co. Pty. Ltd. 1996; Swanson & Wise, 1997).

Chapter 8 focuses on the Early Years team as they explored how to integrate the use of ICT into their Mathematics curriculum. This chapter identifies characteristics of effective numeracy pedagogy and together with effective use of ICT to support and extend numeracy learning.

Chapter 5: Digital Information Resources and New Literacy Demands

Introduction

Connection of classrooms to the Internet has been generally welcomed by teachers and accompanied by great expectations in terms of the wealth of information resources available to students. Claims that such access will be a great equalizer in society, enhance democracy and enable learning without limits, require greater scrutiny and questioning of taken for granted assumptions (Bigum, 1995). If students are to be provided access to the Internet as part of their education, what changes need to occur in teachers' practice and pedagogy to ensure such access results in value-added learning?

Bigum (1995) and Lankshear, Snyder & Green (2000) stress that literacy and technology learning must go beyond an operational focus on the tools, procedures and techniques that enable students to "read and write in a range of contexts, in an appropriate and adequate manner" (p. 30). Instead, they recommend that literacy and technology use be considered from three interlocking dimensions—the operational, cultural and critical— in order to bring together language, meaning and context. The cultural dimension expands the literacy and technology focus to matters of practice and meaning (Durrant & Green, 1998) and requires knowledge of 'why one is doing what one is doing now, how to do it, and why what one is doing is appropriate' (Lankshear et al., 2000, p. 31). The critical dimension of literacy and technology practice raises questions about the practices themselves and what influences them, going beyond merely being 'socialized' into literacy and technology practice to being able to transform and actively produce meaning.

Bigum (1995) notes that the cultural and critical dimensions of technology and literacy practice are rarely considered in education debates about the Internet. This study has taken up the challenge to look beyond the technical/operational dimension of Internet use to the sociocultural and critical. Using teachers' work and research as a starting point, the chapter cross references to related literature and concludes with recommendations for future action.

The structure of this chapter was designed to encompass teachers' descriptions and problematizing of their practice in this area of research, with due reference to the related

literature. The following dimensions of practice were used as an organizer for the resultant discussion:

Table 15: Dimensions of Practice

Sociocultural	Learning literacy and use of technology (technical/operational)	Critical
	Organizational	
	Pedagogical	

While this study has been informed by the constructs suggested by Lankshear, Snyder & Green (2000), Lankshear et al. (1997) and Bigum (1995) in relation to 'technoliteracy' (operational, cultural and critical), teachers' talk and writing suggested that this construct needed to be expanded to more accurately capture their concerns. This chapter has been organized to describe the technical/operational, organizational and pedagogical issues raised by teachers and to interweave discussion related to the sociocultural and critical dimensions of literacy and teaching practice by drawing on teachers' reflections and relevant literature.

Rationale for Selecting this Issue

Although use of electronic information resources was not a specific focus of teachers' action research projects, teachers reflected extensively on the implications of using such resources in their classrooms. In particular, they noted a need for new "digital" literacies. The following influences also impacted the selection of this focus for reconstruction of the data and analysis:

1) Trends in the data: Internet or CD Rom research was a cited use of ICT by all of the project teachers. Teachers' writing problematized such research activities to a degree that suggested further study would be worthwhile.

2) Researcher worldview: A concern about the implications of increased accessibility to information and what this means in terms of knowledge construction and critical thinking.

Literature: The report 'Monitoring Progress Towards the National Goals for Schooling: Information and Communication Technology (ICT) Skills and Knowledge' (Cuttance & Stokes, 2000, p. 71) recommends that Australian students develop:

a. Research and information classification skills: representation, synthesis, evaluation, interrogation of information to create knowledge;

b. Information management skills and knowledge: organization, management, sourcing, storage and transfer of information.

Although the use of the Internet as an information resource is in line with the national agenda re ICT, voices within the literature warn of the shortsightedness of a functional or skills based technology or literacy agenda (Bigum, 1995; Cummins & Sayers, 1997; Ellis, 2001; Lankshear et al., 2000; Loveless, DeVoogd, & Bohlin, 2001) that is disconnected from the contexts of critical pedagogy and educational and social practice (LeCourt, 2001). This issue was selected in an attempt to add the context that is frequently missing from ICT benchmarking agendas.

Background and Context

During the project, the World Wide Web and CD ROM information resources were used extensively by Middle Years teachers, and to a more limited extent by Early Years teachers. Use of the Web and CDs for research related tasks usually took place during two hour Literacy Block times (primary schools only), integrated curriculum sessions or scheduled computer lab times. Teachers generally provided students with a main topic that was the focus of the search for information, with this topic usually connected to the integrated curriculum unit that was the current focus of study. In some cases, students could devise a more specific question to pursue that related to their particular interests within the unit of work. Teachers reported that they tried to design tasks that were open-ended to some degree and enabled students to work at their own pace and ability. The following example situates use of an online information resource in the broader context of pedagogy and practice:

> *Teresa was developing her students' understanding of diary writing. She began by providing them with a range of experiences designed to immerse them in the genre and provide quality models. Students were organized to rotate through a range of reading and writing activities, some of which focused on functional*

skills, while others focused on the genre itself. Students allocated to use the computer learning centre were required to access a website that Teresa had bookmarked for them:

> *For writing I had them looking at a fantastic website ...called 'Writing with Writers'. Well known children's authors present interactive workshops for kids to explore various types of genre and give tips to children on specific points of writing. This site was very helpful in getting the children tuned-in. The kids have got into the site that relates to journal writing, read the journal and have copied the tips given by the writer. There's lots of good advice which the kids have written down.*

At the same time as one group accessed the computer learning centre activity, another group of students completed a cloze activity, requiring them to fill in the gaps in a diary entry taken from a children's book. A third group completed a worksheet on adjectives that could be used to describe particular events, while a fourth group of students stayed with Teresa for a guided writing activity and discussion about the structure of diary writing. At the end of the hour, each group leader reported on how well the group had worked.

Teresa began the follow-up literacy session by questioning her students about what they already knew about diaries. She then involved the whole class in a shared experience. After reading a condensed version of "Little Red Riding Hood", she explained to the students that one task for today was to write a diary entry from the point of view of one of the characters in the story. She modelled this by presenting two diary entries, one from Red Riding Hood's point of view and the other from her mother's.

The students were asked to analyse the types of things that had been included in the diaries. The students responded "feelings about seeing Gran and walking through the wood"; "what she was going to do"; "she was thinking backwards about what had already happened"; "things on her mind". Teresa then asked for a list of suggestions as to what the students could write about as their chosen character. She also asked students to quickly generate a list of adjectives that might be relevant to use for a particular character's diary. The students moved

to tables to do 15 minutes quiet writing. A small number of students then volunteered to share what they had written with the class.

(Compilation of practice, May 2000)

Sometimes, teachers situated use of digital information resources within particular approaches such as the inquiry learning process (tuning in; preparing to find out; finding out; sorting out; going further; making connections; taking action (Hamston & Murdoch, 1996) and the technology design process of "investigate, design, produce and evaluate" (State of Victoria, 2000). The World Wide Web and CD ROMs were used as part of the "tuning in" phase or information gathering and fact finding about a particular topic. Teachers also situated the use of the Web and CD ROMs within literacy practice, some citing the "Western Australian First Steps" program and the "Early Years Literacy" model as adopted structures.

Teachers frequently emphasized reading, comprehension, interpretation, writing, summarizing and discussion as key intentions related to the use of digital information resources. Sometimes students were also required to use or apply the information they located to create a product or design. The use of digital information resources was also connected to teachers' desire to better integrate technology into the classroom, an action research focus for most teachers.

Keeping in mind that presenting examples of practice out of context can misrepresent teachers' overall practice and pedagogy, the specific tasks that teachers reported they had requested in relation to the use of the Web or CD Rom resources were summarized and classified as follows:

Table 16: Descriptions of Activities Using Digital Information Resources

Search and Locate	- Conduct an Internet search using children's search engine - Locate and read factual information on Internet that relates to Integrated topics - Find links and information related to current topic being studied
View and Extract	- View samples of different writing genres - Use website to look up specific information e.g. names - Use Internet resources for comprehension activity - Listen to, read, and record information - Read summary information and copy images - Find dates, names and historical information - Observe cartoon style video and do follow-up quiz - Create fact files on particular topics e.g. country - Search, select, cut and paste, print information - Search, select, plan and present information in PowerPoint
Interpret	- Compare information found in Venn diagrams - Examine, evaluate, select and use instructional text from Internet to build or make something - Observe resources in virtual art gallery, cut and paste to Word document, provide opinions and original thoughts - Consider trustworthiness of Internet information - Use information gathered to present an experiment of a famous scientist in character. - Frame questions suggested (but not necessarily answered) by text.
Create	- Use information found to devise a system to protect a chosen animal from extinction - Use information to develop interviews, surveys and questionnaires

The educational intentions and purposes of the tasks teachers designed for students to use digital information resources reflected a strong emphasis on functional and operational literacy, although some ventured into the realms of the sociocultural and critical. Skill development, particularly in relation to learning technical skills, was often taught during short self-contained tasks that could be completed within a certain time frame. Teachers' educational intentions, the influences of their pedagogical orientation and approaches to change and intervention are discussed in more detail later in this chapter.

Early in the project, teachers had high hopes in relation to the Internet. Several teachers believed that the excellent quality of sites available on the Web would allow students to

use the Internet for research and give them access to various forms of publication. They thought that resources available on the Web would improve as the Web grew and that less time would be needed to find appropriate resources. One teacher believed that "you could find suitable information on anything if you looked hard enough" (Extract from Journal, May 2000).

Another teacher stated that they thought learning would be more dynamic through the use of new ICT and that the motivation factor (in relation to using engaging web sites) was important. Others thought that engaging web sites enabled students to work more productively in terms of reading and promoted interesting discussion. They also thought that more accessible information enabled learning to be in students' own hands. One teacher saw the teacher's role changing as information became more accessible to students, so that teachers were no longer the 'whole access point' of information. Thus, prior to the projects, teachers were positive and focused on the benefits and advantages that they thought Internet access would bring their students. The next section describes the technical/operational, organizational and pedagogical dimensions of teachers' practice and identifies sociocultural and critical considerations raised by the study. The pedagogical dimension includes teachers' struggle as they made tacit practice and thinking explicit, and problematized and theorized their practice.

Dimensions of Practice

Learning Literacy and Use of Technology

Teachers identified a range of practices to support the development of what Bigum (1995) and Lankshear, Snyder & Green (2000,) call the 'operational' dimensions of literacy and technology associated with using the Internet for research. Teachers' technical and operational concerns focused on learning to use the relevant technology and learning to read, manage and use the information located. Sociocultural and critical dimensions of literacy and technology tended to be reflected upon, as teachers problematized aspects of practice and student response or confronted the "normal" (Dalmau, 2002) and made changes to their regular way of working with students.

Learning to use the technology

Teachers identified learning to use a browser as the key technical skill required by students. This included developing proficiency with search strategies, 'bookmarking' or adding to 'favorites', and navigational skills necessary for following and tracking hyperlinks. Students were directly taught how to identify and combine keywords and the basics of Boolean logic. In addition to learning how to print information resources, students were taught how to cut and paste text and graphic resources into a word processing application, and how to save particular files into folders on the school network.

At a sociocultural level, this required students to draw upon their knowledge of the world and their facility with language. Teachers also emphasized the importance of students assisting each other with the technical aspects of Web searching, sometimes surpassing the teacher's knowledge in this area. Thus students were often cast as 'expert knowers' in relation to technical expertise and teachers proudly reported when a student taught them a new skill or shortcut.

Teachers identified the human quality of persistence as being an important component of a successful search for information:

> *Exploring how to do a more effective Internet search during the teacher group of the rotational Guided Reading sessions was interesting because I think that some of my students would have given up on a topic easily if I hadn't shown them how to persevere in order to gain information they were looking for. I kept asking them for ideas of what to look for and different words that could be used and they were excited when they were able to find what they wanted. I think that often students (and adults) give up too easily when researching on the Internet unless they have a specific site to go to. I kept reminding each group of how hard I had to search to find out information about the hotels I was staying at during my overseas holiday.*
>
> *(Gerry, Term 3 Report, Oct 2000)*

By highlighting the human dimension of the technical, this teacher situates technology practice within a framework of social and practical purpose and attitudinal orientation. The importance of being 'in the pedagogical moment' (van Manen, 1991) with students

as she prompted, questioned and encouraged them highlights the complexity of the teaching process. At any moment in interaction with students, teachers must draw upon their background knowledge, beliefs and strategies to craft a response in relationship with their students.

At a critical level, teachers sometimes wondered about the time efficiency of using the Web to locate information, and found it wanting. They noticed that students sometimes were so engaged at a technical level that they failed to engage and actually identify relevant information:

> *... they can sit and waste time browsing without gathering data…They also tend to paddle around and click wildly if they are not sure…*
>
> *(Muriel, Journal Summary, May 2000)*

> *Computers have intrinsic motivational value at this stage, though the completion of the output isn't always paramount in their minds…(I) feel many students see computers as the end result sometimes, rather than a tool for research, communication, etc.'*
>
> *(Liz, Snapshot, Nov 1999)*

Although it was easy to engage students in using the technology, it was more difficult to successfully engage them in the social and intellectual purpose of the task. Thus teachers initial high hopes for the Internet gave way to a more cautious endorsement, and identification of a need for students to learn to weigh up the various information resource options at their disposal and determine which were the most appropriate for the task at hand. Teachers' problematizing of students' strong technical engagement with ICT at the expense of content also led them to seek pedagogical solutions and make changes to their practice.

Learning to read, manage and use information

Examination of the educational intentions behind the use of digital information resources revealed differences in the literacy demands on students. Teachers agreed that students needed to learn a range of specific operational or functional literacy skills to assist them to effectively locate, understand, select, manage, interpret, represent or use information in regular oral, print, 3D, hypertext or multimedia modes of communication. Sometimes this was restricted to an activity that had a specific focus

such as comprehension, while at other times the task was more complex requiring student choice, discrimination, and mobilization to action:

> *Finding all the sites relating to the Chinese New Year, which we planned to use for our guided reading activities, was fantastic. We all got really excited, found some terrific info and adapted the info for some comprehension activities.*
>
> *(Joan, Journal, Week 1, Term 1, 2000)*

> *In reading the groups have been working on the Web to find simple procedural texts for making things such as paper aeroplanes etc. These worked really well in that the children who were involved found texts simple enough for them to follow next week.*
>
> *(Bart, Journal, Week 5, Term 2, 2000)*

Teachers also applied a range of text literacy strategies (note-taking, keyword highlights, use of planning proformas and report writing skeletons) to facilitate more effective reading, comprehension and reconstruction of information that had been located.

In general, many of the teaching structures used by teachers to support students to use digital texts were similar to those used with print based texts, sometimes mimicking the same task. At a sociocultural level, this teacher problematizes her original practice when questioned by her students:

> *And I'm trying to think more globally as well—one of the rotations I used all the time last year was to visit the Herald Sun site and read a news article and talk about why that news article was important. Then last week one of the kids asked whether they could use a paper in America and I thought "yes, you should be." I couldn't believe that I had a group reading the Herald Sun with me, and then I had them on computer reading it also.*
>
> *(Maryann, Interview, May 2000)*

Teachers in the project noticed that students in their classrooms experienced difficulty with what McKenzie (1998) called the 'prospecting' stage of the research process, which required them to 'sort, sift and select pertinent and reliable data' (p. 1). The following classroom observation illustrates some of the specific operational literacy issues:

Most of the students in Group 4 (described by their teacher as her 'bottom group') knew how to get on to the Internet, although one new student needed me to provide her with specific help. They used the available search engine and typed in Bali (their task was to find 5 things they didn't know about Bali). It was quite difficult for them to then work out which sites to visit to gain more information. I realized that, for students already challenged in literacy, scanning through a list of sites and the brief descriptors required particular skills of discrimination.

Once in a particular site, which was rich with information, I noticed that the students engaged in quite a lot of random clicking, going from one web page to another without really processing the information that was available. I had to slow them down and ask questions about what the page was about. They seemed to get most of their clues from the large title on the page and graphics, but struggled to determine a fact from a graphic (another skill)…
Thus the complexity of the task set for these students, already identified as challenged by regular literacy tasks, is perhaps underestimated. The question that came up for me was how do we make this task more accessible and meaningful for them? … I think we need to perhaps teach specific skills to aid them in gaining information from the sites they visit. For example—what can they glean from the graphical clues? How can keywords in descriptors help them decide whether to follow a hyperlink or not? How can we hone their skills to skim entry pages to get an overall sense of the information before going off following hyperlinks and perhaps not managing to navigate their way back?

Perhaps we could begin by getting them to articulate just what is difficult about using the Internet to find information, teaching them what to look at, working out ways that help them to effectively extract relevant information and how to work out which hyperlinks are worth following.

(Researcher Observation, February 2001)

Luke (2000) distinguishes differences between print based and digital or electronic texts and highlights some of the complexities within hypertext navigation:

Reading, writing, and communicating are not linear or unimodal…but demand a multimodal reading of laterally connected, multi-embedded and further

hotlinked information resources variously coded in animation, symbols, print
text, photos, movie clips, or three-dimensional and manoeuvrable graphics. In
the digital information environment, an understanding of the relations among
ideas is as important as, if not more important than mastery of the ideas
themselves…Hence, electronic reading and writing, a sense of intertextual
connectivity, relational knowledge, and thinking laterally across associations
are fundamental to Internet (or CD-ROM) navigation and information sourcing.
(p. 73)

Luke (2000) also notes that reading practices are in 'flux':

We don't read electronic text on-screen in the exclusively bookish direction from
left to right but we scroll text vertically with increasing speed and visual acuity
in order to identify the gist of a message and locate keywords on which to click.
(p. 84)

Although teacher research clearly identified the need to teach students how to identify
and use keywords as part of search strategies and comprehension of information,
reflections did not focus significantly on the demands of reading in a hypertext
environment. This suggests that understanding the different operational literacy
demands on students in a hypertext environment is indicated as an area for future action.
Facility with print based literacy is not enough to prepare students for new technology
mediated literacy experiences. Students require specific instruction and focused
teaching if they are to navigate hypertext environments effectively.

Lankshear, Snyder & Green (2000) strongly emphasize that the operational, cultural and
critical dimensions of literacy are not hierarchical in nature but interdependent and
therefore need to be pursued in conjunction with each other.

What are the sociocultural implications of literacy practice in relation to the use of
digital information resources? When operational literacy skills are taught without
activating student engagement and social purpose, incidents such as the following
occur:

Two boys had found their five facts about Bali and written them in their book.
They had mostly copied text that they had found on the web site. I engaged with
them to try and encourage them to make sense of one of the graphics, to see that

as another source of information. When I suggested they keep looking to find out some more information about Bali, they looked at me in disbelief and said that they'd found their 5 facts. It seemed to me that they clearly regarded this as "school work" and a "school task" that was complete and now closed. I felt worried that there was no desire in themselves to find out more about Bali, only a desire to complete the work that had been set for them. Is this because the literacy demands of the task were too difficult for them to experience independent success or because they made no connection with their own social purposes?

(Researcher observation, Feb 2001)

Engaging student purpose to the extent that they understand what they are doing, why they are doing it and why it is appropriate beyond simply pleasing or obeying their teacher warrants further investigation. Literacy tasks need to present with more than a singular operational literacy intention if they are to maximize student engagement, persistence and perseverance. Harnessing social purposes that are meaningful and relevant to students, responsive to their cultural interests, and which provide opportunities for choice, decision-making and critical evaluation significantly expands the likelihood of increased student engagement with the operational demands of literacy and technology.

The development of critical literacy was of significant concern to some teachers in the project:

I think we're teaching them all the skills and they're becoming really good and fast at finding things on the computer but no one's talking to them about 'What does that mean? You can get on the Internet and you can surf around and click back around and use the history button, but do you know what you're reading? Do you know where it comes from? Do you know that it's true? Do you know that it's factual?' All that sort of thing.

(Maryann, Interview, May 2000)

These concerns problematized the use of the technology itself, as well as the information that was found.

Organizational structures and teachers' organizational strategies were indicated as impacting the sociocultural dimensions of literacy tasks set for students. These are examined in the next section.

Organizational

Teachers identified a range of key planning, preparation and classroom organizational strategies that assisted them to use the Internet more effectively in their classrooms. They found they needed to spend a great deal of time searching for suitable resources, particularly information that was appropriate for students' reading levels, and decided it was best to limit the amount of information that students searched:

> *I consider the information available on the Internet as a valuable source for children to have access to. However I have come across some problems ... Firstly the amount of information available is unimaginably huge and impossible for children to sort through critically. In fact many adults can find the Internet 'daunting' when trying to access what seems simple information. Just as we wouldn't send a grade four child to a university library to find out about bilbies, I don't believe we should let them 'loose' on the Internet. Secondly most of the articles written and available on the web are aimed at adult readers and can be very technical and use sophisticated language. We need to help children use the Internet by bookmarking sites and insisting that they only search through child friendly engines such as Yahooligans or even better EduCache.*
>
> *(Zoe, Commentary, Sept 2000)*

All Middle Years primary teachers favoured use of a structure they adapted from the Early Years Literacy Project (Hill & Crevola, 2001). A two hour literacy block was timetabled most mornings and teachers referred to 'Guided Reading' and 'Guided Writing' sessions. In most classes, this meant an hour focus on reading followed by an hour focus on writing. One team teaching class preferred a two hour focus on either reading or writing and alternated the focus on consecutive days. Students were organized into ability groups so that they could be provided with texts that were appropriate for their developmental reading levels. Sessions were structured beginning with a 15 minute whole class shared experience, followed by half an hour where one or two groups worked with the teacher and other groups worked independently on different

rotational activities, then 10 minutes to reconvene and reflect on learning. In several classrooms, each student group had a leader who was responsible for reporting back at the end of the literacy block on what work had been completed and how well people had worked.

Several teachers problematized the literacy block structure, despite their commitment to adhere to it. One teacher reported unease about his inability to know what students were actually doing on the computers or to effectively evaluate and follow-up the activities that were set:

> *I was a bit frustrated because in my efforts to devote concentrated time to novel groups for my focus, I was only able to get over to the computers briefly. When I did, I found the kids maintaining their concentration for the most part and actually discussing the properties of flight using terms like 'banking', 'flaps' and 'air pressure'. Even if they didn't fully understand these, I was at least happy for them to be extending their vocabulary…In reading, the Internet has been used to give the kids free time to explore the magnificent 'BrainPop' science sites through Yahooligans. They really like the interactive nature of these sites and the follow-up quiz that goes with them. I only wish I had the time to evaluate the knowledge that goes with it! I've come to call it 'Headless Chook Syndrome'. I remain determined to stay with the novel groups as my focus groups with reading, but the interruptions are a problem and I'll have to explore other options.*
>
> (Bart, Journal, Week 2,5 & 6 Term 4, 2000)

The literacy block structure limited teachers' capacity to engage in incidental teaching with the majority of students in the room. When they did 'break the rules' and interrupt their focused teaching group to check on a group or troubleshoot, they felt frustrated that they weren't conducting their guided reading or writing properly. The desire to 'do it right' was influenced by the strong acceptance and promotion of the literacy block structure within the education system. Although teachers in the Middle Years were not required to adopt the structure, these primary teachers reported feeling excluded from 'all the fuss' about the Early Years and the extensive resources that had been poured into this initiative. Thus the overwhelming endorsement of the structure by the Department of Education influenced teachers' commitment to its use.

Gradually, as teachers increased their own confidence in using ICT, they sometimes made Internet research the focus of their guided teaching groups. In some classes, there was also a 'blurring of the boundaries' where Internet research was no longer consigned to a literacy block rotation where the task was finite and needed to be completed within a short time frame.

Use of the literacy block structure meant that students were required to use the World Wide Web independently or with support from their peers. The practice of ability grouping meant that students who struggled with literacy were less likely to have a more able peer nearby, although sometimes these groups had the assistance of an integration aide. Some teachers set up a system of peer experts to provide more support for those working at the computer learning centre:

> *My students are all at different levels of ability. Some are very good at different programs and these people I would use as 'student experts' when a problem arose, especially while I was working with my teacher group. I used peer tutoring for some programs, because I found that having someone beside you while you're actually learning a new computer skill really helps because the tutor picks up very quickly what hasn't been understood.*
>
> *(Gerry, Professional Learning Evaluation, Aug 2000)*

Teachers valued student independence, particularly when they were able to select information that was 'at their level', thus beginning to relieve teachers of the burden of finding appropriate web sites beforehand. The need for independent student activity sometimes led to simplistic, closed tasks being set:

> *I think because everyone's now using the Early Years model, people could do more with it and not be so sheet orientated. They need to keep revisiting Bloom and Gardner so that there are a range of things for students to do without turning them off. Doing a sheet with 15 activities that are exactly the same, writing, writing, writing, it's no wonder kids get sick of writing. There are still some teachers who, in comprehension activities, ask children to write the question as well as the answer. And you think 'Why are you doing that?' because that's a waste of time if ever I saw it. So it's getting teachers to think more carefully about the sort of things they provide the children and are they*

using that half an hour in the best possible way? Sometimes the answer's a clear no.

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(Interview, School Leader, Mar 2001)

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When particular system initiatives are so strongly endorsed that the structure itself is not questioned, the options that teachers consider in terms of a pedagogical response can become significantly constrained. Thus although teachers subscribed to pedagogical belief systems that valued tasks with 'higher order thinking' and 'productive pedagogies', Middle Years literacy block practices often had a functional or 'operational' (Lankshear et al., 2000) literacy focus with comprehension, skill acquisition and consolidation, fact finding, summarizing etc. as a focus.

Pedagogy and Change

Intellectual quality and the framing of the research task
When teachers first started integrating Internet research into their curriculum, they tended to adapt its use within their existing pedagogy and classroom structures.

> *Over the last few weeks my students have been using their Guided Reading time on the computer to search for information related to their Geography project—creating Fact Files on Australia and one country from each continent. While it is good to see them gather information, l really don't feel that they are selective in what they print off... Some of them have tried to cut and paste onto a word document but we are still having problems with the programs.*

> *Even though l have done heaps of work with the grade on how to find the main facts within a text, I'm finding a lot of the information they are handing in to me with these fact files is copied information. I know there are things they need to copy, such as population distribution, but they need to try and put the information into language they themselves understand. What l want to see them do is to use a dictionary if the aren't sure of the meaning of a words and then to rewrite the material in their own words. Some students are doing this, while others aren't— it is a real concern.*

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(Gerry, Extract from Journal entries, Aug 2000)

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Teachers identified the issue of copying and plagiarism as problematic and complex. On the one hand, proficiency with word processing, desktop publishing and presentation

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software requires students to learn the technical skills of copying, pasting and editing text and graphics. There are times in the authoring process that these skills are useful and appropriate to use. On the other hand, such proficiency can be used to avoid the synthesis of information and the development of comprehension and understanding. The participatory research process problematized not only the issue of copying and plagiarism, but also some of the pedagogical responses. For example, one response when the above example was shared suggested:

> *This makes me think that we should be looking to the way we teach in our classroom and whether we have or haven't adapted our practice now we have such a massive resource of information literally at our fingertips. I believe we should be looking at the way we teach children to research, and the processes that are involved. We should be investigating the impact the Internet has had on our teaching and learning and have conversations about the best way to use it so that we no longer find students bogged down with information that is too hard to comprehend. But mostly we should be looking at the assignments we set children and what skills and capabilities we are fostering. Are we wanting children to regurgitate information found or are we wanting children to create new knowledge from the various sources of information mixed with their own views opinions and ideas?*
>
> *(Commentary, Zoe, Sept 2001 in response to Gerry's Fact File vignette)*

Zoe's theorising goes beyond functional literacy concerns and raises questions about what Bigum (1995) calls the 'cultural' elements of technology use (the stories and practices we tell ourselves about using it). She also moves into the critical dimension of literacy when she considers the impact of asking students to 'regurgitate' information and raises the challenge of supporting students to create new knowledge.

When the pedagogical responses of Gerry and Zoe were compared, a difference observed was the dimension of pedagogy that provided the dominant source of impetus for action. Gerry drew primarily upon her knowledge of teaching strategies and her philosophical orientation and beliefs about what children need to learn:

Table 17: Dimensions of Pedagogy applied to Gerry's Fact File Example

Dimensions of Pedagogy	Practice Described (D), Interpreted (I) and Theorized (T)
Educational intention	Developing children's functional literacy: ability to locate and select relevant text and compile facts in their own words. (D) Developing students' factual knowledge about other countries. (D)
Context and structures, norms	Two hour literacy block, Early Years Guided Reading and Guided Writing model, parallel group work. (D)
Thoughtful awareness and response	**Identifies problem:** Observes that a lot of information is copied information (I) **Identifies problem:** Feels students aren't selective in what they print off (I)
Philosophical orientation, beliefs and values	**A possible rational for the task:** Heaps of work done on how to find main facts within a text (D) **A possible way forward:** Students need to try and put the information into language they themselves understand. (T) **A possible way forward**: It would be better if students cut and paste relevant information before printing off. (T)
Knowledge of teaching methods	**A possible way forward:** Students should use a dictionary if they are not sure of the meaning of words and then rewrite the material in their own words. (T)
Relationships and interactions	Students obey instructions of the teacher. They have some choice to select within parameters of the task. Teacher with a different group during task. Students grouped by ability (D).

The pedagogical response in Table 18 also draws upon the teacher's philosophical orientation and knowledge of teaching methods, but illustrates a more dominant influence where children's experience of pedagogy is considered:

Table 18: Dimensions of Pedagogy applied to Zoe's Commentary to Fact File

Dimensions of Pedagogy	Practice Described (D), Interpreted (I) and Theorized (T)
Educational intention	**Questions intent**: Questions skills and capabilities being fostered in the assignments set for children, regurgitation of information (T)
Context and structures, norms	Multi-age classroom, integration of reading and writing in literacy block rather than separating out. (D)
Thoughtful awareness and response	**Problem identified**: Suggests that students get bogged down with information that is too hard to comprehend (T)
Philosophical orientation, beliefs and values	Values students' ideas and opinions. (T) **A possible way forward**: Should investigate the impact the Internet has had on teaching and learning and have conversations about the best way to use it (T)
Knowledge of teaching methods	**A potential problem identified**: Need to look to the way we teach and whether we have or have not adapted practice (T) **A re focusing of educational intent**: Should be looking at the way children are taught to research, and the processes that are involved. (T)
Relationships and interactions	**A possible way forward:** Should ask students to mix own views, opinions and ideas with information to create new knowledge. (T)

Theorizing and the crafting of action in this commentary ranged beyond operational and functional concerns to consider sociocultural practice in schools and critique educational intentions. In contrast, the first description of practice (Gerry) was concerned with first order changes that largely maintain the basic organizational features of the classroom and the way children and adults perform their roles (Cuban, 1988, p. 342). The second commentary (Zoe) addresses issues which are necessary if second order changes are to occur, those which impact on the goals, roles and relationships within the structures and culture of schools and classrooms (Fullan & Stiegelbauer, 1991).

The two teachers cited above differed in the way they crafted pedagogical solutions. One focused more strongly on achieving curriculum outcomes while the other focused more strongly on how the child would experience practice. Educational intentions and the crafting of pedagogical responses are not framed in isolation but connect to each teacher's philosophical orientation, the structures and norms of their organization, values, knowledge of teaching methods and the pedagogical relationship they define with their students.

Another strategy recommended by teacher researchers in response to the problem of copying information identified the framing of the research task or question as crucial if students were to avoid what McKeown (1999) calls "read and regurgitate disease":

I felt that I could relate to the difficult situation that Gerry faced. It made me question the way we do information searches in our class. Recently we asked the children to undertake a home/school project on a native animal of Australia. It was an information-gathering task primarily but we also wanted the children to create new knowledge from various sources, and devise a system to protect the chosen animal from extinction.

(Zoe, Commentary, Sept 2001)

The framing of this research task illustrates "high cognitive load" because it provides students with opportunities for higher order thinking and application of knowledge. McKeown (1999) contrasts 'fact finding' with 'information literacy' as considerations in terms of educational intention. She cites the National Forum on Information Literacy (1992), which stated that an information literate person is one who:

- recognizes that accurate and complete information is the basis for intelligent decision making
- recognizes the need for information
- formulates questions based on information need
- identifies potential sources of information
- develops successful search strategies
- accesses sources of information including computer-based and other technologies
- evaluates information
- organizes information for practical application
- integrates new information into an existing body of knowledge
- uses information in critical thinking and problem solving.

These descriptors address the operational, cultural and critical dimensions of literacy, and provide a level of complexity characteristic of the "intellectual quality" recommended by Luke et al. (2000) as productive pedagogies. When educational intentions broaden from 'fact finding' or information gathering to information literacy considerations, both initial and 'in the moment' pedagogical decisions draw upon a

more complex range of skills and understandings. Fact finding may be part of this complexity, but benefits from being situated in a broader overall educational intent.

The educational intentions of Internet research tasks would benefit from being framed to require students to engage in inquiry where they apply information gathered in socially meaningful ways that encourage knowledge construction as information is integrated with students' own ideas, opinions and understandings. Initial research questions need to be posed to encourage students to look beyond the information gathered and problematize the content, the process of attainment, the purpose for which it is used and the effectiveness of how it was communicated. They also need to be posed in such a way that they cannot be answered through simple comprehension of text.

Examination of educational intention in relation to the use of digital information resources is suggested as a worthwhile pursuit for future professional development programs because of the following indicators:

- Teachers articulate different educational intentions in relation to student use of digital information resources and these differences can be a stimulus for dialogue and reflection on pedagogy;
- When teachers share and make their educational intentions explicit, they engage in re-visioning of their own practice;
- Recommendations within the literature call for consideration of broader dimensions of literacy and technology to be considered alongside technical and operational dimensions.

The locus of pedagogical influences
A strong influence frequently referred to by teachers in the project was the influence of the state Curriculum Standards Framework (CSF) II. Some teachers valued tasks that addressed a number of CSF II outcomes across several key learning areas, using these as a criteria for "richness":

> *I felt that the work my students did in their Geographical Fact Files provided me with a rich assessment task as it allowed me to assess them in lots of different areas of the CSF.*
>
> *(Gerry, Extract from Journal entries August 2000)*

Other teachers felt a conflict between the way they wanted to craft their pedagogical action and the system demands of reporting to CSF II outcomes. They questioned the impact of the outcomes emphasis on students and their own teaching:

> *I just worry that we're too outcome driven. Got to tick the boxes, we have to cover this and we tick all the boxes and it's out of the way. Then on to the next thing that we have to concentrate on…I'm sure kids are feeling really pressured to get things done and to produce something the teacher wants…they're trying to go 'Right, what does she want me to show here?', rather than just explore. Like even though I think there's something more important than saying "Here are all these dates, regurgitate all these dates, regurgitate all the information", kids know exactly what you're looking for so they produce these projects that cater exactly for reporting. Because I am looking for something in particular, because I have to cross and check the box!! …*
>
> *(Maryann, Interview, May 2000)*

Maryann's frustration with the conflict between the structural demands of outcome reporting and her own beliefs about student learning and good teaching are apparent. Even though she considered how particular tasks and teaching practices were likely to be experienced by her students, pedagogical action was strongly influenced by external system demands (which were also schoolwide demands). The locus of the dominant influence in terms of teachers' pedagogical response could generally be determined by either curriculum or student concerns. The following example illustrates how drawing upon relationship with, knowledge and observations of a student were the more dominant influences:

> *The task we asked students to do was to research a famous scientist, with the final aim of presenting their work to family and friends. They were told that they needed to understand what this scientist was famous for in order to present their work. Tom, a sixth grade student who was not normally focused on his work came in the next day and said 'I've finished my project'. He had printed what he had found on the Internet and pasted it neatly on a piece of cardboard. Not wanting to lose this rather disenchanted boy, I congratulated him on his efforts of choosing Isaac Newton. I explained to Tom that for the presentation, he would need to become Isaac Newton and choose one of his experiments to demonstrate.*

One step at a time, we found this information and discussed what was relevant and rephrased it into Tom's language and understanding. He was becoming involved in his work and began looking at the demonstration of Newton's first law of motion. He has gathered the resources and information himself and is working on suitable clothing so that his work will be real.

The Internet was valuable in providing the information. The questioning and the knowledge about the learner and his learning environment was the important factor in this becoming a rich task and bringing change to work habits of a student who once relied on quantity rather than quality.

(Maree, commentary, Sept 2001)

This example illustrates how a teacher crafted a response 'in the pedagogical moment' (van Manen, 1991) to support the student to learn in a way that reflected her philosophical position in terms of what was 'good' for the child. The teaching strategy, which required the information to be translated into a different communication mode (performance), assisted in the transition from copying to comprehension to understanding.

Teachers also drew upon their own background experiences to confront the problem of copying and plagiarism, and the issue of intellectual quality of student work:

In the past I have given children 'research' assignments as independent assignments that were to be completed at home or in school time. When they were handed in I have felt dissatisfied with the content and have felt that children had put a lot of effort and time into the presentation but the content was weak and/or copied from a text. I felt that the intellectual quality was low for the intelligence of the child.

I was concerned about the issue of children downloading information, but remained keen for them to use the Internet as a research tool, along with other sources such as books and interviews with experts. When talking to the children about this concern they told me that the information they got from the Internet and books was well written and they felt they couldn't put it in their own words as well as the author had. I could sympathise with this through some of my own assignments. I also related this to some frustrations I had felt as a student,

having to write assignments when their sole purpose was to rewrite what someone has already come up with—a task I view as futile and time wasting. This led me to think about the task that was set for the children in my class and whether we had placed enough emphasis on valuing the conclusions and ideas they came up with. It also made me think about the way the children valued their own written work. Are they seeing the words of an author as more important than their own, and do they not realise that as a teacher I want to see the original ideas and concepts that the child has come up with that been informed and maybe influenced through other sources?

<div style="text-align:right">*(Zoe, Commentary, Sept 2001)*</div>

This response demonstrates critical thinking in relation to van Manen's (1991) dimensions of pedagogy. In particular, the educational intention is clarified in response to student work, the philosophical orientation and values position move beyond comprehension to higher order thinking and ways of viewing the world, and the pedagogical relationship with students (consulting them to try and understand the way they experience teacher practice) are all indicated as influencing pedagogical action.

Thus, depending on teachers' individual pedagogical orientation, the locus of dominant pedagogical influences varied. Sometimes, curriculum and external structures were the main point of reference in crafting action and response. At other times, empathy for students and consideration of their perspective predominated as the main determinants of the pedagogical response. This was often connected with teachers being able to recall how they had felt during similar experiences.

Pedagogical moments and relationships with students
Sometimes educational intentions that began with a functional or operational educational focus changed "in the pedagogical moment" (van Manen, 1991):

At the moment we're doing the Eureka Rebellion and the events leading up to it and we're trying to find some dates and names and who James Scobie was. Most of them went to the books that I had and a couple of them went to the Internet. They actually found the information more quickly in the books, so we had a bit of discussion about information and where you could find it, and how it can be really hard to search for things. Then I was interested because on the Sovereign Hill website one of the dates was different from what was in the book so we had

a huge discussion about how you can trust information, what you can find on the Internet, who puts it there, and could you put information on the Internet? That's why you need to check different sources. They were saying, well, what if it is different, what do you do? They've become more aware of the social and communication issues rather than computer programs.

<div align="right">

(Interview, Maryann, May 2000)

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Maryann made the most of an unexpected occurrence and prompted students to think about information sources in a critical manner. As Maryann moved beyond her initial framing of the task there is evidence of "productive pedagogies" in action (Luke et al., 2000). By pursuing the difference in dates, Maryann encouraged her students to see "knowledge as problematic". She also engaged students in substantive conversation about the process of inquiry and made connections to the world by exploring issues of authorship and trustworthiness. She moved into the critical dimension of literacy and also raised questions about the "assumptions and taken for granted aspects of technology" or "critical" elements of its use (Bigum, 1995, p. 12).

Teachers referred to norms and values as they determined their pedagogical responses. Sometimes they found that despite the best of intentions, such as to give students greater opportunities for negotiation and decision-making, this had not occurred in practice:

Donna: Sometimes it was too teacher directed. They worked together but we planned too much. The unit was teacher directed because of that. Next time I'd set it all out for the kids to select. Kids want to do a variety of activities. The whole way we presented outcomes—they didn't have a total overview. Next time I would present the whole unit at the beginning—allow students to decide how they'll use resources and us. They'd have to do experiments.
Liz: That's hard— you have your pet activities you want them to do…I suppose they're making their own decisions, even if the task is quite closed.

<div align="right">

(Dialogue, Middle Years Team meeting, Dec 2000)

</div>

In this case, Liz experienced a conflict between wanting to provide more open-ended tasks and choice of learning activities for her students but also wanting them to experience the activities that she valued for them. The dominance of competing influences, particularly in terms of what is most valued, can be linked to how the main pedagogical response is shaped.

Several teachers noticed that students helping other students was a cultural change that caused students to move out of their friendship groups:

> *I observed students helping one another in a number of situations. I saw some cross friendship groups helping when Peter responded to Julia's command to help. She asked him for help and as he is such a polite student he obliged. This is good however for both Julia, who in this instance had no problem admitting she did not understand, and for Peter who is a very quiet student and may at times help his quiet friends but has never before worked with Julia who is a very strong and loud (almost scary) student in the room. I think such 'cross friendship' helping is part of the nature of IT where it is OK not to know how to do something. There doesn't seem to be any negative connotations attached to not knowing at this stage.*
>
> *(Liz, Journal, Oct 2000)*

Regardless of their values orientation, teachers made interpretations based on student responses to their practice and reformulated a pedagogical response. How they interpreted student responses, the type of questions they asked themselves and their own personal pedagogical orientation determined what that response was. The use of ICT became a catalyst for renegotiating the relationships and interaction patterns in the classroom

Confronting the need to change

Most teachers were keen to increase the intellectual quality of the tasks they set students and provide opportunities for higher order thinking (Dalton & Smith, 1986) and development of multiple intelligences (Gardner, 1983, 1993, 1999). Several teachers cited an overemphasis on comprehension exercises as problematic in terms of how students experienced such activities. One strategy was to ask students to pose questions and devise strategies for seeking out information, in contrast to the normal practice of asking students to find the answers to specific questions:

> *I have been teaching them to frame questions about an overseas issue based on newspaper reports. Many chose the Fijian crisis. Some students were able to extrapolate from the issue and set higher order questions. They then had to suggest information required to answer these questions, to identify their sources, and finally to actually locate and take relevant notes. The final step was to*

explain how this information increased their understanding of the issue. Some students found the concept of framing questions that didn't necessarily have the answer in the text, and the notion of not being compelled to answer them (as a comprehension style exercise), a confusing task. (I must admit they cheered when they realised they didn't have to answer them all! This says volumes for the popularity of comprehension questions as a learning tool.).

(Liz, Journal, July 2000)

Teachers identified a need to intervene and question, conference and guide students to deeper knowledge and understandings during the research process, as well as providing students with clearer expectations and standards:

During this last assignment, Stella and I decided to guide the children through the project, taking many opportunities in class time to teach the skill of taking notes, highlighting key words and report writing. We also had conferences with the children throughout the project and made suggestions where we thought they could go further and deeper. We used a rubric to guide the children so they were clear from the beginning what was expected of them and they were able to determine the standard they would set. The Internet was a major source of information in the class, but we ensured children would have access to material that was at their level by book marking viewed and checked sites. We found the intellectual quality and original thoughts and ideas in these assignments to be mostly excellent.

(Zoe, Commentary, Sept 2000)

This example illustrates productive pedagogies in action (Luke et al., 2000). By increasing the explicitness of the task, Zoe increased the social support available to students. Opportunities for recognition of difference were provided, with significant opportunities for students to negotiate aspects of the task and clarify what constituted intellectual quality. Authenticity (Kruger et al., 2001) in terms of talk and communication in teaching and learning and thoughtful awareness and response are also in evidence.

Changes in the way the Internet was used as an information resource were linked to teachers' pedagogy and, in particular, the educational intention of the tasks teachers designed for students, the change in relationship dynamics between teachers and

students and the teaching structures that shaped and constrained practice. When teachers were introduced to the concept of productive pedagogies, they consciously incorporated considerations of intellectual quality into the tasks they designed for students in an attempt to make them 'rich', 'open-ended' and more likely to engage students in higher order thinking. Teachers also reflected upon the degrees of student control, support and self-regulation they offered within their teaching practices and structures. Increasing awareness of the dimensions of pedagogy leads to confronting and reconstructing of existing pedagogy.

Linking ICT and Literacy

Langford (1998) notes that there is confusion in the literature as to a clear concept of information literacy and even in terms of whether it is a concept or a process. She cites Holloway (1996), Lincoln (1987) and Henri (1995) as agreeing that the notion of information literacy is 'fuzzy' and that 'teachers are not clear about what is meant by this term or how it relates to classroom practice' (p. 2). One problem that she identifies is that, because there is an understanding that schools must develop literate and numerate citizens, reading and writing skills at a functional level have been emphasised. She notes a broadening in the world view of literacy as it transforms 'from a functional literacy through to a set of literacies, tied to advances in technological society' (p. 4). This broader view of literacy is now connected with the expression of people's thoughts and attitudes (Kuhlthau, 1995; Ross Tweed & Bailey, 1994) as well as affective and cognitive understanding in cultural contexts (Breivik, 1993). Not only must students' capacity to confidently challenge ideas develop as a result of their increased ability to access and use information effectively (Langford, p. 8), but they must also act on information and become *interdependent* as well as independent and self-directed learners (Owen, 1996).

In a similar vein to Bigum (1995) and Lankshear (2000), Cummins and Sayers (1997) distinguish 'functional', 'cultural' and 'critical' literacies. They argue that a focus on technical and functional skills, or 'functional literacy' disadvantages marginalized groups of students and is likely to lead to a skills surplus that results in 'a buyer's market whereby people can be hired cheaply and controlled more effectively' (p. 97). Marginalised groups are already at risk in terms of not having opportunities for the 'shared experiences, knowledge and expectations' needed to 'comprehend adequately

texts, media, or patterns of social interaction within particular communities' (p. 88) which they term 'cultural literacy'. In contrast 'critical literacy' enables students to 'use language powerfully to analyse social issues that affect their lives' (p. 87) and is crucial if marginalised students are to engage effectively at a functional literacy level. Unless content or dominant 'cultural' knowledge is questioned and students are provided with opportunities to reflect on their own experience and realities, affirm their identity within the curriculum, and become aware of how knowledge, power and resources have been distributed in society, they are unlikely to develop the capacity to engage in the reflection and social action necessary to change the circumstances of their marginalisation (pp. 90-92).

McKenzie (1998) recommends that schools focus on becoming 'information literate' communities. He distils information literacy into three major components:

- Prospecting: discovery of relevant information;
- Interpreting: converting information to show relationships and help resolve issues and questions;
- Creating new ideas: development of new insights.

Here 'fact finding' could well be addressed during the 'prospecting' stage of research but the overall task set for students is situated in a broader context which later moves them into McKenzie's 'interpreting' and 'creating' stages. Although clearly targeting the development of higher order thinking (including creative and critical thinking), McKenzie's categories do not necessarily require students to move beyond the culture of 'school' learning to actively examine the relationships that cause them to investigate particular issues, use particular knowledge and take particular action.

Conclusion

The use of digital information resources clearly creates new literacy demands in the classroom. This in turn has created impetus for new practices, pedagogies and appropriate professional development strategies to support such development.

This research identified differences in the framing of educational intentions of tasks requiring students to use digital information resources. Teacher research raised questions in terms of how broad the educational intentions of tasks were framed and variations occurred as to whether such intentions encompassed the

functional/operational, sociocultural and critical dimensions of literacy. When teachers framed tasks for students that addressed these broader dimensions of literacy, they reported improved intellectual quality in student work.

Teachers recognized that there are new functional or operational literacy demands on students when they use digital information resources. The hypertext environment requires new skills in reading and making sense of information, in addition to the traditional print-based and critical literacy demands still applicable in the digital and multimedia information environment. Although teachers identified the need to identify and use keywords to search for and comprehend information, the specific demands of working in a hypertext, multimedia environment did not become the focus of discussion during the data collection period of the project. In general, teachers tended to draw upon strategies they had previously found successful with developing print literacy, whereas new literacy requirements have emerged with the advent of new technologies that require teachers to:

> *...develop appropriate pedagogies for these new electronic media and forms of communication...(and) become familiar with the many issues at stake in the 'information revolution' so that we know how and where we must intervene with positive and critical strategies for Multiliteracies teaching, and how to make the best judicious use of the many multimedia resources available.*
> *(Luke, 2000, p. 71)*

Teachers highlighted the importance of planning for intellectual quality and providing opportunities for higher order thinking or high "cognitive load" (McKeown, 1999). This meant that tasks needed to be "rich" or complex, encompassing application, use and/or transformation of information. The multiliteracies agenda, which requires students to develop facility with multiple modes of communication was touched on briefly by several teachers as they asked students to design original products or reconstruct understandings from one mode of communication into another (e.g. text to graphic or performance or vice versa). Teachers identified the way students engaged with information, the degree to which they made sense of it, and the purposes for which it was used as problematic. Teachers' response to this problem was pedagogical, causing them to: question the types of projects they were setting students; reflect upon and question the educational intent of such projects in terms of the skills and capabilities

they were fostering; reflect upon the intellectual quality of tasks, analyse the application of knowledge and engagement of higher order thinking skills; draw on a range of different teaching methods and knowledge of specific learners; question teaching practices; and look to students to seek further understanding of how they experienced practice.

The operational or functional skills of learning to use the Internet for research benefit from being situated within the broader pedagogical context of sociocultural and critical literacy which encourage higher order thinking, creative use of information and critique of both the medium and the message (McLuhan, 1964). The huge learning curve often associated with harnessing the technical and the 'wow' factor of technology use can mask 'lower order' thinking activities dominating the way digital information resources are used.

Differences were observed in the dominant pedagogical orientation of teachers, which in turn affected the pedagogical response they crafted. All teachers were responsive to their students, with theorizing and problematizing about practice usually arising from concerns about student reactions to class activities. When teachers reflected upon and proposed possible ways forward in response to their dilemmas, several predominating influences were observed. Some teachers were most strongly influenced by considerations of how students experienced the learning activity—by empathizing with the student, they questioned the relevance and purpose of the original intention of the task. This included considerations of relevance and social purpose from the students' point of view. These teachers also considered the way they related to students and expressed strong preferences for constructing the teacher/learner relationship as an interchangeable two-way partnership based on negotiation and shared decision making.

Other teachers were more strongly (not exclusively) influenced by curriculum considerations and the State recommended outcomes framework. When crafting their pedagogical response, they were more likely to reference what their students were not yet doing, and identify a way forward that they perceived would enable students to achieve the specified outcomes. The teacher/learner relationship was more likely to be constructed as one where the teacher knew what was best for the student.

A third strong influence was that of structure. In secondary schools, the timetable and short periods influenced teachers' pedagogical decisions in terms of what could successfully be achieved in the allocated time. Despite espoused beliefs and values to the contrary, this sometimes meant favouring a teacher-directed style of activity in order to cover content or produce a product. In primary schools, the favoured literacy block structure resulted in teachers setting a range of simple tasks designed to enable students to work independently. This frequently required students to work in an independent and parallel manner on identical tasks that emphasised fact finding, comprehension, functional skill development and consolidation of operational literacy development. Teachers struggled with their desire to "do it right" when using focused teaching groups and their inability to simultaneously remain attuned to what students were doing in independent group work. Teaching structures, that constrain or inhibit teachers opportunities to react in 'pedagogical moments' with their students also restrict their ability to invoke new and relevant educational intentions not foreseen during initial planning or to make the most of incidental learning opportunities.

The way that students viewed the tasks that required them to use digital information resources indicated a further need to rethink the way such tasks were framed. When students saw tasks as discrete and disconnected from their own social purposes, their investment and engagement were limited to compliance with teacher directions. When tasks required them to invest something of themselves, teachers reported higher satisfaction with the quality of work produced.

Student roles were observed to change during Internet research tasks. Some took on the role of technology expert, resulting in a culture of providing assistance at the computer that crossed friendship lines. Teachers' patterns of work changed most noticeably in the preparation and planning they conducted to facilitate use of the Internet in their classrooms, but their roles within their classrooms were often constrained by existing structures.

Thus teachers' work in the area of using the Internet as an information resource was mainly characterized by first order changes which did not greatly disturb the basic organizational features of the classroom or alter radically 'the way children and adults perform their roles' (Cuban, 1998, p. 342). Teachers' existing pedagogy in relation to how students conducted research shaped the way that the Internet was used for this

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purpose in their classrooms. The fact that teachers differed in their pedagogical orientation provided opportunities for dialogue and reflection to occur that challenged some taken for granted assumptions. This resulted in some teachers questioning their own practices and making changes to the teaching strategies they used within their own classroom structures.

Pedagogical action that draws upon 'tacit' knowledge to make sense of educational situations (Kincheloe, 1991), needs to be made explicit if it is to be of benefit to others (Bukowitz & Williams, 1999; Liebowitz, 2000). As teachers describe, inform, confront and reconstruct (Smyth, 1989a) their practice and pedagogy, they develop insight and confidence to make informed decisions from a greater reserve of pedagogical understanding. Increasing awareness of the dimensions of pedagogy is indicated as a worthwhile strategy to assist teachers to engage in further dialogue and reflective practice. As the pedagogical response is something that often occurs 'in the moment' without specific prior planning, increased awareness provides teachers with broader reserves from which to make decisions.

Professional development programs for teachers in relation to use of digital information resources mostly focus on the mechanics of using the technology coupled with basic information literacy. Such programs rarely address pedagogy. Yet pedagogical considerations are the major determinants of what teachers do on a day to day basis in their interactions with students. Professional development programs therefore need to encourage teachers to dig deeper to look at the tacit connections between their practice and theories, beliefs, values and personal philosophies. Such programs also need to address teachers' organizational concerns and how these impact on roles and relationships in the classroom as well as effective strategies that assist students to read more effectively in a hypertext environment. It is important that such strategies do not become yet another tool kit for teachers to implement but remain connected to the sociocultural and critical dimensions of pedagogy. Such professional learning programs would also benefit from re focusing on how students experience practice and correlate this with the educational intention of learning activities. Professional development programs that encourage teachers to discuss and reflect upon such issues as intellectual quality (Luke et al., 2000), beliefs, values and teaching philosophy (Fullan, 1999), educational intentions, the teacher's role in the learning moment and student

experiences of teaching practice (van Manen, 1991), shift the emphasis from technical first order changes to consideration of possible second order effects of an innovation.

Making the connection between technology, literacy and learning also has significant implications for teachers' professional learning programs. Firstly, expanding the focus of such programs to embrace the operational, cultural and critical dimensions of literacy and technology as suggested by Lankshear, Snyder & Green (2000) and Bigum (1995) provides teachers with a broader basis for crafting their educational intentions and engaging in dialogue and reflection to further develop their pedagogy. At the operational level, new technical and functional literacy skills are required for students to locate, select, comprehend and manage the information that is now available to them. Luke's (2000) analysis is that students need to develop facility with mulitmodal reading of laterally connected information that stresses the importance of developing understandings of relations between ideas in hypertext environments. This provides practical advice to further understand this aspect of pedagogy.

At the cultural level, teachers need time to reflect upon and discuss the social practices they engage in with students, the values and norms that are being communicated, the sense of identity that students are likely to develop within that culture and the connections they are making between school practices and the real world. The critical level of literacy and technology learning must question the operational and cultural dimensions of literacy and technology learning and interrogate the mode of communication along with the content of the message. Consideration of the impact of the technology upon society, culture and human relationships is crucial if students of today are to develop the facility to shape their social future of tomorrow (Cope & Kalantzis, 2000).

Chapter 6 addresses this aspect of technology use in more detail as teachers and students embarked on their first collaborative online projects. In particular, the impact of ICT on relationships and the capacity to interrelate are explored, together with the pedagogical implications of practice.

Ch 6: Collaborative Online Projects

Introduction

The communications potential of ICT to expand the possibilities of human interaction beyond the four walls of the classroom excites educators the world over. A range of different educational uses of communications technologies has been identified. Burniske and Monke (2001) distinguish between 'telecomputing' where networked computers are used to send and retrieve information, 'telecommunication' which adds the dimension of genuine interaction and 'telecollaboration' when students who are separated by distance "share the labours" of research and inquiry (p. 11). Harris (1998) has identified three primary genres of telecollaborative projects: interpersonal exchanges, information collections and analyses, and problem solving projects. The online projects that are the focus of this chapter all took the form of interpersonal exchanges, but varied in terms of achieving telecommunication or telecollaboration.

The rationale for selection of this issue as an analysis focus is presented, followed by an overview of teachers' practices and educational intentions in relation to their projects. Key practical and philosophical issues that emerged in the course of teachers' practice are explicated, together with a discussion of the issues they identified as problematic. Teachers' theorizing, particularly in relation to the impact of ICT on communication, pedagogy, relationships and quality work are discussed as well as leadership issues that emerged during the projects. Pacey's (1983) dimensions of technology practice (technical, organizational and cultural) were found to correlate with teachers' concerns and have been adapted to provide an overall analysis structure. (Lankshear et al., 2000; Pacey, 1983). These dimensions have been modified for the purposes of this analysis to consider i) technical (including operational or functional literacy); ii) pedagogical; iii) sociocultural; and iv) critical (including value conflicts and power issues). These dimensions are analysed in the context of the online projects and student learning. This chapter aims to contribute to pedagogical understandings and theoretical frames that support teachers' decision making in relation to the conduction of online projects and identify indicators for future action.

Rationale for Selecting this Issue

Email is one of seven online environment types (Wallace, 1999). Teachers began to use this form of communication more extensively during the overall research project and the

initiation of online curriculum projects was an extension of their own personal and professional use. Email was the main form of communication in the online projects, although at times face-to-face, phone and fax communications were also necessary. The main rationale behind selection of this analysis focus was as follows:

1) Trends in the data: Nine online projects were attempted at the project schools during the course of this research project.

2) Directions in ICT: The use of communications technologies is a recommended learning technologies teacher capability (State of Victoria, 1998), with national and international statements defining goals for students to leave school proficient in the use of communications technologies (Department of Education Training and Youth Affairs (DETYA), 2000); International Society for Technology in Education, 1998; European Experts' Network for Educational Technology (EENeT), 1998). Burniske and Monke (2001) note that "little is known about the efficacy of telecollaborative activities and what exactly 'goes on' inside them" (p.11) and call for more testing of this kind of innovation before embracing it. In particular, they raise questions about what students actually do and learn and what pedagogical practices ought to be encouraged or discouraged. Abi-Raad (1997) points out that "very little has been written on how the use of the Internet in the classroom has affected the role/perceptions of the classroom teachers (and) …there has been relatively little research on how and why Australian teachers use telecommunication technologies" (p. 206), with most attention in this area focusing on the impact of ICT on students.

3) Researcher Worldview: A view that the communications potential of ICT to enable new opportunities for collaboration and inquiry is a desirable 'second order effect' that moves ICT use beyond 'amplification' (Moursund, 1998) of what is already possible in schools. In particular, 'collaborative critical inquiry' through global learning networks is linked to school reform agendas that aim to maximise the learning opportunities of all students (Cummins & Sayers, 1997). This led to an interest in how the potential of communications technologies could be harnessed to genuinely extend and deepen learning opportunities for students.

Background Context and Educational Intentions of Online Projects

Middle Years Projects

Secondary

Secondary teachers attempted three online projects, with increasing degrees of success. Their projects aimed to increase student engagement in the learning process and incorporated an integrated curriculum unit.

Project 1: **The Water Project**.

During their first attempt to set up an online project, two teachers (Liz and Donna) spent 9 months negotiating with a rural high school to try to conduct a common curriculum unit (Water Resources) and connect students with email buddies or 'keypals' (Harris, 1998). Despite communicating by phone, fax and email, changing the unit of work that was initially planned, and changing the classes involved so that the project could align with the collaborating school's curriculum, the project was eventually stalled by technical blocks (no student email system set up at the school level, not being sure how to get this working, not prioritised by IT staff and leadership) and time running out. They remained highly determined to make another attempt the following year.

Project 2: The Gold Project

During their second attempt with a different school, Liz and Donna hoped to develop students' content knowledge about the Gold era and develop "research skills, email facility and web page construction"[2] as students exchanged information/research:

> *The intention was to do some kind of shared curriculum and use each other as a curriculum resource. We were studying gold and obviously (country town) is a gold town. And our area was on the way to the gold fields so we had this automatic connection. We connected it from here, knowledge of the local area and how it got its name, the impact of gold here, then to the gold fields and the impact of gold on their town. We were going to use their students to help us with that. Look around, what is there now, the lasting benefits of gold, what's different because of gold.*
>
> *(Liz, Interview, Nov 2001)*

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[2] In-text quotes in this chapter have been extracted from interview and journal data in order to more accurately represent teacher voice (unless otherwise indicated).

Despite Liz and Donna's desire to engage in "shared" curriculum, this did not occur, due to the difficulty of matching their unit of work with the collaborating school's curriculum structures. The teachers went ahead, however, and asked the collaborating class to help them with their unit by acting as information resources. They began by asking students to write a profile of themselves and took photographs that were sent to the collaborating school. Students were matched on the basis of common interests, in one class students selected a collaborator themselves, while in the other class they were matched by their teacher. Students were encouraged to ask "getting to know you" questions at the beginning of the project (related to hobbies, leisure and musical interests etc.) before sending specific curriculum related questions. The country school did make one reciprocal request for information from the city class in relation to the topic of Federation, and Liz responded by taking her students to the library where they found images, scanned and emailed them to the country students. At the end of the unit, Liz and Donna organized a bus trip to their collaborating school to meet the email buddies and walk around the town to visit places of interest. The collaborating teacher in the country had previously sent photos of the town to the city school and each student group was required to select six photographs to guide their walk.

The teachers identified a number of benefits they associated with the project. They felt that their students had developed a different perspective about rural living and had found out about another area of the State. The project challenged initial perceptions, "Oh yeah, what music will they like—Hank Williams, Slim Dusty?" and enabled them to see similarities as well as differences. Both town and country students were particularly interested in each other's after school leisure activities. Both teachers felt that there had been real communication between the students, which added "another level to the history and the kinds of things that mattered to them…kids empathized with the kids there". They also thought that the project had validated the other students as a resource "kids know things, they can be useful" and felt that this boosted esteem and awareness of personal knowledge. Students had also developed technical proficiency in their use of email.

The two secondary teachers also identified several areas of concern in relation to their project. Although they had very specific curriculum goals—finding out about the impact of gold on the country town, developing an understanding of a rural community, identifying issues there and what life was like—they identified a lack of clarity in their

objectives as problematic, and felt they needed a more "purposeful idea of what kids needed to do". They also questioned "how committed the kids were" but, at the same time, noted that their students were not always sure what was expected of them. The secondary teachers reported that most of the communications between students were personal, although they did sometimes show them a message, commenting that it "talked about some old buildings or something". They questioned how meaningful the relationship was for students and theorized that a physical meeting needed to take place at the beginning of the unit in order to have a successful online relationship. They were disappointed in the lack of interaction that occurred when the students finally met each other.

In general the quality of the information received was regarded by teachers as "pretty brief" and "lacking in integrity". The teachers theorized about the level of intellectual rigor of the project:

> L: We didn't have enough guts there for them, they treated it just like their usual email. I think it's because we didn't force the intellectual rigor on them.
> D: I think the intellectual rigor was lacking because we weren't sure of what form it had to take.
>
> *(Liz and Donna, Interview, Nov 2001)*

Project 3: The City Project

The third project, *The City Project*, involved email collaboration with community organizations rather than another school and was an integrated curriculum unit that involved teachers of Science, Maths, SOSE, English and IT. Students were asked to identify a city-based problem of their choice and come up with an hypothesis that was "doable" within the project time frame. This included two weeks of preparation, one week at an inner city (non-school) campus, and one week follow-up. Once teachers approved the students' hypotheses, students were required to produce interview questions and surveys or questionnaires. Students were expected to obtain mostly primary data but were encouraged to use secondary data such as the Internet to get an overview of their topic (e.g. tourism, law enforcement, multiculturalism). Teachers in the five key learning areas each focused on "skilling up" the students prior to the relocation to the city campus. Interview questions were refined in English and SOSE, hypothesis formation was taught in Science and SOSE, and Maths looked at statistics.

On completion of the week in the city, students developed a presentation, which required some form of technology use, and groups made formal presentations to parents and the school community. This was a significant move to curriculum interdependence, in contrast to previous efforts at parallel, shared curriculum.

During this project, students used email to obtain information from some primary sources:

> *They organized interviews and some of them conducted their interview by email. When one of them emailed a café owner and asked if it would it be possible to visit during the week, they got a response, "Look I'm really busy, but I'm happy to answer your questions now for you."*
>
> *(Liz and Donna, Interview, Nov 2000)*

Donna also noticed that some students took the initiative and followed up gaps in their information through email:

> *Kids also used email during the week in the city—like the kids doing the tourist locations. They thought, "Oh we're missing somewhere here" so they checked the 10 most popular tourist attractions and then realized they hadn't considered one, so they contacted them straight away. They used their initiative. We had a laptop there with a phone line attached so we could go through the email system.*
>
> *(Liz and Donna, Interview, Nov 2001)*

Teachers reported that students had found they "felt nervous, lacked confidence and found it difficult to approach people". They spent time with some students, role playing phone calls and interviews to ease this nervousness.

Teachers felt that the City Project was successful in terms of achieving genuine curriculum integration and collaboration amongst teaching staff, and offered authenticity of learning experiences for students. The project also led to students changing their perceptions of some teachers, as they saw them in different roles at the off-campus site. A major challenge identified in connection with this project was the tension between providing opportunities for student-directed activities while at the same time scaffolding learning to achieve intellectual depth. Teachers noticed that some students struggled to manage their time when given the freedom to do so. Teachers also

identified concerns related to how well students managed the teamwork and responsibility within student groups.

Primary: Middle Years

The first online projects in the primary school Middle Years classes involved individual teachers contacting friends who were working in schools overseas.

Project 4: The Saudi Arabia Project

An informal email exchange was conducted between students in a predominantly Caucasian Australian community and a class in Saudi Arabia. The project teacher (Maryann) wanted to develop her students' intercultural understandings and hoped they would come up with "more global issues". The stimulus for the project was a visit to her class by a friend who taught in Saudi Arabia. Students did not show much interest until a question prompted the teachers to get a map out and show them where Saudi Arabia was located. Subsequent questioning enabled the visiting teacher to confront students' perceptions of 'normal', noting that boys would not be allowed to write to girls. This sparked further questions that led to discussions about religion, arranged marriages, lifestyles and customs. A keypal (Harris, 1998) or "email buddy" arrangement was organized between the two classes. The first emails were described by Maryann as "fairly basic" with students describing their families. This prompted Maryann to concentrate on email etiquette ("I think some of them have the potential to be a bit silly") and wonder how she could move them to thinking more about global issues. She decided to suggest a general focus each fortnight to guide the framing of student questions. This led to students asking more "in-depth" questions of their buddies, about such topics as religion, how their buddy felt if they did not want to get married at a particular age, what they could do if they did not want to. The issue of different holidays and religious years came up when a Saudi student asked what Easter holidays were. The project petered out when the friend in Saudi Arabia returned to Australia. It was also plagued by slow and intermittent responses from email buddies. A few female students continued to email their Saudi buddies informally.

Project 5: The Travel Brochure Exchange

A travel brochure exchange was conducted between a strongly multicultural school in a low socio-economic area of a major Australian city and a class in Bristol in the United Kingdom. This project was initiated by Bart, a Year 5/6 teacher, and required students

in the UK and his class to question each other about their home cities and use the information to design a travel brochure, which was to be exchanged at the end of the project. Students were matched with another individual or pair with whom they communicated. Bart prepared for his travel brochure project as follows:

> *I've sent Dave guidelines on how to have his children plan for their questioning and I've planned for the same thing myself this week with my Guided Writing… The children were introduced to the concept of different types of questions (i.e. open-ended, closed, general etc) and developed their own, based on the sub-headings of: geographical location, basic historical background, population/culture, transport etc.*

> *(Bart, Journal weeks 5 & 6, Term 2, 2000)*

Bart also provided his students with a "design brief" to guide their development of the actual travel brochure. This included requirements such as a comparative population graph constructed in Excel, downloaded images from the Internet and use of desktop publishing software to do the final brochure layout. He also raised the issue of a need to adhere to an acceptable use policy in relation to sending images via email. Thus Bart was very explicit with his students about the technical dimension of the project and what he expected.

The highlight of the project for Bart was in the sociocultural dimension of practice, when a comment by one of the Bristol students led to a discussion about slavery:

> *I used the opportunity to touch base as a class regarding the sorts of data the kids had collected. This brought out some very interesting discussions because some of the UK kids gave info about Bristol being built on the slave trade. The follow-up comment by one of them was that although it was part of the city's history, people still didn't like to talk about it. A rich conversation ensued with many questions being asked, the most basic being, 'What is slavery?' and many follow up questions like, 'Why don't they…', 'What about…' etc. We then used this as a basis of comparison between Melbourne and Bristol and the children were visibly and genuinely fascinated. It's probably the first time in the collaborative project that I've felt some real dividends.*

> *(Bart, Journal, Week 8 Term 2, 2000)*

Bart's project was beset by technical and communication difficulties, with little or no information supplied at times, and a network and email system that were regularly dysfunctional. Despite this, his students managed to complete and send their travel brochures to the collaborating class, although this required a last minute duplication with different software when the other school communicated that they did not have access to the same desktop publishing program that Bart's class had used. No brochures from the UK school eventuated, despite assurances that they were almost finished, which was a source of great disappointment and disillusionment. Despite this, Bart and his class began negotiations for their next project almost immediately.

Project 6: The Biography Exchange

This project was conducted between two schools in this study, one in a rural, predominantly Caucasian community and the other in a multicultural city community. Three project teachers (Gerry, Maryann, Bart) and one other colleague joined together for this online exchange, which involved student keypals or email buddies questioning each other about their lives and developing their buddy's biography. These were later physically exchanged at an end of year picnic. As well having the students learn about the biography genre, teachers particularly wanted to "focus on the communication process" and develop students' ability to question more effectively during the information gathering process. In addition to teaching the difference between open and closed questions, teachers raised social issues with students in conjunction with asking questions:

> *We discussed issues related to asking questions about sensitive issues such as nationality, religion, addresses etc., through 'what if' scenarios. For example, if your email buddy asked you for your address, would you feel comfortable in giving this information over the Internet? Why/why not? Why do we need to take care in asking sensitive questions about things like nationality? Why is it a sensitive issue for some people? If your buddy asked you what religion you were, would you feel comfortable in answering this? Is it too personal? Etc.*
>
> *(Maryann, Journal, Aug 2000)*

All teachers used the strategy of immersing their students in the biography genre before commencing the online project. This involved 'tuning in' by sharing various biographies and identifying the features of that particular text type. Maryann recruited

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the Library Specialist to assist with this, while Bart asked his students to construct a biography for one of their classmates before starting the online project. All teachers taught their students how to use a concept mapping software tool and required them to organize their focus areas and specific questions for the biography in this format. Teachers felt that this was a key strategy for assisting students to keep track of their progress and the information gathered.

Teachers saw the project as another opportunity to further students' development of intercultural understanding and challenge their preconceptions about the world so that "they realize there's more out there". One teacher was particularly concerned that:

> *These days, there is so much emphasis on computer skills acquirement and nothing on computer cyberspace communication and the effect that this ever-shrinking world has on the lifestyles, beliefs and judgment calls of young adolescents.*

> *(Maryann, Snapshot, Feb 2000)*

Maryann also wondered how she could develop empathy and etiquette in her students when dealing with online communication. In particular she wanted her students "to develop an awareness of what they are doing with technologies, how it affects their life, the interaction within their social relationships… that someone at the other end is going to read this".

One of the main issues to emerge in this project was related to quality. One teacher raised concerns about the quality and nature of the questions her students received from their keypals, noting that the questions did not seem to match up with the focus areas that had been discussed with the collaborating teacher. All teachers expressed a range of concerns about the final products. Bart and his students noted that the biographies they had developed with their online partners were shorter and lacking in information compared to the biographies they had developed for their own classmates through face-to-face communication. Another teacher described the biographies her students received as "flash things" which looked impressive at first sight but lacked the complexity and inventiveness that she perceived in her own students' work. A third teacher reported that her students were disappointed with the biographies they received, as many were hand written, whereas they had gone to a great amount of effort to digitize and laminate the biographies of their keypals. She acknowledged that the partner school had less access

to technology and felt that the quality of the information in the exchanged biographies was similar. Overall, teachers felt that the use of ICT in this instance had not realized the potential they initially hoped would be achieved.

Project 7: Transition Brochure

After an approach by the local high school to engage in collaborative literature based activities, Maryann organized for her Year 6 students to be ability matched with students in Year 7 at the local high school. Their task was to produce an information brochure to support the Year 6 to 7 transition program from primary to secondary school. After she described her previous biography project to the secondary teachers, they agreed to pursue a similar format, where the Year 7 students would provide information and the Year 6 students would formulate questions in three areas of interest and produce the brochures. Areas of interest ranged over such areas as school uniforms, canteen, timetable, teachers and subjects. Primary school students asked such questions as, "How have you found moving around to different classes?" Their keypal would then interview a range of Year 7 students and send back responses to inform the brochure.

The high school teachers' main focus for student learning was use of attachments, digital photos and scanning. This was a shift from their original intention, which had been for some of their higher ability students to create a magazine for transition. Maryann had felt strongly that, as transition affected all of her students, they should all have the opportunity to be involved, and the idea for a transition brochure was born. Maryann hoped that, for her students who would move to the high school the following year, the email buddy would turn into a real life buddy who would provide support during the first year.

At the end of the project, the students met and shared a sausage sizzle and the brochures were handed over to the high school. The high school agreed to display the brochures in their foyer and hand them out to parents and visitors.

The main difficulty during the course of the project was high school students' access to technology, as this was constricted by timetables and structures—sometimes high school keypals had to wait two weeks before they were timetabled into the lab. Also, not all teachers were aware of the project and this sometimes led to communication breakdowns, which further delayed students' access to computers. Data on whether real

friendships developed as a result of the email buddy project was not available in time for this study.

Early Years Projects

Project 8: The Troll Project

An 'Electronic Impersonation' project (Harris, 1994) was conducted between a Prep/1 class and a local University-based teacher education class. A group of four first year teacher education students impersonated a book character who communicated with one of the project teachers (Zoe) and her class via email. The intention of this project was to engage the younger children in philosophical discussion about issues that were raised in relation to a familiar story (*The Three Billy Goats Gruff*). This project was initiated as a result of a reading that was distributed to the inquiry teams (Harris, 1994). Zoe already had a strong interest in children's philosophy, so this was incorporated into the design of her project. In this case, ICT was used to mask the real identity of the university students who wrote to the younger students using the identity of 'the Troll'. Zoe also used the project to introduce her students to the concept of email and online communication.

She began by asking her students what they knew about email. They knew it was a way of writing letters on the computer and some had had previous experience, saying they had emailed *The Wiggles* and got a reply. Some knew it was good for long distance communication and felt it eased the job of the postal worker. Her next step was to tell the children the story of *The Billy Goats Gruff*. Zoe decided not to use a picture story book as she wanted to stimulate children's imaginations. She describes the children's reaction to her introduction of the project:

> *The story ended with the Troll being butted into the river by the large Billy Goat Gruff and was last seen floating away screaming and kicking...until the other day when I received an email from the Troll. The children were amazed that I was in contact with the Troll and some of them didn't believe me. They were soon swept up with the excitement of the prospect of communicating with the Troll and decided to become involved whether they believed me or not. I started off by asking the children if there was anything at all they would like to ask the Troll. I explained they were very lucky to be able to communicate with such a character and encouraged them to find out as much as they could. They were*

keen to ask questions and I was initially concerned there were too many for the Troll to answer. They were also more eager than I thought to make judgments about the Troll. I encouraged the children to rephrase their statements as questions as they were quick to make assumptions about the Troll that were not in the story and that were not necessarily true. (E.g. The colour of the clothes, he wore, and what happened after the story ended.) The children are very excited about receiving the reply from the Troll. I showed the children how I receive email on the computer but it was difficult with a small screen. At this stage it has been the story that has captured the children and not the technology of the email. This reinforces my notion that ICT is predominantly used as a tool for a greater outcome, in this case being the children's character analysis, thinking and questioning skills. At this stage I am the one using the technology but I am explaining the process as I go to the children. I think it is important that the questions have a speedy reply so the children's interest is maintained and they are clearly able to see the benefit of email over snail mail. It would also give us more of a sense of conversation.

(Zoe, Journal, May 2000)

Zoe identified "housekeeping types of questions" as a starting point for building a relationship with the Troll:

I decided to get the children to ask questions about what the Troll looked like and we could just start with those sorts of housekeeping questions first. I don't think we can go straight into philosophy type questions. We need to build up the character analysis so we build up the personality.

(Zoe, Interview, May 2000)

A response from the Troll provided the children with a text description of himself and the children then drew pictures and sent these to the Troll for comment.

Zoe noted that later questions asked by the Troll were important in shifting children's considerations from the mundane, "what footy team did the Troll barrack for?" to the moral. When the Troll asked the children whether or not he should have let the billy goats cross the bridge, the children were divided in opinion. Zoe split the class into two groups and brainstormed what the arguments were for the two cases. After she recorded the children's responses, the two groups of children had a debate. Zoe was thrilled to

see her children thinking critically and talking about their arguments and justifying them: "I really felt that this was a moment of where ICT had enhanced children's thinking skills" (Journal, May 28, 2000). Zoe reported that she had never seen a group of Prep and Year One children debate over an issue so deeply. A long semester break caused this project to end prematurely.

Project 9: Senior Citizens Project

This project was initiated by a colleague of two of the project teachers and involved online conversations between a Year 2 class and a senior citizens hostel. The teacher began by teaching her students how to "email a friend" in the school environment. Later she contacted the local senior citizens hostel and organized an email project to coincide with their unit of work, *Then and Now*. The children emailed their questions to residents at the hostel, and they responded with information related to their experiences. Two meetings were organized between the senior citizens and the children, with a BBQ held early in the project and a shared lunch at McDonalds held at the end.

Characteristics of Pedagogical Intentions

The educational intentions of the online projects were characterized by: i) strong technical or practical concerns in terms of organization and learning to use communications technology; ii) functional literacy concerns related to questioning and writing in a particular genre; iii) pedagogical concerns in terms of promoting intellectual quality, thinking, inquiry learning and ways of incorporating use of ICT into the curriculum; and iv) sociocultural concerns that raised issues about social practice, relationships and developing understandings about the world and the different world views of others. A critical view of technology and pedagogy sometimes filtered through these concerns as intentions were put into practice.

Burniske and Monke (2001) note that when teachers first attempt telecollaborative projects, they often 'achieve little more than 'telecomputing' if the project's design emphasizes information collection without demanding analysis or problem-solving' (p. 12). The educational intentions of the information exchange projects are best characterized as 'parallel' rather than joint inquiry. In the case of the Gold project, the inquiry was mostly one way, with only one request for information coming from the participating school. The projects that used a keypal and information exchange structure (Gold, Travel Brochure, Biography) could be more accurately characterized as

'telecooperation', where students cooperate to provide each other with requested information resources. Although the students were dependent upon each other to provide information, the factual nature of the requests did not really require co-construction of new understandings.

The Saudi Arabia exchange was more strongly predicated on conversation and relationship building. Thus the students in this project were not so much providing information resources for each other to create a particular information product, but developing their understandings of each other. The Senior Citizens project, although having a focus of information gathering, was also about community, connecting the young with seniors beyond the school and incorporating both real time and online conversation. Bigum (2001) believes that future thinking in relation to schools and ICT needs to shift from an information focus, which keeps schools in the role of information consumers, to a focus on relationships:

> *A technology can be understood in terms of the relationships they affect or mediate, the new relationships they support and the relationships they terminate or diminish. Thinking about the new information and communication technologies in schools in terms of relationships shifts the focus from the technology per se and problems of how best to integrate IT into the curriculum towards schools as social organizations, their relationships, particularly those with the local community, and other schools. In effect, the focus shifts from the question 'What on earth do we do with this new technology?' to 'Given that this new technology has contributed to significant change outside our school, what kinds of relationships should we now have with our local community? (p. 30)*

Bigum (2001) states that a local community will need a rich source of knowledge about itself in order to "read and act on the global influences that it encounters" (p. 30) and that schools could play an important role in producing, accumulating and disseminating such research-based information. The Senior Citizens project went part-way toward this goal. The challenge remained to find a way of broader dissemination in a form valued by the local community. The Transition project managed to address this wider dissemination in addition to building relationships and making a contribution to the local community. The content and structure of this information resource more strongly reflected student interests, compared to the earlier Travel Brochure and Biography

projects. Thus, although a similar structure was used, the purpose evolved to be more community based, relationship oriented and encompassing of student initiated concerns. Although the primary school interests were well served during this project (the students all faced transition the following year), it is less clear what the benefits for secondary students were in terms of their involvement, apart from developing technical and research skills. Thus, the interests and purposeful activity of all concerned, teachers and both sets of collaborators, need to be considered in the design of such projects if they are to be considered authentic (see Chapter 2). Curriculum interests also need to be balanced with human and personal interests.

The Electronic Impersonation project, although based in fantasy, relied on an interdependent relationship between the participants. The questions posed by the 'Troll' were the catalyst for the young children's thinking and also required the university students to engage in higher order thinking and analysis of the types of issues that could be addressed through the story. Responses to the young children also needed to be considerate of their age and conceptual development. The project therefore provided a mutually purposeful context for all collaborators to develop relevant skills.

Analysis of the intentions of the online projects points to several areas of future development. Teachers would benefit from having a way of talking about and discriminating between different types of online projects, so that they can move beyond familiar structures. Thus discriminating between telecomputing, telecommunication, telecooperation and telecollaboration, may be a useful planning consideration, particularly in terms of pedagogical benefits to students. Berenfield (1996) sees telecollaboration as one of the most "sophisticated" ways to use telecommunications technologies in the classroom as it "advances online cooperation to distributed problem-solving, collaborative design and cross-classroom, collaborative inquiry" (p. 78). He also stresses that telecollaboration must go beyond sharing of data. If teachers are aiming for telecollaboration, the framing of educational intentions, so that they include interdependent inquiry and problem solving in their design, is an area for future action. Burniske and Monke (2001), with their intention of telecollaboration, wanted to inspire their students to engage in dialectics, critical thinking, interrogation of information, assessment of the credibility of sources and, to ultimately, "stretch students minds" (p. 29).

Bernstein's (1975) theories in relation to 'visible' and 'invisible' pedagogies may also inform future directions. As teachers engaged in new practices with new technologies, their pedagogy was sometimes invisible not only to their students ("What do you want us to do Miss? Do you just want us to write?"), but to teachers themselves, ("Perhaps we puddled around a bit…I needed to have a purposeful idea of the structure, what kids needed to do." Donna, Interview, Nov 2001). Bernstein's concept of visible pedagogy requires the development of "(1) explicit hierarchy; (2) explicit sequencing rules; and (3) explicit and specific criteria" (Bernstein, 1975, p. 119) and adherence to the rule that "things must be kept apart" (p. 120). This, however, contradicts teachers' goals of integrating curriculum and moving to more purposeful action with students. Invisible pedagogy, with implicit hierarchy, sequencing rules and criteria, has the underlying rule "things must be put together" (p. 120). Teachers online projects for students favoured invisible pedagogy and integration, but continually strived to make aspects of the projects more explicit. When teachers introduced online projects into their classrooms, they also became 'novices' again, needing time to internalize telecollaborative concepts before they could externalize them for students (Burniske & Monke, 2001). Thus the desire to make aspects of projects more explicit may have been partially motivated by the need to address the dissonance created by the shift from expert to novice and to regain confidence through the articulation of particular pedagogical strategies.

Bernstein (1975) sees the locus of social control in invisible pedagogy as being "vested in the process of interpersonal communication" (p. 135) and suggests that as the outcomes of socialization are less certain, ambiguities are created. Although the move to invisible pedagogy is likely to create greater ambiguity, such a move also has the potential to make visible "fundamental social contradictions" and, when the implicit is made explicit, such ambiguity has "less disguise" (p. 146). The next section addresses teachers' struggle and desire to make the implicit more explicit as they wrestled with the technical, organizational, pedagogical and sociocultural dimensions of their practice.

Technical, Operational and Organizational Concerns

Teachers' analysis of their experience with online projects focused strongly on technical concerns, operational literacy considerations, practical organizational concerns and sociocultural issues. Teachers discovered that if these issues were not addressed, projects would end up being stymied. Teacher theorizing about these issues was used to

inform recommendations for the future, both for themselves, in terms of attempting another project, and for other colleagues.

Technical

Teachers identified a number of basic technical concerns that needed to be addressed in the course of successfully conducting an online project. They recommended an initial assessment of technical needs and ensuring everything was in place prior to introducing the project idea to students. Significant frustration developed due to the inadequacy of local infrastructure and personnel to support projects:

> *This week has also seen lots of ongoing problems with the network and this has made working on the computers very frustrating. The fact of the matter is that of the five computers in my classroom, only two work on the Internet but don't work on the network; one works on the network but not on the Internet; and the other two are Macintoshes. This has made responding to the UK input very difficult and we have had to work extra sessions in the lab to try and keep things moving...I don't feel I have been supported in this area and I've had to run around like a headless chook as a result.*
>
> *(Bart, Journal, Week 7, Term 2, 2000)*

Inequitable access to technology, both hardware and software, proved to be problematic in several projects, with collaborating schools being constricted by lack of machines in their rooms or inability to obtain lab access due to tight timetabling structures. Unstable networks and unresolved problems with the State's school email system were also sources of frustration to teachers.

Operational and functional literacy

Learning to use technology

Teachers needed to prepare their students (and sometimes themselves) to use and manage email. They were often learning technical skills associated with email along with their students and were delighted when they successfully worked out new ways of using technology, often through their own problem solving. This increased their confidence in taking the lead in teaching technical skills to their students:

> *I felt very clever when I wanted to create folders for each child to keep his or her mail in (both incoming and outgoing). I asked Bart and Bill if they knew how*

to do it and they didn't. I knew how to do it on the email program I used at home but Dingomail wasn't very user friendly. I experimented with the different things on the screen and was rapt when I taught myself how to actually create individual folders for all students and how to store emails in the different folders. I then proceeded to teach all my students and I was thrilled when they were able to store their own mail directly into their own folders…I don't think I would ask Bill (computer teacher) to teach my students any new skills on the computer because I really needed to know what the kids understood and what they didn't in relation to emails.

(Gerry, Journal Week 9, Term 3, 2000)

A range of technical skills were directly taught (sending and checking email, setting up an address book, saving mail, sending attachments etc). Acceptable use policies and protocols for sending keypal messages on a class email address were also developed with students.

Several teachers began their projects by finding out what students already knew about technology, generally by asking students to draw pictures to represent their understandings. They noticed considerable variations in understandings and attitudes, ranging from "the person who invented the Internet types it all in" (Prep child), to "airy-fairy ideas of mail floating in space and connecting to computers somehow" (Maryann, reporting on Year 6 students), to intricate and detailed information on emailing systems. This starting point for their projects proved to be extremely valuable to teachers:

I definitely had preconceived ideas about what the children know about emailing. In particular, one student that I thought had a very good, sound understanding of emailing, expressed her concern that she didn't know much at all. She told me that she has to ask someone to help her every time she composes and sends an email. Why she chose to hide this fact is extremely interesting. Student (H): "I didn't want to ask you because you said to email our buddies and I thought that I was supposed to know."

I assumed that she knew because she is so competent in other areas in relation to ICT such as Internet and publishing that I just took it for granted that she knew how to email as well. It is also interesting to think that she wouldn't ask for help as she didn't see that emailing was a learnt skill. If it were a straight

out Maths task, such as 3D shapes or the like and (H) didn't understand she would have no hesitation in asking for my help. I have created a classroom where students are very comfortable in asking questions and taking a risk yet, all of a sudden, this has changed. This puzzles me.

(Maryann, Journal, May 2000)

Thus learning about what students thought and felt about the medium was just as important as learning how to use it, and laid the foundations for the development of a critical view of the technology:

I think a lot of the time the kids are shown the skill of how to email or get on the Internet but no one's ever talked to them about well, 'What do you write on an email? Is it the same as a letter? If you type in all capitals, it means you're yelling? Does anyone know that?'

(Maryann, Interview, May 2000)

All teachers reported that the learning of technical skills involved some direct instruction from teachers, but more often than not involved peers assisting each other and sometimes students teaching teachers. Teachers felt strongly that students had a legitimate role in the classroom as teachers of technical skills and that it was important that they enabled this to occur. One teacher stated:

More and more I see that we as teachers need to change the way we learn…teachers and students sharing the knowledge and skills. This way of thinking and teaching is the only way that the ever-increasing computer skills can possibly be addressed in the classroom.

(Maryann, Journal, July 2000)

Student evaluations indicated that they were enthusiastic about the opportunities afforded by the online collaborative projects, but critical of the logistical problems.

Learning to use language and manage information

Teachers found they had to invest significant time in clarifying the task for students and structuring the planning process for them. Several teachers introduced planners and graphical organizers to assist students with this task.

All teachers engaged in direct teaching of questioning skills, teaching students the difference between open and closed questions. Students were encouraged to construct open questions (who, what, where, when, why, how) for their telecollaborators. Questions were usually developed under a series of sub-headings that guided information collection and reconstruction.

Students were required to develop information management and organizational skills, which teachers found improved in the course of their projects, but was a struggle to begin with:

> *I found that the thing that really got me was that the software wasn't reliable and the organizational skills required of the kids to keep track of a constant flow of information is really enormous.*
>
> *(Bart, Dialogue with Gerry, Nov 2000)*

Information products that resulted from the keypal exchanges all required students to develop familiarity with a particular genre. This required cultural as well as functional literacy. For example, at the end of the Travel Brochure exchange, when questioned by colleagues during an ANSN protocol[3], Bart realized that his students had no previous experience with travel brochures. Teachers therefore recommended modelling and immersion in the types of information/communication products that were to be shared in online projects.

Thus, the key operational literacy concerns were i) technological literacy in relation to using email; ii) developing the ability to question effectively; iii) information management; iv) reconstructing information in a particular genre; and v) quality work.

Organizational and practical concerns: "It's a lot of hard work!"

Teachers identified a need for more explicit planning in relation to online projects, stressing that this needed to occur well in advance of the project launch and involve articulation of project goals, structures and guidelines for both participating teachers and students. These needed to be clarified recursively during the project in order to shore up joint understandings and commitment.

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[3] See Appendix 5: Consultancy Protocol

As well as common goals and a clear purpose, teachers also stressed the need to negotiate the following: i) timelines (long lead in or preparation time, short timeframe for formal information exchanges); ii) sharing mechanisms and frequency of communication; iii) project structures and processes to support student learning; iv) clear criteria in relation to quality and intellectual rigor of the project output and expectations of students; and v) technical requirements.

For the above recommendations to be facilitated effectively, teachers highlighted the importance of taking time to establish rapport and communication at the start of any project, both between collaborating teachers and student keypals. Primary Middle Years teachers all advocated matching students by ability, while secondary teachers recommended matching by interests. Early Years teachers did not match individuals but communicated as a group.

Organizationally, teachers also needed to make a decision whether to use a class email address or individual addresses. Teachers found that the use of a class email address had the advantage of making it easier to track what mail was being sent and received but required students to use more complex protocols in terms of how they addressed and saved mail. Students sometimes struggled with this aspect of information management and messages became mixed up, lost or confused. When students used individual email addresses, teachers reported a "loss of control" in that they no longer knew what information or communication was being exchanged. This made it harder to know how to intervene. Students with access to individual email addresses found it easier to establish and maintain communication, however, often using email from home as well as school.

Secondary teachers recommended setting clearer boundaries for students in relation to developing an online "curriculum relationship" in contrast to a personal relationship, particularly when individual email addresses were being used.

A major organizational challenge for secondary teachers was ensuring that there was curriculum congruence between the participating schools. They recommended this as necessary to enable formal collaboration and improve the integrity of information exchanged.

Information management was problematic for teachers. Information often arrived in "flood or famine" fashion, with some students getting regular responses and others very little. Teachers were concerned that students would lose motivation and enthusiasm, so went to great lengths to find out what was happening to expected mail:

> *It was frustrating to find just how little information has been sent from the other school and while some pairs are working really well, many have received nothing at all...On Monday morning I decided to do an audit of where each of the kids were in terms of their correspondence. We went into the lab and spent time doing some folder organization and checking incoming and outgoing information so far. I was frustrated to find that while a small number of the kids have received regular correspondence, the vast majority have received nothing to very little. I spent the next two hours going to each and every child and marking down where they were at (ie. Email sent/received). My lunchtime was spent speaking with Karen about the problems and typing this up to send to her...(A week later) The project is becoming more frustrating by the day. I've now completed 3 detailed audits of where my kids are at and with all the communication between Karen and myself we still can't seem to match the results of these. For all the emails I know my kids have sent (re-checked them all personally which took bloody ages!) for some inexplicable reason they don't seem to have arrived!*
>
> *(Bart, Journal, Week 4, 5 & 6 Term 4, 2000)*

At one stage when the school network went down, this teacher spent hours retyping messages his students had written by hand and sending them from home. Teachers spent a huge amount of time sorting, tracking, auditing and maintaining the flow of information.

Time, whether lack of, or activities taking longer than expected, was a source of tension for teachers. When teachers provided students with looser structures that allowed more opportunities to work in collaborative ways and address some of their own interests, they noted that more time was required for students to achieve. In the tight structures of the secondary school this was particularly problematic, with teachers sometimes making a choice to engage in direct instruction because it was the most efficient way to cover a topic in the allocated time. Invisible pedagogy, which secondary teachers were

attempting to shift to, requires more time to implement, particularly to shore up the social and interpersonal relationships upon which it is reliant.

The huge increase in workload and effort on the part of the teachers helps to inform Abi-Raad's (1997) question in relation to the impact of telecommunications on the role of the teacher. Without a significant increase in effort and commitment, the practicalities of maintaining the communication link are unlikely to be sustained. This is consistent with Bruce and Levin's (2001) review of studies on the impact of new technologies. They note that some studies confound the effects of new technologies with issues of pedagogical approach or teacher enthusiasm. Data from this study support the latter view.

Pedagogical Dimensions of Practice

Online projects in this study were largely motivated by a desire to use the technology, Department of Education advocacy to integrate ICT into the school curriculum and the opportunity to learn to use email in the context of purposeful action. Teachers also saw online projects as a way of reaching out beyond the four walls of the school, connecting with others and finding out about the world through a different medium, that of conversing with peers and community members.

Some projects, such as the Travel Brochure project, were most strongly characterized by existing teacher and curriculum interests, with a pre-determined structure that prescribed what students should obtain information about. This structure was 'visible' in that separate factual categories such as geographical location, historical background, population/culture, and transport formed a framework to guide student inquiry and questioning. Similarly, the Gold project was also initiated as a result of strong teacher and curriculum interests but, in the process of "losing control", when students began using private email, took on a range of student interests. Student interests were more strongly represented in projects such as the City, Transition, Saudi Arabia, Senior Citizens and Electronic Impersonations projects. This increase in the representation of student interests may be viewed as a repositioning of power and identity, made possible when 'boundaries' become more fluid (Diaz, 2001):

> *Power is inseparable from physical and symbolic boundaries of experience,*
> *meanings, and the contexts of interaction in which realisations of meanings take*
> *place…Boundaries are the critical point for definitions of knowledge and*

practice, as well as for the subject. The more the boundaries, the more the distribution of unequal spaces and the more the distribution of inequalities between positions, discourses, and practices. (p. 84-85)

The City Project most strongly illustrates the impact of shifting boundaries, both physical and psychological. The physical relocation of the learning space impacted the pedagogical relationship in the new environment. Away from preconceived notions of the teaching and learning relationship, student perceptions of their teachers and their role changed:

> *Even though I didn't think I did things differently—I still have the same attitude to integrated curriculum as then and try these techniques in my normal classroom—it was much more obvious to kids that it was authentic, that it was real learning with them. It was also more obvious there what we were doing with the kids. That I was working with them, that I was a facilitator. The kids understood that better. Even though I'm a facilitator in the classroom, they still see me in the teacher role, but there I wasn't. I think moving away, them doing their own thing, having a bit of freedom, they really thought she does mean that we're working as a team. That week I was their main contact and the most important person to them and they enjoyed that.*
>
> *(Interview, Donna, Nov 2001)*

When Donna resumed her teaching back in the school environment, she noted that the above situation "didn't last that long" because there wasn't the same "continuity", with contact reduced to three 48 minute periods per week. She noted that restricted contact equated with restricted opportunities for relationship building, which in turn affected how students saw her.

This return to the existing physical and psychological boundaries of the secondary school highlights a significant issue that can be informed by Bernstein's theorizing about pedagogy (Bernstein, 1971; Bernstein, 1975; Bernstein, 1990; Bernstein, 1996; Bernstein, 1999; Bernstein, 2001a; Bernstein, 2001b). Secondary schools have traditionally been characterized by visible pedagogy, with clear differentiation between curriculum areas (classification) and a prescribed "modality of socialization" (framing) (Bernstein, 1975, p. 143-144). The secondary school teachers in this project were in the process of moving to a more integrated curriculum (invisible pedagogy) that

'weakened' these classifications and framing. When the physical and psychological boundaries were changed to allow for the construction of new relationships and freedom, the invisible pedagogy associated with the City Project was deemed successful by teachers and students. However, when the teachers tried to continue practices that were more oriented to invisible pedagogy back in their schools, they viewed their efforts as less successful. The constrictions of time, space and, more importantly, how teachers were viewed by students, worked against their enactment of invisible pedagogy. Secondary school structures are, in the main, designed to maintain visible pedagogy.

Bernstein's (1975; 1990; 1996) theoretical construct of 'code', or the organizing principle that generates a variety of pedagogic structures, can be used to inform the above example. The form of the code or its "modality" contains "principles for distinguishing between contexts (recognition rules) *and* for the creation and production of specialized communication within contexts (realization rules)" (Daniels, 2001, p. 108). Daniels points out that schooling "constitutes a form of collective social activity with specific forms of interpersonal communication" (p. 101) which can vary in content, structure, and the function of interpersonal communication both within and between schools. Applying the concept of code and modality to the City Project experience provides a way of seeing connections between school modality (discursive, organizational, and interactional practice) and students' "recognition and realization rules" (Daniels, 2001, p. 109). Students also appeared to reconstruct their identity differently in the two physical locations associated with the City Project. Diaz (2001), in his analysis of Bernstein's work, explains this further:

> *The external symbolic order is to individuals the means for production within them of internal cultural and social structures. At the same time, this internal order is the means, perhaps the regulative principle, for constituting the principle of identity. (p. 85)*

Daniels (2001) interrelates theories stemming from Vygotsky's (1978) activity theory of the social formation of mind to Bernstein's (1975) theories of cultural transmission, and in particular suggests investigation of the connections between "the rules children use to make sense of their pedagogic world and the modality of that world" (p. 109). Although beyond the scope of this research, the City Project outcomes suggest that students clearly make different sense of their pedagogic world when the modality is changed. A

further example of this was in the keypal projects where perceptions of students and their roles in the learning process changed. Keypals became legitimate providers of information or 'knowers', which was a pedagogical shift for most classes.

Teachers identified a number of specific structural changes in relation to their pedagogy and the online projects. Several primary teachers reported a "relaxing" of structure, allowing students to work at lunchtimes and continue past prescribed time allocations. This is what Bernstein (1975) calls a move to 'weaker framing' where clear cut and separate boundaries no longer exist. One teacher noted that, as he relaxed structures with students, he conversely increased structure in relation to planning and organizing with his collaborating teacher. This trend, where teachers become more explicit, accompanied shifts to more invisible modes of pedagogy. The role of the teacher, their intervention with students in the learning process and the structures within which learning was to take place, were all aspects of practice that needed to be communicated more explicitly as a part of this shift.

Authenticity and aspects of productive pedagogies were raised as issues by teachers in connection with their projects. The City project was viewed by teachers and students as particularly successful in this regard. Students were given greater control in the learning process and expected to manage their time to a greater degree than normal. The move to "a really lovely environment" in the city was also viewed as important and teachers noted that students "felt they were special and important… it made a difference in terms of how kids felt about their own learning". Student use of ICT was connected more strongly to student purpose in this project and was also a vehicle for connecting and communicating with an authentic audience. ICT, in the form of phone, fax and email, linked students to outside community members. Not only did students use these technologies to contact their organizations, but they also received feedback about their performance as many organizations emailed, rang or faxed the school to comment on "how fantastic the kids were and what a credit they were to the school". Teachers reported that students "really got on a high" when this communication was passed on to them.

Online projects necessarily involved students working with others, either in partnerships or groups, a characteristic of authentic learning (Kruger et al., 2001). Such partnerships and reliance on others also proved problematic to students, particularly when

collaborators did not make agreed contributions, and when some group members were so dominant that others suffered in the degree of understanding they developed. Commitment, shared responsibility and distributed leadership were identified as necessary if groups and partnerships were to effectively facilitate the learning process.

Degrees of social support (student control and support, explicit criteria, engagement and self-regulation) and relevance for students (Luke et al., 2000) varied in the different online projects. Engagement generally remained high, and teachers attributed this to students' high motivation to use the technology. Students sometimes struggled with self-regulation as they were given greater control and opportunities for decision making in the learning process. Donna discussed this in the context of the City project:

> *They had lots of free time because they didn't realize the amount of work they had to do and they didn't really grasp the full extent of analysing material...they got a little bit bored at times. I was a bit disappointed that they didn't make the most of the opportunity...I don't think kids really know how. They really couldn't see the depth of their topic. Some of the projects were a bit superficial because they're really not mature enough to grasp the fullness of them. I'm not sure how you go about teaching something like that.*
>
> *(Donna, Interview, Nov 2001)*

All teachers struggled with how to increase intellectual quality and depth in student work and they were not always sure how to scaffold student learning in order to achieve such work. The quality of the actual information provided during keypal exchange projects was often perceived as low by teachers and students. Sometimes this was simply because not enough information was communicated. The effort required by students to communicate in text as opposed to voice may be a consideration in this instance.

These projects also used a structure where the person who knew least about the topic was responsible for creating the information product. The audience, although authentic in terms of being beyond the school (Newmann & Associates, 1997) was actually more expert in the subject matter than the authors. This raises questions about authenticity of purpose and how valuable and relevant the final information product was for the target audience. This dilemma was overcome in the Transition project, where the target audience was not the collaborators but new students, who would start high school the

following year, and their parents. The Transition project was also high in relevance to students and based on a very real experience they would have to face in the near future. The Senior Citizens and Saudi Arabia projects, which did not require an information product to be exchanged with the collaborators, also avoided the problem of authentic audience as their intention was more strongly connected to relationship building. The City project contributed to community building by bringing parents into the school as an audience for project presentations.

The Electronic Impersonation project stood out as being strong in facilitating activity characterized by high intellectual quality (Luke et al., 2000). In particular, this teacher noted that her students engaged in higher order thinking (critical analysis and justification), the project provided opportunities for substantive conversation and also encouraged her students to view knowledge as problematic. This project was structured very differently to the keypal information exchanges, with more expert collaborators communicating with the students and the teacher playing a much more explicit role in mediating the communication. She stayed firmly in control of the learning process itself, while still allowing for student interests to provide some direction to the task. This contrasts with keypal project structures where teachers either felt they "lost control" or had to go to enormous lengths to maintain their awareness of student learning and activity. The teacher's role in the learning process can be connected to the degree of intellectual quality achieved or experienced by students.

The online projects were successful in helping students develop their understanding of human difference (and similarities) as 'cultural knowledges and narratives' were shared (Luke et al., 2000). The concept of group identity was particularly poignant in the Biography project, when students from the multicultural community met those in the rural, predominantly Caucasian community:

> *Can I bring something up here which I though was really strange—my kids said, "Aren't there any other kids here?" when we went to Maryann's school because they were all Anglo Saxon looking and ours are very high Vietnamese and multicultural. So the kids found it very different because they thought culture was a big part of the biography for them whereas I don't think for Maryann's kids it was—we were looking at a cultural exchange and my kids could give lots of information on their culture but they weren't getting much back.*

The online projects that connected students with collaborators who were "different" in some way to themselves caused students to confront their own identity and culture and the degrees to which identity and culture were connected in ways that were visible. Projects such as Gold, Saudi Arabia and Biographies also encouraged students to confront their beliefs, understandings and preconceptions of others.

Understanding the nature of invisible pedagogy (Bernstein, 1975) and developing a 'strong vocabulary and shared theoretical frame' (Luke & Freebody, 2000) present as possible ways forward in the development of pedagogy and understanding in relation to online projects. The need to be more explicit, in terms of teaching strategies, ways of scaffolding learning for intellectual depth, balancing student control and teacher support, and the visibility of the role of the teacher, are strongly indicated as areas for future action.

Sociocultural Dimensions of Practice

As humans use the resources of language (mediated by various 'technologies' such as writing (Lankshear et al., 1997), they engage in social practices which are parts of larger social activities. Such practices are "learned socially, function socially, and are socially meaningful" (Lemke, 1988, p. 82). Sociocultural practice, in relation to online projects, is still a relatively new area for teachers in schools. Theory and practice for such innovations gradually became more explicit and teachers increased in confidence as they learnt from their experiences and made recommendations in relation to future practice. Issues arising from the use of technology-mediated communication are discussed then extended to consider the following sociocultural dimensions of practice:

- Forms of communication
- Commitment and relationship building
- Reciprocity

Forms of communication

Teachers engaged in technologically mediated synchronous and asynchronous communication during the course of their online projects and, where possible, face-to-face communication as well. First, asynchronous communication via email was greeted

with great excitement by teachers and students alike, and relief that initial efforts to establish contact had finally paid off:

> *After much disappointment and frustration at trying to get it off the ground, I'm 'over the moon' with the fact that my kids have all written an email to introduce themselves to their English counterparts. That coupled with them sending their images over as attachments means that they're really excited, not to mention me!*
>
> *(Bart Journal, Week 3, Term 2, 2000)*

> *Finally getting the students communicating with the other school through email was wonderful to see. The kids were so enthusiastic and eager to read and then answer any mail they received. They wanted to learn as much as they could and get on the computer as often as possible.*
>
> *(Gerry, Journal, Week 9, Term 2, 2000)*

Communication between project participants was characterized more by breakdowns, delays and lack of response, however, than ongoing excitement. The teachers who initiated online projects were frequently frustrated by the organizational difficulties created when their collaborating teacher did not respond quickly. They resorted to synchronous communication, phoning the other school or contacting their colleague at home. Sometimes the synchronous communication revealed that ICT was part of the communication problem, with emails seemingly becoming "lost". Synchronous communication often sorted out misunderstandings and increased understanding of the difficulties faced by collaborating teachers. This helped to restore the commitment and enthusiasm to keep going with the projects:

> *Even though I have said that Maryann and I needed to organize a meeting, I hadn't done anything about it because I had found it difficult to make contact with her. She's not getting my emails or the messages I've left with the office at her school. It was great to have Thursday to talk to Maryann and to work out what was working or not working with the email communication between our schools. When I told her about the two students not receiving mail she was stunned. She then showed me copies of emails that had been sent to the two students. So we both agreed that there was some sort of problem at her end and she would get her technician to check it…Having the chance to talk to Maryann*

twice in two weeks (face-to-face) has ensured that all students are getting mail now and finally we are all set up properly.

(Gerry, Journal, Week 4, Term 3, 2000)

Sometimes even synchronous communication was not enough to get a project back on track and functioning smoothly. When asynchronous email and fax contact was found wanting, primary teachers concluded that face-to-face communication was necessary to properly plan and organize an online project, with synchronous phone conversations a minimal requirement for success. Secondary teachers relied on asynchronous communication, despite its limitations:

We only used email. I just kept on emailing. I didn't ring up at all. I tried ringing Mary, it took 3 times and it didn't work—it's too hard to catch people. So I just stuck to email. Even that wasn't very successful.

(Liz, Interview, Nov 2001)

Dede (1998) issues a word of caution about computer-mediated communication which also reflects the primary teachers' concerns:

Reflective discussion of shared experiences from multiple perspectives is essential in learners converting information into knowledge, as well as in students mastering the collaborative creation of meaning and purpose. Some of these interpretive and expressive activities are enhanced by educational devices, but many are best conducted via face-to-face interaction, without the intervening filter and mask of computer-mediated communication. (p. 203)

Although Dede (1998) refers to the context of student learning, his comments are also relevant in the context of teacher planning and organization for a telecollaborative project. This process required collaborative creation of meaning and shared purpose and, because such projects were a first time innovation in their practice, necessitated reflective discussion of shared experience. Primary teachers found that such planning and reflection was more easily mediated by face-to-face or verbal discussion and, at the same time, enabled rapport, shared understandings and commitment to be better established. Face-to-face communication also reduced the likelihood of jumping to incorrect conclusions or judgments as to what was happening at the other end of the online connection. Although technology can accelerate the pace at which we exchange

information, it does not necessarily improve communication and can in fact "help us miscommunicate more rapidly" (Burniske & Monke, 2001, p. 48). Thus the act of communicating needs to be considered in the context of human and social relationships, which involve conversation, commitment and reciprocal involvement.

Commitment and relationship building

Green (2002) notes that "all changes in communication patterns have complex social and cultural ramifications, and eventuate from complex social and technological forces" (p. xxvii). When teachers began communicating asynchronously through email and fax, they were not only faced with delayed responses (compared to real time communication), but they had to read such responses without the interpersonal clues that accompany face-to-face communication. This impacted how teachers viewed their collaborating teachers (how committed they were, how much initiative they were demonstrating, how reliable, how responsible) and in turn impacted the relationships between the teachers. One existing friendship was put under significant strain due to the attempt to conduct an online project together, particularly over delayed or non-existent replies to both teacher and student emails:

> *I'm quite angry with Dave and feel that perhaps our friendship allowed for too much informality. I wonder whether this is in part my fault because I wanted to do this with someone I knew on a friendship basis? Was this inappropriate for the project? Part of me really hopes that he's feeling guilty for committing in the first place, or was it me pushing too hard?*
>
> *(Bart, Journal, Week 1, Term 3, 2000)*

At one point Bart sent an email exclaiming "This project has been a real yoyo…my kids are going to kill you if they ever meet you Dave!" (Bart, Journal, Week 3, Term 3, 2000). Other teachers reported similar frustrations in relation to lack of response or delayed responses, but managed to maintain their relationship through occasional face-to-face contact. Watson (1997) notes that without ongoing communication, a community (or in this case an online relationship) will dissolve.

Initiating teachers expended enormous effort, enthusiasm, drive and commitment in facilitating their online projects. To their disappointment, they found that collaborating teachers rarely demonstrated the same levels of commitment, often being content to let

the initiating teacher lead. The concept of 'consumption motivation' (Green, 2002) may help to explain why some collaborating teachers were unable to match the effort and commitment of initiating teachers. Green warns that:

> *The consumption of a new technology, over and above its purchase, creates pressures upon time and skills. Sometimes these pressures become too great to be overcome by the original 'consumption motivation'. (p. 26)*

Teachers strong desire to 'have a go' at using the new technologies was certainly part of their motivation for engaging in online projects. However, data clearly indicate that their continued commitment was due to more than consumption motivation. Teachers in the project identified their own enthusiasm as important for the success of the projects, in terms of keeping students motivated and willing to continue despite constant disappointments when mail did not arrive and technical setbacks occurred. Although teachers expressed frustration about the online projects in their journals, they made a point of remaining positive in the classrooms. Thus, part of their drive and motivation can be linked to their pedagogical relationship with their students.

Hargreaves (1994) points out that teachers' work is subject to "intensification", which has resulted in "pressure, stress, lack of time to relax and lack of time to even talk to colleagues" (p. 136). Each of these possible interpretations was found to be relevant (access and commitment/drive to participate/work intensification):

> *Peter didn't have the same access to technology. In fact for those first six months, he couldn't even get his students into the computer room for one period per week. So then what do I do? He was the designated teacher but he couldn't give access to the kids. I was insisting on an online project not snail mail— someone said at one stage "have you ever heard of letters" so he sent photos by letter — he said we can't take digital images, we just can't do that. So there was that kind of communication. He got a bit better later on. I think he was a just busy person.*
>
> *(Liz, Interview, Nov 2001)*

> *My project partner and I tried to start off the emailing and I found that I was always forgetting or running out of time and therefore the students weren't getting enough time to put their best effort into the email.*

Burniske and Monke (2001) suggest that the "personal desires of participants" (p. 123) is one of the most important determinants for establishing effective communication within telecollaborative activities. In the case of the online projects, all had initiating teachers who were able to find collaborators responsive to their ideas. This immediately raised the likelihood of a difference in motivation, with initiating teachers having more investment in their project. Green notes that people invest differently in communities at different times and that:

> *Since membership of a community is likely to involve a significant individual relationship as well, a psychoemotional 'span of control' limits the number of communities to which people can realistically belong. As one community or conversation grows in relevance to an individual's life, so another becomes less important; and as one commitment becomes less important, so a space is opened for an involvement elsewhere. (p. 229)*

This may help to explain the differences in commitment/contribution that were noted by the project teachers. If, as Green suggests, the concept of community derives from things that are held in common or shared interests, differences in the degrees to which those interests are shared are likely to impact degrees of participation or engagement in telecollaboration. This might account for differences in both teacher and student investment in the online projects.

Project teachers reflected to a significant degree on the nature of interpersonal relationships during telecollaborative projects. Several teachers noted that their students found it difficult to compose messages to people they did not know:

> *It was a very interesting process watching the children introduce themselves to an unknown entity. On a couple of occasions I had to re-direct the kids who tried to include a few 'private jokes' in their emails. It was an indication that some of the children were unable to grasp the concept of their audience being a foreign group, sight unseen! I also had to encourage many groups to 'relax' and write about things that people their age might be interested in, rather than write something that I might mark in their books.*

(Bart, Journal, Week 3, Term 2, 2000)

We still haven't established the email buddies yet. While the students were still given a particular area to focus on when thinking of open-ended questions, I think that not knowing who they were writing to seemed to make it a meaningless task.

(Gerry, Journal, Week 7, Term 2, 2000)

Teachers stressed the importance of "keeping in touch", sometimes sending emails that did not have a curriculum or organizational focus:

Mary and I talked quite a lot on the email—she's the Vice Principal and I think she's in her office a lot more. We didn't communicate a lot of meaningful stuff but we were constantly in contact. At least we kept in touch and involved.

(Donna, Interview, Nov 2001)

Telecollaboration, in Burniske and Monke's view, is not about computers but "about people learning how to read each other" (2001, p. 48). However, electronic mail not only filters out personal, social and behavioral cues which are normally used to maintain interpersonal relationships and regulate interaction (Markus, 1996), it also operates outside the taken-for-granted conventions of regular face-to-face discussion. One teacher noted that her students saw sending email as connection between computers rather than communication between people:

*Through their drawing and writing, I found that many of the students expressed email as being from one **computer** to another **computer**. This reaffirms my thoughts that students see email as something very impersonal.*

This was also backed up by what the students wrote about email. Many thought that emailing was a "lazy" way to communicate and that you should "say what you want to say to their face, or on the phone." I noticed in past emails that we had sent each other during our integrated units, there was a distinct lack of correct spelling, grammar and punctuation. So what? Well these errors related very much to their thoughts on email.

"Do you need to use capital letters?" asked K.

"Why wouldn't you?" I asked.

"I don't know, because you're not really writing to anyone," was the response.

Who do they think they are emailing to? Do they realise that there is someone on the receiving end? If asked to write the same information and send it to my home

address rather than email it to me, I can assure you that these particular
students would have written out a rough copy, edited their text and published it
with a lot more care than they did for emailing. There is a quickness about them
when using email. They are desperate to hit the 'send' button!

<p align="right">*(Maryann, Journal, May 2000)*</p>

The students' responses in this example point to a problem that has previously been associated with technology mediated communications and the importance of people distinguishing between "looking at" the media and "looking through" the medium to the human beings at the other end (Bolter, 1991; Burniske & Monke, 2001; Lanham, 1993). The teacher's response also reflects a trend to initially apply past text experienced to the new text environment. Students were questioning the need for traditional conventions in the new text environment, and most likely had experience with text messages that collapse spelling and don't include punctuation and grammatical conventions. A critical view was necessary here, that explored how the technology was actually shaping literacy practices.

Electronic mail, while capable of collapsing physical distance and speeding up communication, can at the same time expand "cognitive space" (Burniske & Monke, 2001) and the interpersonal or emotional distance between communicators. One teacher researcher captured this sentiment calling email a distant and impersonal form of communication:

Email is such a far distance…it's not personal I think. Like if someone sits down
and takes the time to handwrite a letter you sort of feel a bit guilty if you haven't
answered it. Whereas you open up your email and go, 'Oh, 25 emails, I can't be
bothered, I'll read it later'. And then you do. … You don't know whether it's
gone or not, you don't know if the person's read it or not. And half the time you
think—gee, just pick up the phone!! Sometimes you forget that even though
emailing and online communication is really quick and easy and great fun,
there's still other really quick really easy ways as well. And I think people have
forgotten about that. I think there are times for email and there's time for giving
someone a phone call. Or a friend in hospital, send them a nice card or
handwrite a letter rather than send them one of those email-o-gram things.

<p align="right">*(Maryann, Interview, May 2000)*</p>

Teachers in all Middle Years projects reported that inappropriate and/or upsetting messages were sent between email buddies at least once during each project, indicating that students constructed a different sense of social responsibility towards their buddies. Teachers theorized about possible causes of this:

> *I also wonder how I can develop empathy and etiquette in the students when dealing with online communication. I want the students to develop an awareness of what they are doing with technologies, how it affects their life, the interaction within their social relationships… that someone at the other end is going to read this… They just go off and email people and say whatever they want to say and they're not thinking about the consequences of how that other person's going to react… If you think about it, when you send an email, there's no consequences. They don't know if the other person got it and they don't care until they open their own email box. Whereas if you send a letter to someone, someone might come to the house and you show them. All that sort of thing. And you've signed it. Whereas computers, it's very impersonal. So I don't think they think about consequences—that's my impression.*
>
> *(Maryann, Interview, May 2000)*

The teacher researchers in this project were alert to shifts in the nature of the communication, interaction and feelings of connectedness that occurred when their students used email. They noticed that the sharing of digital photos of keypals impacted student reactions to their keypal, and all Middle Years teachers decided that it had been a mistake to exchange such images. Students tended to make snap judgments about their partners based solely on appearance and were at times derogatory. Green (2002) notes that "the screen at the edge of cyberspace…also screens the individual from the contents of cyberspace, and from its other users" (p. xxxii). This characteristic of the technology to mediate anonymous communication was perceived by teachers to have advantages, in that it could be used to mediate a conversation and relationship minus the 'baggage' of preconceptions that students often bring to a relationship. It also had disadvantages in terms of how close and 'real' a relationship actually developed between keypals.

Burniske and Monke (2001) talk about this issue as "the benefits of blindness" during email communication but at the same time raise some serious questions about student learning and relationships which rely on an "amputation of human senses" (p. 142-143).

Although some authors celebrate the social egalitarianism made possible through online communication, which hides characteristics such as race, age, status, location, income and disability (Smith & Taylor, 1995), Burniske and Monke challenge the human benefits of such neutrality, which simply prevents people from seeing or hearing each other. Instead they ask if such practices are actually suppressing bigotry and whether an 'out-of-sight-out-of-mind' approach to teaching tolerance and acceptance of others can genuinely foster tolerance in real, face-to-face relationships.

Secondary teachers noticed that, when they included a physical meeting as part of their online projects, it was difficult for students. The nature of technology mediated relationships did not necessarily better prepare students for real life interaction and relating:

> *It's different for adults. Kids don't tend to write to others. I don't think kids have that skill in keeping up contact. They all use these MSN messages to talk to people but make no meaningful contact. I think that's a real skill that kids need to develop, keeping up relationships...But despite the fact that they'd emailed back and forth, it didn't really break the ice when we arrived at the other school on Tuesday, despite the fact that most of the communications were personal. They were still that shy...you can't just have an online relationship, it doesn't work. You need more for it to be meaningful, that's for sure. We have to set it up, so that the physical contact happens early, that's what it is.*
>
> *(Liz and Donna, Interview, Nov 2001)*

Normally, students did not meet the people they communicated with via email, "they just have these fleeting contacts with people on email", and teachers theorized that, because of this, they were not interested in relationship building with collaborating students in the online project. The physical meeting appeared to "take them out of their comfort zone…we were requiring something else because you actually had to make contact with these people…we were asking them to take the next step". Thus the nature of the more 'neutralized' online relationship did not really prepare students for confronting individuals in all their diversity. A physical meeting also required students to present more of themselves than they had previously had to reveal in the online relationship. By organizing a physical meeting, the teachers increased the risks involved in the student relationships and the psychological and emotional baggage that

accompany such face-to-face interaction (Burniske and Monke, 2001). At the same time, they were requiring their students to make a connection between 'real' and 'virtual' interaction.

Primary teachers reported that the online relationship did in fact pave the way for "breaking the ice" when students met and that most students interacted with their email buddy, with some continuing to exchange personal email after the project ended. The ages of students may therefore be a factor to consider in terms of the types of relationships they are prepared for or interested in forming. Secondary teachers noted that their students needed to "get through the bravado stage" where "they were out to shock or humour…they all seem to go through that first off, making these wild claims." When photos were received, they had to remind their students that "it wasn't a dating game" and noted that, as students at that age were developing their own sexuality and identity, it added more complexity to the establishment of online relationships.

Although teachers concluded that online relationships in the curriculum context needed to be short, with clear starting and finishing points, they were also concerned at the shallowness of the relationships and communication that developed. Secondary teachers tried to set boundaries for the communication and relationship building and regretted allowing students to use their own private email, as the boundaries between the personal and the curriculum relationship became confused:

> *We wanted to keep it within the boundaries of: This is curriculum, you can have another relationship out of class but you have to keep this on track.*
>
> *(Liz, Interview, Nov 2001)*

Secondary teachers initially viewed student use of email as different from their own, particularly in the case of the Gold project, stating that, "We go on email to make contact and do something but these kids don't. It's a fairly pointless sort of…they talk drivel!" (Liz and Donna, Interview, Nov 2001). These teachers also touched on other theoretical positions that may have impacted the nature of communication and relationships, as evidenced in their comments after the Gold project: "We didn't have enough guts there for them, they treated it just like their usual email" and "I'm not sure how committed the kids were". The first comment suggests that students did not make the same discrimination as teachers between 'curriculum mode' and 'personal modes' of communication with peers in their first online project, although they had no difficulty

when communicating with businesses and community organizations as part of the City Project. The second comment about student commitment may indicate that students had weak information and/or emotional connections to the project.

Sproull and Kiesler (1996) link the motivation and commitment of individuals to their work to the relative strengths of how well informed individuals were (information connection) and their feelings of attachment, involvement and affiliation (emotional connection). Green (2002) similarly suggests that the value of Internet-delivered information for community-building "is proportional to how interesting or relevant other people find it" (p. 47). Planning for telecollaborative projects needs to therefore consider the varying interests of students and collaborating teachers and how well these are served through the design of the project. Although students could be engaged in a project at a technical level (the desire to use the technology), engagement at the sociocultural level (shared concerns) and critical level (questioning the message and the way technology massaged the message) need to also be addressed.

Reciprocity

Burniske and Monke (2001) cited "poor reciprocity" as a common problem with the telecollaborative projects they were involved in and one that required careful vigilance. This was also a concern for teachers in this project. Reciprocity was an important determinant of the success of projects, going beyond Burniske and Monke's (2001) use of the term, where they referred to a timely response to email messages, to encompass reciprocity of interest, commitment, responsibility, desire to participate, investment in relationship, leadership and initiative.

Teachers frequently read a lack of email response as a lack of commitment by their collaborating teacher, although they were also aware that collaborators often had problems with gaining regular Internet or computer access. For students, poor reciprocity (delays or not receiving responses to their questions), together with poor quality or not enough information in the responses they received, were the main problems that affected their projects. Burniske and Monke (2001) report a similar situation, and found that students "felt betrayed by unrequited messages, which they often interpreted as a sign of indifference rather than limited access" (p. 115).

Leadership was not equally distributed in the online projects. Teachers who initiated projects all decided that they would need to take the main leadership role if the projects were to be successful:

> *Will Dave rely totally on me to do the bulk of the work in leading the project?*
> *He's keen, but has so far ridden the wave rather than suggest things for himself.*
>
> *(Bart, Journal, Week 3, Term 2, 2000)*

Bart found that he needed to do an enormous amount of pushing to get his UK partner to respond, at one point noting that he seemed to be able to get an email response only after leaving several messages on Dave's answering machine. Gerry also concluded that the only way her biography exchange was going to go ahead was if she took the initiative:

> *I'm going to have to be the one to organize things because I can see the push*
> *will have to come from me otherwise it won't happen.*
>
> *(Gerry, Journal, Week 7 Term 2, 2000)*

> *During the network meeting, Maryann and I had arranged to get together on the*
> *first Thursday back this term and nothing happened. I'm finding that I have to*
> *do all the pushing ...I will wait for a week before trying to make contact again. I*
> *want to see if she will do something.*
>
> *(Gerry, Journal, Week 1 Term 4, 2000)*

The Assistant Principal of the secondary school jokingly referred to "the Liz and Donna" show, and they agreed that they were the drivers of the project in the school. The demonstration of initiative and leadership could be linked to degrees of commitment and investment in the online project, which may explain why the initiating teachers were far more likely to keep the project on track. Perhaps greater collaboration at the design phase between teachers would generate improved reciprocity in more dimensions of the human relationship. Burniske and Monke (2001) managed to maintain a 10 year professional relationship and telecollaboration with only three face-to-face meetings. The difference in their relationship was the time and effort that they both expended in the design, planning and reflective dialogue associated with their telecollaborative projects.

Critical Theorizing and Questioning

Value Conflict and Dissonance

Teachers faced a number of value conflicts during their involvement in online projects. The pressure of time constraints created a conflict between teaching in a way that was considered to be 'doing it right' and 'just doing it' so that there could be some closure:

> *The clock is ticking and although we're very excited about the project, I can see myself 'fast-tracking' a lot of the processes that I wanted to spend more time on, such as design processes…Will we be able to properly follow the Inquiry Learning model and still finish the project?*
>
> *(Bart, May Journal Summary, 2000)*

> *The kids are about to compose and send the next round of data in the project but we've moved away from covering two sub-headings per week to just putting together what we can.*
>
> *(Bart, Journal, Week 9, Term 2, 2000)*

> *I was so intent on enabling the students the independence and responsibility of emailing themselves that a term has almost elapsed and students still haven't made contact! Consequently I suggested to (country teacher) last Friday that we go with plan B, ASAP and email via my address. I'm awaiting her response.*
>
> *(Liz, Journal, Sept 1, 2000)*

As one teacher found himself using the computer lab more and more often, due to technical difficulties in accessing the Internet in his classroom, he mused:

> *Thankfully we were able to access the Internet in the lab during these sessions, but my planning went out of the window as a result and the whole idea of integrating the computers into the classroom has been somewhat farcical.*
>
> *(Bart, Journal, Week 7, Term 2, 2000)*

Teachers had initially asked students to let them read all emails before they were sent so that they could 'monitor' the information going out of the school. This surveillance role led to dilemmas in relation to editing and censoring what students wrote:

> *Monitoring progress has been very difficult and on a couple of occasions I've had to re-type messages that have been caught up with dialogue on relevant*

topics like Pokemon. This is very unfair on the kids and not the way I wanted to go. I'm a bit cross that it's come to this.

<div align="right">*(Bart, Journal, Week 7, Term 2, 2000)*</div>

I've asked all students to ensure I read all mail before it is sent out. What I found I was doing was not only reading the letter but also correcting mistakes. I really need to decide whether it is important to send mail that has no mistakes or do I use the letters as a way of assessing any growth in language skills and knowledge. I can't have both happening because the draft isn't kept, only the good copy that is sent. Do I want a record of mistakes students are making? Also the time it takes to correct mail is difficult. While it may seem to be only a few minutes, when you multiple it by 25 it becomes quite a lot of time.

<div align="right">*(Gerry, Journal, Week 9, Term 2, 2000)*</div>

In the above examples, there is conflict between functional literacy interests (spelling, quality, content of message) and social interests (students' rights as authors of their own mail, demands on teacher time). Thus the use of new technological practices raises issues in relation to changed social practice, particularly in regard to the moral or ethical question of reading and changing student mail. Burniske and Monke (2001) point out that the use of either public or private email accounts brings a particular social conundrum, in terms of assessment, instruction, response and moral and ethical questions (pp. 47-48). The above example raises questions about the desire to edit: was it because print convention dictates that the final copy should go out without mistakes or because students' writing represents teachers' teaching and reflects upon them? What rights should students have? How public should email be? To what degree should assessment considerations impact the way communication is conducted? The less teachers knew about how students were experiencing online communication, the less likelihood that a 'pedagogical moment' would present itself requiring their thoughtful intervention. The more they knew about student communication, the greater the moral, ethical and organizational dilemmas in terms of the intervention possible.

A commonly held value by all of the Middle Years primary teachers was the importance of ability matching students for the online projects:

I've outlined to Dave the nature of group work based on ability and I hope that we can operate along those lines so that the kids can be stimulated by each other

intellectually…I still think it's important to group the children according to their sophistication level, as they are more likely to develop a rapport if this is the case.

(Bart, Journal, Term 1, Week 6 and Term 2, Week 3, 2000)

You know there's something that I thought was a very important part of the process that I'd be telling another teacher and that is to match kids with like abilities because I think if you've got a high achiever with a low achiever, the low achiever feels inadequate when questions are being asked and the high achiever might get disappointed. I think it was a good thing to do.

(Gerry, Dialogue with Bart, Nov 2000)

To overcome these problems, I set up the email buddies with ability issues in mind and split the grade into ability groupings so that the students would be able to write and express themselves at their level as well as receive feedback and interaction on-line with students similar to themselves.

(Maryann, 6 month Action Research report, 2000)

These responses indicate how influential the system-endorsed practice of ability grouping had become, going well beyond the Early Years project that it was initially recommended for. When ability grouping was questioned after a classroom observation, the following response was made:

You asked about ability grouping and mixed ability grouping. In Maths and Language, it is a lot easier to plan and then teach using the ability grouping because the teacher can really home in on specific skills. However l feel in measurement areas, mixed ability grouping can be very effective, particularly when there are students within a group who have a lot of problems understanding a practical task. Peer teaching can be very valuable as it assists in building a student's self-esteem. It aids both the capable student and the one having problems.

(Gerry, Response to School Visit Reflection, March, 2000)

Another response, when ability matching was questioned, also strongly reaffirmed the practice:

If we hadn't thought about grouping them together, the higher ability kids last year would have got their biographies and gone, "Oh dear," do you know what I mean? I can think of particular students like Sally who's really mature, CSF level five, content driven, very particular about her work and how it's set out. I can imagine her e-mailing someone of less ability and getting very frustrated. I can see that she would be. She would be asking these in depth questions and if she was asking that of a lower ability student the response wouldn't be what she was looking for. So therefore, I don't think she would put the effort in. Whereas she's linked with a buddy who is on her wavelength and Sally is getting exactly what she wants. I think where children are relying on written information, matching by ability is really important. If they were able to get on camera and ask the questions face to face I don't think it would matter. But I think because it is written text you have to be aware of the content of that text just like you do if you were putting up a book. If you were giving Sally a book, I would choose a book that is at her ability level. I wouldn't give her something that is not a challenge or something that she couldn't read so why would I do that with emails? They have to feel success in their e-mails. Just like they do with any other reading. That's how I look at it. It's just a digital text.

(Maryann, Interview, Nov 2001)

Thus teachers' rationale for ability matching was strongly connected to Department of Education sanctioned literacy practice of matching students to appropriate text. In the above example, the text that students were capable of producing overrode other possible matching criteria, such as common interests. Pedagogical decisions were therefore made on the basis of a dominant functional or operational literacy interest, without critical regard for the broader sociocultural implications of practice. The need for multiple perspectives and the broader social implications of ability matching practices warrant further investigation and critique. Although such practices may be successful in enabling students to achieve success at a functional literacy level, it is important to look beyond to other dimensions of literacy and human success.

When communication in online projects is considered as nothing more than 'digital text', the humanity of the message is removed. If, however, electronic mail is constructed as 'conversation' or 'dialogue', requiring the existence of an interpersonal relationship, we keep the human dimension of the communication in consciousness.

Green (2002) asserts that "people construct their membership of communities through conversation and conversation increasingly is technologically mediated" (p. 218). She distinguishes between "conversation" and "communication" where conversation involves "a personal sphere of influence, and the number of participants remains small enough to allow reciprocal personal exchange" (p. 219). It is this "interactivity" that "exposes individuals to ideas and possibilities that are capable of informing the development of new perceptions and perspectives…and changes people" (p. 219).

This conceptualization of the communication process within online projects is much more closely aligned to teachers' original intentions, which went beyond the functional perspective of reading text and collecting information, to a desire to broaden student perspectives and understandings of their world. If teachers regard email as being only 'digital text', then they are thwarting their intention to raise students' consciousness about the social consequences of the messages they send and receive.

Burniske and Monke (2001) note that computers bring certain values to the educational table, amplifying some kinds of learning while ignoring or even discouraging others (p. 25). They point out that use of ICT amplifies such values as efficiency, measurability, objectivity, rationality, progress and the accumulation and manipulation of data. They raise a concern that human-centred educational values, which are not explicitly encouraged by use of the computer, are at risk of becoming less valued. Such values include:

- *the pursuit of truth*
- *the comprehension of complex ideas*
- *the generation of one's own ideas*
- *the discovery of meaning*
- *the use of good judgment*
- *the exercise of emotional maturity*
- *the development of wisdom. (p. 25)*

Pedagogical action and teacher agency are crucial determinants of whether human centred or machine centred values dominate in the classroom.

ICT and Quality

Teachers theorized that ICT actually had had a negative impact on the quality of student work. One teacher had direct evidence of this in relation to the online biography project as he had examples of biographies that his students had developed for each other without the use of email. The problem he and his students identified was a lack of information:

> *The big difference that really surprised me was that I expected there to be an improvement from having practised and had the experience of writing a biography. They didn't have any problems writing the biography and in terms of organizing a lot of information—it was a credit to their organization skills. The problem was the final products—the kids really did remark on the fact "Gee they're a lot shorter than the one we did the first time and we really are lacking a lot of the information". And you ask them what did you think of the processes and they said, "We didn't get the information we required from our email, there were problems." That was very interesting for me because here I was thinking that the technology would be this fantastic vehicle and it was a real learning vehicle and it was very much a collaborative process but the tyranny of distance and inability to sit down and really nut it all out instead of going parallel—it really got away from us in the end.*
>
> *(Bart, Dialogue with Gerry, Nov 2000)*

Another teacher raised the issue of ICT being used to mask the quality of the work:

> *When we went to (the other school) last Thursday, I was feeling fairly hesitant because we walked in and saw all these laminated front covers and it was bound and it was pretty and I'm thinking "Oh my God, the work my kids have done wasn't as good." But I had said to my kids, "We don't have time on the computer." My thing was to use that as a way of getting information. They didn't have to present the information using technology. They could do it differently—create a story, draw and write it—because they had to use time at home as well. So I found myself apologizing to the other teachers. Interestingly, when we got back to school and saw these flash things, flash books that had come from the other school, I realized that my kids' work was actually better because I had said to my kids I want you to be inventive. Some had an interview*

style, some had created a story around the other person they were writing the biography about. So I found that while it wasn't flash looking by the laminated sheets and everything, the actual content of my kids' work I thought was of a much higher standard and I felt silly later for having apologized to the other person saying " Oh look, some of my kids haven't done really good work" and I was really proud of what they had done.

<div align="right">

(Gerry, Dialogue with Bart, Nov 2000)

</div>

A teacher at the partner school for the Biography project also had concerns about quality, as did her students:

Oh the biographies were sensational. Really great! I think it was because they were so intent on who they were giving it to at the end, that it was a swap. I remember a couple of my kids being disappointed with the ones they received because they had put in so much effort. I have no doubt that that the other students put in as much effort as we did, but my kids felt they put so much hard work into the ones they were giving away and they couldn't see that there was as much effort in the ones that they were given. Their biographies were the more superior effort and they were getting something inferior in return. I think that our kids had more technology than the other school. We had the colour printers and the laminators and the binders and all that sort of thing that we take for granted and the kids see their shiny laminated covers and every single page was in colour whereas at the other school they didn't have that technology to hand that to us.

Q: What about the quality of the actual information they received?

M: Great. Just as good. Definitely.

<div align="right">

(Maryann, Interview, Nov 2001)

</div>

In the case of the Biography project, there were different values and definitions of 'quality' in play. The quality that teachers valued most was usually associated with student thinking—critical, grappling with big issues in the world, creative—although in several cases quality also referred to complexity of technological presentation. Thus teachers and students alike had differing views about what constituted high quality. For one teacher, technology was used to mask a lack of quality, whereas some students equated quality with technological design and presentation, rather than the actual

content of information. These examples highlight the importance of being explicit with students, and explaining the 'recognition and realization rules' (Bernstein, 1975) in relation to quality.

Teachers in the project agreed that teaching students how to question more effectively was a crucial strategy for obtaining better quality information:

> *We've done a lot of work on questioning. This took a while to take hold, but the children are also very aware of the difference between 'open-ended' questions and 'closed' questions. Small group planning sessions have seen questions go from things like 'Is sport popular in Bristol?' to "What are the most popular sports in Bristol and why are they so popular?"*
>
> *(Bart, May Journal Summary, 2000)*

> *The other problem we seem to be having is that the questions my kids are being asked by the students at the other school seem to be all over the place. There doesn't seem to be any focus to the questions (as Maryann and I had talked about). I've told my students to answer the questions that were being asked of them but to make sure that when they were asking questions they stay focused on the questions they've written down using the graphic organizer. If they follow their plan they will get information for the biography they have to write and it will flow a lot more easily for them.*
>
> *(Gerry, Journal, Week 2, Term 3, 2000)*

One teacher theorized that differences in approach and commitment led to a lesser quality of work coming in from the other school, both in terms of the questions for information gathering and the final products. She was disappointed that there wasn't 'more depth' in the work from the other school.

Conclusion

When teachers engage in online projects for the first time, they experience a sense of 'fuzziness' in terms of intentions, organization and outcomes. This quickly creates dissonance which, in this study, teachers strove to remedy as a part of their PAR experience. Trying an innovation causes an expert-novice-expert effect, as teachers move out of their comfort zone, experience the 'fuzziness' that accompanies the role of novice, then work to return to their expert comfort zone. This study suggests a

conceptual and practical planning framework that could shorten the period of 'fuzziness' and provide a structure to assist in the reduction of dissonance. This planning framework addresses technical/practical, pedagogical, sociocultural and critical dimensions of practice.

Technical / Organizational Dimension

The technical/operational dimension refers to the practical and functional decision making that is required in terms of learning to use ICT, the literacy or language capacities necessary for effective participation, and the basics of organization. The following questions are suggested to guide the planning process:

- What technical requirements (hardware, software, network) are needed and who will provide technical support?
- What technical skills are involved, who needs to learn them and how will skills be learned (e.g. group instruction, peer tutoring etc.)?
- What functional language, literacy and information management skills are necessary for successful participation?
- What email protocol will be used (e.g. whole class or individual addresses)?
- What understandings do students need to develop in terms of the technical medium they will be using?
- How will common goals and a clear, shared purpose be negotiated for the project? How will you balance the use of both synchronous and asynchronous communication for this purpose? Who will prepare the project description?
- What will be the project timelines, sharing mechanisms, and frequency of communication? What is a realistic time commitment given other demands? What will need to change in order to provide this time commitment?

The experiences of teachers in this study suggest that it is possible for the technical and organizational dimension to overwhelm an online collaboration. The implementation of extensive audit procedures may have been an attempt to bring complexity and the unknown under control, as well as enabling communication flows. Dalmau (2002) notes that tendencies to increased control and regulation or a form of 'reductionism' (Turner, Farrand, & Craven, 1932 cited in Dalmau, 2002 #319) appear during times of rapid societal change.

The reality of teachers' working lives must be acknowledged, however, in conjunction with any innovation in practice. Work intensification includes "heightened expectations, broader demands, increased accountability, more 'social work' responsibilities, multiple innovations and increased amounts of administrative work" (Hargreaves, 1994, p. 136), impacting on everyday practice. This, in turn, affects the capacity of teachers to involve themselves in projects that require significant time, energy, motivation and commitment to implement successfully. Teachers' recommendation that online project structures allow ample time for planning and preparation and a shorter, confined time for online communication and collaboration, could be construed as a response to work intensification. However, reducing the time frame for curriculum conversations conflicts with another concern of teachers, the shallowness of the online student relationships.

This dilemma, created by competing organizational and interpersonal concerns, needs to be addressed by considering pedagogical intentions and weighing up competing values that each path of social activity reflects. From a critical standpoint, it raises questions as to what alternatives to increasing regulation and control are possible.

Pedagogical Orientation

The pedagogical dimension of planning determines the orientation of the project to student interests, curriculum interests and the world beyond the school. It takes into account the balance of relationships and involves clarification of the intention of the project in terms of values and purpose (technical, social, moral and political), process (e.g. telecollaboration), and outcomes (e.g. social action, social product, cognitive and social/emotional development). The following questions were developed to guide planning for this dimension:

- What is the purpose of the online project e.g. a) technical: to experience the medium or achieve a particular curriculum outcome; b) social: to develop new understandings, perspectives and relationships through interaction with others; c) moral: to prepare students for the future by addressing issues of consequence or value and collaborating in meaningful contexts; d) political: to engage in social action that makes a difference in terms of power, status and identity or to raise consciousness about issues of equity, social justice and fairness.

- If telecollaboration is the goal, what pedagogical support, structures and intervention will ensure the co-construction of shared meaning and interdependent action?

- How will the interests of students, teachers/curriculum and the broader community be balanced within the project?

- What will students need to demonstrate as a result of participation in the project (intellectually, socially, politically)?

- What criteria will be used to judge quality, rigor and success, and how will these expectations be negotiated with and communicated to students?

From a critical stance, discussion in relation to the intention of online projects needs to consider whether the project design genuinely provides students with new learning opportunities, or whether it simply transfers an existing structure and strategy to a new activity.

School practices can vary in the degrees to which they are socially meaningful beyond their immediate environment. In order to raise awareness of the pedagogical orientation of a project, it is necessary to consider whether the designs of projects are oriented mainly to the growth of the student or to curriculum and the structures of schooling (van Manen, 1991). Balance between the teacher's curriculum agenda and students' needs, interests and perceptions is required. Working towards such balance is a political act in itself. However, sometimes awareness of the political implications of some practices, such as ability grouping, was limited. Views as to the 'rightness' of such practices were maintained by perceived endorsement by 'research' and the Department of Education. This tendency towards more generalised adoption of a practice that had been initially endorsed for a specific context was a concern identified in this study and highlights the need for increased attention to the political dimension of pedagogy.

Telecollaboration that goes beyond technical interests requires a focus on the humanity of situations. Online projects that are guided by values that make explicit the human qualities to be developed and encouraged, which in turn give direction to technical or practical concerns, have greater potential to go beyond product or knowledge creation to more complex community and relationship building. Genuine telecollaboration requires the interests of all involved in the project to be considered in order to ensure that

purposeful and authentic activity takes place. Rather than simply considering other students or community organizations as information resources, telecollaboration requires a partnership to form, conversations to take place, an area of mutual interest and value to be addressed and the co-construction of shared meaning

Teachers are the crucial link in determining whether students simply telecooperate or complexly telecollaborate. The outcome is determined by the pedagogical choices teachers make in terms of their intentions for student learning, the authenticity of the tasks and learning environment they create, the beliefs and norms they accept or reject, the range of strategies or craft knowledge they can draw upon in response to the situations that arise in their classroom, and responsiveness to student perceptions, purpose and needs.

Sociocultural Dimension
Exploring and making explicit the nature of human communication, relationships and community building provides a crucial context for online telecollaborative projects. As soon as teachers and students venture online, they are participating in 'technoculture' (Green, 2002), which will be characterized by 'communication ecologies' (Sless, 1995, cited in Green, 2002, p. 229), where relationships and conversations wax and wane or 'co-evolve'. Communication, relationships, roles and reciprocity are all social considerations that require attention, as does the context for the project in terms of cultural relevance, meaning and social product or action.

When teachers restrict their conception of electronic mail to 'digital text', they also restrict the humanity of the online interaction. Telecollaboration involves partners helping each other to better understand their world and themselves, and must go beyond the sharing of factual information to employ dialogue and questioning that requires participants to share more of who they are and what they think and feel. It is based on a relationship foundation.

There are psychological and emotional barriers to be overcome for a telecollaboration interaction to take place—and both teachers and students benefit from discussion as to what these are and how they could be addressed. This might include considerations of online identity and the growth of a particular technoculture (Green, 2002) that grows from the shared interests of an online community. If culture is viewed as "the way the

social relations of a group are structured and shaped (and)…also the way those shapes are experienced, understood and interpreted" (Clarke, Hall, Jefferson, & Roberts, 1981, p. 52-53), then the critical dimension of any online telecollaborative project requires that the structure and experience of such relationships become part of the learning associated with the project.

Teachers in this study experienced online social relations as 'less than' real time relations. Further research is indicated to develop greater understanding of the student perspective, in terms of how they experience such relationships and whether for them it is simply 'different' rather than 'less than'.

The following considerations are suggested to assist planning for the sociocultural dimension on an online telecollaborative project:

- How will you ensure high commitment, enthusiasm and motivation with other telecollaborating teachers and students exists?

- How will you establish rapport and engage in relationship building with telecollaborators. What will be the role of the teacher in mediating and supporting the relationship between student telecollaborators?

- How will you balance/highlight the humanity of the online relationship compared to the technical interaction?

- What is involved in teaching students to 'read' another person in an online environment and avoid misrepresentation?

- How will you foster a sense of social responsibility in the online environment, particularly in terms of reciprocity?

Teachers found online, asynchronous communication to be wanting in terms of its effectiveness in mediating the planning, design and organizational stages of the projects. When things went wrong and messages did not come through, there was a tendency to blame collaborators for the problem in the absence of evidence to the contrary. Face-to-face communication enabled misconceptions to be quickly sorted out and, as a result, the relationships were more resilient and sustained. Lack of response was generally interpreted as human failing/shortcoming rather than a technical failing. Thus teachers,

as well as students, need opportunities to develop their capacity to 'read the person' by looking *through* the communication medium rather than *at* the digital text. This is inherently more difficult than 'reading' the person in face-to-face communication as online communication is stripped of contextual, sensory and behavioural cues and takes place in a different construction of place and space.

Reciprocal social responsibility is necessary if any relationships are to be sustained, regardless of whether they are virtual or real. Students exhibited confusion during the projects as to exactly what their responsibilities were in relation to their email buddies. Explicit understanding of those responsibilities are clearly indicated as a necessary component of awareness raising and critical thinking in relation to the online projects. The notion of connectedness needed to shift in the projects from computers connecting, to people developing a sense of connection. Teacher researchers noted that students struggled in their understandings of connectedness at this level.

Critical Dimension
Classes that engage in online projects need to engage also in offline dialogue that looks at 'what's really going on here?' and 'how is it similar to or different from face-to-face interaction?' Weighing up the advantages and disadvantages of using electronic mail to mediate social relations is an important critical consideration. The following suggestions could be used to frame the critical dimension of a telecollaborative project:

- What opportunities will you create for students to engage in expressive, reflective and interpretive activities that encourage them to theorize about the nature and content of online communication, relationships, culture and community?

- How will you encourage self-confrontation, in terms of beliefs, values, identity and preconceptions?

- What opportunities might there be for exploring social, moral and political issues? What constitutes ethical behaviour and social etiquette in online culture?

- How will you raise awareness of the implications of online communication stripped of human sensory information?

- What has influenced the project design and structure? What boundaries (e.g. relationships, curriculum, time and physical and psychological space) could be made more fluid?

The characteristics and possibilities of email use for communication raise some ethical and moral dilemmas. Teachers in this study noticed that email relationships did not necessarily prepare students to engage more confidently in face-to-face relationships, particularly at the secondary level. Students displayed prejudice in relation to the appearance of others and held preconceptions as to what their collaborators were like. Teachers generally concurred that their preference was to remove social indicators from early email messages (photographs etc.), but at the same time they wanted students to connect on a personal level and establish rapport. When social indicators are removed from email messages, the sender becomes sanitized to some degree, and while this may enable communication to proceed, confronting prejudice and stereotypical assumptions with students is more likely to develop students' capacity to function humanely in society. Thus the social implications of online relationships and communication must be addressed through the lens of the critical.

Attention to the critical involves problematizing experience, as well as maintaining a focus on human values, relationships and the big picture implications of action. By permeating all other dimensions of online collaborations, the critical dimension shapes the original intentions, clarifies whose interests are served and how, and enables humans to control the mediation of relationships, culture and community building, rather than being at the mercy of the characteristics of the technology. Attention to the critical must also "locate any analysis of personal action within wider socio-historical and politico-cultural contexts" (Hatton, 1995, p. 3. Also cited: Lovatt, 1991; Noffke & Brennan, 1988; Zeichner & Liston, 1987)

The efforts of teachers in this study have enabled important future directions for development to be identified in relation to this area of ICT use. Involvement in online projects would benefit from a stronger focus on human values, relationship and community building, and developing new understandings of technoculture. For this to occur, attention needs to focus on the technical/practical, pedagogical, sociocultural and critical dimensions of the project. When this attention is conscious and balanced, the

challenge of cultural change, in the form of new ways of relating and collaborating, has a greater chance of occurring.

Chapter 7 takes up this challenge and looks at how ICT can be instrumental in actively shaping and transforming classroom culture. The introduction of animation led to the most innovative practice and cultural changes in classrooms. Teachers and students used a relatively new technology (in this case a digital web camera) in new ways to produce animations that harnessed student creativity, changed the normal socialization patterns within the classroom and required students to imagine, design and communicate effectively to a target audience.

Chapter 7: Innovation, Animation and Multiliteracies

This chapter reports the work of several of the project teachers when they introduced their students to digital animation. Large scale pedagogical change occurred during this stage of the project, as teachers created processes to involve the use of animation tools within their programs.

There are different forms of animation that have been used in schools, most commonly stop motion animation. This consists of successive digital photographs that are replayed at a speed that gives the impression of movement. This is the form of animation used by teachers in this project, with students creating sets and figures from a range of natural and synthetic materials, such as paper, cardboard, plasticine, clay, twigs and leaves. Although it was possible to find technical information in relation to constructing an animation, articulation of a teaching and learning process for young children that went beyond technical skilling was not found in the literature. Teachers in this study identified such a process, which they situated within their pedagogical concerns. Of particular import is the fact that the software used in this case was not in general use by schools or business. Thus teachers pioneered their own processes initially, rather than modelling others. Teachers' use of animation thus represented an innovation.

Much of the software which predominates in schools was originally designed to serve the interests of business (e.g. Microsoft Office). While valuable in terms of being open-ended and able to be adapted for different purposes, such software is also limited in concept to the purposes for which it was designed. Efficiency is frequently a dominant value, giving rise to the quickly available use of templates and clip art to enhance publications. In contrast, the use of stop motion animation appealed to teachers in the project because it enabled children's creativity to predominate, as well as providing opportunities for higher order thinking, problem solving and teamwork.

Rationale for Selecting this Issue

1. Teachers' practice in this case represented a significant innovation in their use of ICT;

2. Change occurred in teaching strategies, pedagogy, classroom structures and the teaching/learning relationship;

3. Teachers' concerns with the technical were given much lower priority, compared with their concerns for the pedagogical dimension of their practice.

Context

Teachers in the project were introduced to the concept of stop motion animation after one teacher (Zoe) learned how to use the technology during her participation in another project. Zoe invited the animation facilitator to visit her classroom and he assisted her in conducting a session with a group of her students. After witnessing this session and being impressed by the potential of the process, I asked Zoe to demonstrate the students' work at one of the project network meetings. Following an enthusiastic response from the teachers, an introductory animation session was organized at Zoe's school so that teachers could come along and experiment with the software and equipment themselves. Two other project teachers enthusiastically embraced the idea immediately and introduced animation to their students in the next term. During the following year, five of the project teachers visited an animation studio to obtain further advice and ideas on the process. The classroom processes were then adjusted to more closely reflect the real life process used by professional animators.

Educational Intentions

A noticeable change associated with the introduction of animation into the project classrooms was the breadth of the educational intentions. Technically oriented intentions took a backseat during this process, with teachers focusing much more strongly on supporting students to develop their ideas and storylines effectively and to work together collaboratively as a team. The planning, drafting, editing and refining processes were all highlighted by teachers with noticeable increases in student control and responsibility.

Zoe exhibited a strong preference for students to use the animation process to express what they were concerned about in the world, which is one of the characteristics of authentic pedagogy and curriculum (Kruger et al., 2001, p. 148). Kozma and Schank (1998) also note that:

> *An important motivation for learning comes from relating events that happen in the workplace and larger community to things that happen in the student's world…Connecting the needs, problems, and experiences of the outside world*

with the formal learning of the classroom makes the acquired knowledge more useful and the world outside more comprehensible. (p. 11)

The following year, after allowing children to experiment with the equipment to become familiar with the technical features, Zoe was disturbed by the animations that the children were producing:

I felt the children needed guidance, as they were coming back very excited about stories of space battles and explosions. When I thought about this later, it dawned on me that this is the type of story these children would mostly be exposed to when watching animation. They were relating animation to video games and found it difficult to go past the combat idea. I then put aside the whole animation idea and pulled the children together to have a discussion about what the children were concerned about in the world. It was then that we started to get some base concepts for them to work from.

(Zoe, Reflection after animation studio visit, April 2001)

Following this discussion, one group of Zoe's students developed an animation that was a response to an oil spill that had occurred on the Great Barrier Reef. Later in the year, another group developed a response to child poverty, a strong concern they had after studying a unit of work on the Philippines. As well as her intention for students to use animation to make a meaningful communication about an issue of significance, Zoe also wanted her students to develop their understandings about animation as a new genre of communication:

It's also really important for them to keep the genre in mind because it's actually different to a report where you can include lots of things. This is a very short animation that is labour intensive. So the idea might be huge but they need to distil that information…In some ways it's really good because they do distil the information and get to the core of their feelings and what they are really on about.

(Zoe, Interview, October 2001)

All three teachers desired to provide their students with "rich" tasks and opportunities for higher order thinking. Earlier in the year, both Gerry and Bart had referred to rich tasks as those which encompassed a range of different CSF II outcomes in different key

learning areas. The tasks they designed that included the animation process differed markedly from this earlier conception, with 'richness' now derived from the complexity of the planning, design, production and evaluation stages of the animation process. Interestingly, teachers did not make any references to CSF II in any of the data related to animation. Instead, their intentions addressed the following:

- Conceptualizing and fleshing out ideas (generating a focus and purpose from the current curriculum and student interests, creative thinking, considering needs of the audience);

- Planning, designing, drafting and refining (providing students with a breakdown of the planning and decision-making steps they needed to engage in, use of product design briefs);

- Teamwork and collaboration (requiring skills of communication, negotiation, decision-making, ideas integration, organization, time management, problem solving, specialized role definitions, cooperation and coordination);

- Producing and fine-tuning the product (materials organization and production of the animation);

- Presentation of the animation to an audience;

- Reflection and evaluation (critical thinking, feedback).

Kozma and Schank (1998), in their assessment of the skills students will need in the 21st century suggest:

> *They must have the ability to see how their work fits into the larger picture, to understand how the pieces work together, and to assess the consequences of any changes. They must develop the capacity to work with others to develop plans, broker consensus, communicate ideas, seek and accept criticism, give credit to others, solicit help, and generate joint products. (p. 4)*

The tasks that teachers designed for students that used animation are much more closely aligned with the above vision than previous uses of ICT in the classroom. Koszma and Schank (1998) cite Reich (1991) who suggests that workers of the future will need to adopt the role of "symbolic analysts" who:

...use a variety of tools and resources, including computers and scientific and creative instruments, to generate and examine words, numbers, and images. They often have partners and associates and work in small teams. Their work schedules may vary, depending on a particular project. Their work products range from plans, designs, sketches, and scripts to reports, models, and multimedia productions that are judged on such criteria as originality, cleverness, and the degree to which they solve a problem. (p. 4)

For Bart and Gerry in particular, the introduction of animation into their classrooms was also a catalyst for them to change their teaching strategies to provide students with greater opportunities to develop the skills associated with becoming symbolic interactionists of the future.

Strategies, Methods and Technical Knowledge

Organization and Planning

Teachers' approach to introducing the animation process to their students involved planning and organizing in the following key areas:

- Development of a design brief for the animation product;
- Provision of a process brief outlining stages that needed to be worked through during construction of the product;
- Clarification of teamwork, role differentiation and organizational skills;
- Technical skilling and familiarization with hardware and software.

Design briefs

A difference was observed in the way teachers constructed the design briefs that were given to students. Some of these focused on technical requirements. For example, in Gerry's first animation, students were asked to include a glider, a torch, a musical instrument and 3-D figures. Bart's briefs added increasing complexity and special effects, beginning with 2-D paper animation, incorporating the use of 3-D objects, developing 3-D claymation, then experimentation with lighting effects. Students in Bart's and Gerry's classrooms then developed storylines to encompass these props. In one case, Bart also requested that students develop a scene that related to 'physical change', a topic they were studying in science.

Zoe's first animation effort was tied to the term topic:

> *The children quickly came up with ideas and short stories that would be*
> *appropriate to animate. They decided on an under water scene. I asked the*
> *children to include an environmental focus as this was the topic we had been*
> *covering last term. The children drew and made props that would depict an*
> *underwater scene with the intrusion of a plastic bag that would float through the*
> *water and collect up the fish.*

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(Zoe, Journal, July 2000)

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Her main strategy for developing a design brief always involved beginning by talking to students about their concerns. Using questioning and activities to encourage visualization, she would then guide them to develop a clearer brief about what their task would encompass. Zoe also related the animation process to TV advertising, particularly advertisements that delivered a social message. She asked her students to think about how these messages were constructed in order to develop ideas for their own animations. In this way, she hoped to raise their understandings of how this particular form of communication worked.

Most design briefs for the animation product combined student interests and input with some degree of teacher guidance, usually in the form of a request to include technical or conceptual components in the animation. Although all design briefs required the construction of a narrative, variations in the starting points for the briefs were observed, with some being more strongly influenced by either technical or social concerns and others distinguished by the degrees to which students were involved in shaping the initial brief. These differences represent pedagogical differences in both philosophical orientation and relationships.

Process Briefs

All project teachers scaffolded the animation process (Vygotsky, 1978) with prompts and procedures that broke the overall planning, design and production into discrete tasks.

The following observation describes the process as it was developed in Gerry's class. Students related the process as part of a presentation they made to a regional Learning Technologies Festival:

Group 2 was the first group to present. John gave an overview of the drafting involved in the animation process. He talked about first having to think of an idea or topic, then each person in the group wrote their own story and read it to each other. After they listened to each story, they chose one as a main focus and used the other stories to contribute refinements or changes where they would "maybe take some things out or put things in." John mentioned that that they couldn't just say, "We like yours the best," but had to say why. Gerry noted at this stage that she wanted to develop their ability to evaluate ideas and converse about them. During the process she had had to encourage each group to have a lot of talk and at one stage sent some groups off to rework their original ideas in order to improve the quality of the storylines.

John's partner, Cara, explained to us that a lot of cooperation was required to make the animation, particularly in terms of keeping hands out of the picture…She was able to articulate the process her group had gone through and explained the roles in the teamwork for shooting the animation: one person that clicks, a camera person, and everyone else to move the parts. Even the decision as to who would present the group's work today had been the result of student negotiation. Jana reported, "Everyone in the group came up with ideas for a speech, then took turns to be the speaker. We looked at how confident they were and their expression and then decided who we thought would be best."

(Researcher observation, March 27, 2001)

In Gerry's class, the animation process developed from the initial ideas of individuals, went through a negotiation and refinement process, then on to set development and animation production, before being presented to an audience. As well as students taking on different roles during the animation shoot, Gerry also asked her students to allocate roles within the team related to earlier aspects of the animation process. This included designing the final storyboard, making the props and set, working out music etc. Bart also required his students to take on different roles, such as 'director', 'camera operator' and 'camera assistant'.

Teachers' understandings about the process of animation developed with greater complexity after a visit to a professional animation studio. During the visit, the studio director summarized the animation process as follows:

Any animation is shaped by the question "How do we do this as a narrative for an audience?" Animation is actually another form of storytelling, and the principles of good storytelling and narrative apply. There are three main aspects that have to be planned for:

- *Show where we are (background)*
- *Frame the story for action (movable figures)*
- *Brainstorm how to get the audience involved and care about the action*

(Researcher reflection, animation studio visit, April 2001)

In response to this, Zoe noted:

The message was clear that if your story was weak then the animation would never be anything more than technically clever.

(Zoe, animation studio reflection, April 2001).

Zoe used the understandings that she developed from the visit to the animation studio, together with what she had learned from her own experimentation with students, to develop the following process brief to support her students:

How to Animate

1. *Idea: What story do you want to tell?*

2. *Script: Write a script including sound, dialogue and movement.*

3. *Story Board: Represent your script visually.*

4. *Art Work: Create background and props, decide the materials you will use.*

5. *Animate: Use Presto Video Works to animate.*

6. *Sound: Add sound to animation.*

7. *Present: Present animation to an audience.*

(Extract from video interview with Zoe, Oct 2001)

After developing several more animations with students, she elaborated her process even further for a teacher audience:

1. **Structure**: preferably multi-age groups of 2-6 children. Children need time to work on their animation each day so scheduling this as their learning center activity for several weeks is recommended. You need to be flexible, allow children to work for longer periods than normal (even all day) and make time to conference them and provide media lessons in a variety of ways. Other children who had done previous animations can help and guide the new group where appropriate and necessary.

2. **Understanding animation:** The first thing children need to do when animating is to reflect upon the animations they have encountered. Ask children to brainstorm the animations they know and the characteristics they have. It can be a shock when they realize how long a professional animation takes to produce.

3. **Technical experimentation**: Play time with animation is very important. Set up the equipment and let the children 'have a go' at animating. The purpose at this stage is simply to discover the limitations and characteristics of an animation. Encourage children to develop small sequences, learning just how far to move each character to get a smooth transition. Get them to experiment with size, colour, shape and other features, such as eye movement. The need to find out and make judgments about what works best with this new medium.

4. **Story telling:** The narrative is the most important aspect to animation. At this stage it determines whether the animation will be of high quality or little more than technically clever. Children need to be guided with their story writing. A good prompt is to ask the question, "What do you care about in the world?" Children then need to discuss and think through how they could convey their message to an audience using the medium of animation. Animation requires children to distill their story to key messages and ideas. This also requires them to merge their understandings of the technology with the story they wish to tell.

5. **Scripting and Story boarding:** The next stage requires children to develop a script and separate the narrative, sound and movement elements of their story. This requires them to be very clear and final about the story. Story boarding gives the children an opportunity to visualize their ideas. This stage requires them to be clear about where the camera will be placed and what shots will be

used. A lesson on camera shots, angles and the impression they can make is worthwhile. Children need to develop awareness that camera angles can have an impact on audience reaction.

6. **Artwork:** *Children then build their set and props, keeping in mind what they want the audience to understand about the scene. They build and draw their characters, remembering the importance of the eyes and the size of the characters if details are to be seen. The children now apply what they learnt at the 'play' stage to the production stage. They can be as unique and creative as they wish.*

7. **Animating:** *This stage requires patience, persistence and cooperation from the group. Some children choose a character or prop to move while another child captures stills and manipulates the digital video camera. The careful planning and preparation pays off at this stage. The children are guided by their scripts and storyboards as a cooperative group.*

8. **Editing**: *The captured images are then downloaded. The children are able to manipulate the frames and sequence them as their storyboard dictates. This is the opportunity where stray hands in the frames can be removed. Sound, in the form of spoken voice, music and other effects can now be added to the animation to further enhance the story.*

9. **Presenting:** *Children show their work to an audience and have their important message heard. This is also an opportunity to received reflective feedback from their peers.*

(Zoe, Adapted Email Communication, June 2002)

Although all of the teachers required their students to design storyboards for their animations, the idea of scripting the dialogue, sound and movement only developed in response to the animation studio visit. After seeing real scripts and storyboards, Zoe reported that students were also more highly motivated to engage in this aspect of the animation planning and design process, seeing it as integral to getting to the "fun" part of actually shooting the animation. The strong emphasis on design and planning in the animation process has strong links with the concept of design as proposed by

multiliteracies advocates (Cope & Kalantzis, 2000; Luke et al., 2000; The New London Group, 1996). Cope and Kalantzis state:

> *The notion of design connects powerfully to the sort of creative intelligence the best practitioners need in order to be able continually to redesign their activities in practice. It connects as well to the idea that learning and productivity are the results of the designs (the structures) of complex systems of people, environments, technology, beliefs, and texts…The term…can identify either the organizational structure (or morphology) of products, or the process of designing. (pp. 19-20)*

Cope and Kalantzis (2000) identify six major areas of design—linguistic, visual, audio, gestural, spatial, and multimodal—and begin to articulate the metalanguages that represent each area of design and enable meaning-making to occur. Such metalanguages also form the basis for enabling refinement and critique to occur, providing users with greater power over the various modes of communication they choose to use and combine for specific ends (pp. 23-30).

The three teachers highlighted the evaluation and reflection stage of developing an animation as important stages to include in the process. The need for the development of metalanguages, to assist critique of both the process and the product, emerged during this stage:

> *Also impressive was the strong reflective nature of the task, with evidence of students developing metalanguage to be able to describe what they had been doing. I thought about where to from here and it seems to me that developing metalanguage around the actual animations themselves—what's a good animation, what makes it work more or less effectively, principles of animation, design issues, and developing the ability to provide a simple critique based on this, would appear to be the next step. I hope the visit to the animation studio will provide us with more knowledge as to how we can develop this with our students.*
>
> *(Researcher observation, Gerry's classroom, March 2001)*

The visit to the animation studio did provide some additional metalanguage to assist animation critique:

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Mike made some suggestions as to how Zoe's student animation could be improved. The student animation showed two oil tankers moving towards one another, crashing and producing an oil spill. It ended with a sign, "Keep oil tankers off the Barrier Reef". Mike's comment was that the narrative was too linear, all shot from the one "perspective". To improve it, it was necessary to 'cut' to another perspective, such as to the faces of the two captains who should look increasingly frantic, then back to the oil tankers to see the progress of the action. The children had gone to a great deal of trouble to have small storylines happening in their story, with passengers bailing out on to life boats. This was difficult to see, so again a cut to their perspective would have enhanced the story telling. He told us that one of the challenges of developing an animation was directing the attention of the audience where you want it to be.

(Researcher Commentary, Animation Studio Visit, Apr 2001)

The notion of different perspectives, using the technique of cutting, and planning to direct audience attention all added to teachers' ways of discussing and critiquing animations, which was then passed on to students.

Zoe also connected the professional animation studio experience to how the process brief should be executed in the classroom:

It also occurred to me that the storyboard was the final stage and there was no room for improvisation or change of script at the filming stage. All problems and technical methods are worked out before the filming begins. I got the impression the filming aspect was strictly following the instructions of the script and storyboard. In the oil spill animation the children did improvise when filming and this caused some conflict as it was not agreed upon.

(Zoe, Animation Studio Reflection, Apr 2001)

Teachers brought their pedagogical orientation to the way they designed process briefs for their students. Stages were clearly articulated to students, with development of one stage being necessary before moving on to later planning and designing. Process briefs were designed to support students to conceptualize the whole, while working on separate aspects of design. Teachers reported that students developed a strong sense of process that included "pre-planning, implementation and evaluation" (Gerry and Bart, Final Evaluation, 2000). All process briefs were strongly characterized by the valuing of

student input, with teachers providing only decision-making structures and students providing the majority of the content and ideas. For Gerry and Bart, this was a significant shift in their normal pedagogical orientation to students, which in the past had been more characterized by teacher-directed, didactic approaches:

> *Whereas there was a need for me to use computer sessions for information dissemination and have a teacher directed focus, there is now a much greater onus on the students to become leaders and peer trainers and I am able to treat most work-station group activities as student-centred.*
>
> *(Bart, Professional Learning Evaluation, Aug 2000)*

> *The project has brought about a change in our teaching styles, strategies and classroom organization.*
>
> *(Gerry and Bart, Final Evaluation, Nov 2000)*

Teamwork and Collaboration

All of the teachers requested that students work in groups to produce the animations. For Gerry and Bart, teams remained organized in ability groups, their normal literacy block structure. Zoe's teams were multi-age, also her normal practice.

Each teacher highlighted the importance of supporting students to develop their ideas. Both Gerry and Bart noticed problems in this area, with some students tending to dominate and "railroad" their ideas through for the animation, while others held back initially:

> *Each Guided Writing group was asked to discuss possible storylines and then try to develop a story that could be storyboarded. What l found interesting was that while some students were initially ready to agree with anything, just as long as something was down on paper, after some discussion they were more ready to state their ideas. Group 4 (the strugglers) had the integration aide working with them and she observed that while initially she had to really probe to get a story going, after a little while students became enthusiastic, wanting their ideas to be incorporated.*
>
> *(Gerry, Journal, Week 1, Term 4, 2000)*

Students were asked to allocate roles within their teams, during both the planning and production phases of the animation. Early teamwork in Gerry's classroom was

characterized by all students performing parallel tasks, then negotiating to select the best ideas to proceed with. This structure was similar to students' previous work in groups, which was also characterized by all students in the group engaging in the same task. Gerry's rationale for this structure was to ensure that all students contributed to the thinking and ideas phase of the animation development. As students moved in the scripting, storyboarding and production phases, role requirements became more differentiated, with separate tasks being assigned to different group members. Zoe noticed that this more closely resembled the real world teamwork of the professional animation studio:

> *The studio made it clear that animation relies on teamwork and cooperation. In reality a team of four or five people may do the concept, scripting, storyboard, filming and editing. This is why it is so important to be clear and accurate at all stages. The children would need to work together as a team and work out the roles of each member.*
>
> *(Zoe, Animation Studio Reflection, Apr 2001)*

Bart also began by requesting that his students work in parallel ways to develop initial ideas. Within teams, they then engaged in discussion, negotiation and selection or integration of ideas before moving into real world, differentiated roles, such as 'director', 'camera operator' and 'camera assistant'. At the completion of each animation, students were required to write post-production evaluations that commented on both process and product.

Technical Issues

At the technical level, access to and availability of equipment was problematic, with the leadership at one school reluctant to invest in the required equipment for such a new process until its value was proven. This caused anxiety and stress for the two teachers concerned as they had planned a unit of work using animation. Organization of adequate hardware was subsequently recommended as an important aspect of early preparation.

Teachers felt that they needed time to play with the equipment themselves and become somewhat familiar with the different features. Although their students learned a great deal through trial and error and experimentation, teachers felt that their pedagogical intervention could have been more useful if they had more confidence in the full

capabilities of the equipment and software. Technical knowledge was generally developed along the way, with one person sharing discoveries with other teachers or problem solving such issues as adding sound when the need arose. This conflict between how much knowledge about the technology was necessary before introducing it to students, and learning to use it alongside students was common. In reality, teachers mostly learned enough to get started with their students, then learned the more advanced features either through experimentation, being shown by other colleagues, or being shown by their students.

Teachers generally provided their students with the use of their own personal laptop for the animations and, as a consequence, quickly found their hard drives full due to the large file sizes. A range of technical problems consequently arose around storage and capacity of networks and hard drives, in one case halting animating because of a reluctance to delete existing files.

Both Bart and Gerry taught the technical skills of the animation process during their focus teaching groups within the literacy block structure. Zoe more often made a special time, frequently her non-teaching time during or after school, in order to work with a particular group. Her busy team-teaching, multi-age classroom made a special teaching session difficult in the normal course of her day, and equipment limitations meant only one group could animate at any one time.

Technical issues could therefore be characterized as learning oriented (what teachers and students needed to learn in order to successfully use hardware and software to produce an animation) and practically oriented (issues of access to equipment, obtaining leadership support, storage capacity of networks and computers).

Philosophical Orientation

Each of the three teachers who introduced animation articulated an orientation that reflected particular values. Zoe married her strong values in relation to children's creativity with this new form of technology use:

> *I really loved the way the children were able to maintain their unique creativity whilst using technology as a vehicle to present their work. The children's art work and story telling were valued within the animation and able to be shown*

off in a high tech way. This to me was especially exceptional as I have shown concern about the lack of creativity in many software programs.

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(Zoe, Journal, July 2000)

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During the project, Zoe had frequently expressed her dislike of clip art and the homogenization of student work that was facilitated by the use of technology. The animation product overcame these concerns and she was able to situate its use in a process that fostered the development of higher order thinking skills and independent learners, other strongly articulated values. Zoe was also able to guide students' use of animation towards matters of substance, another theme that was regularly articulated by her during the course of her reflections.

Bart expressed conflict over competing values in relation to introducing animation into his classroom. After making the animation groups the target of his teaching groups during his literacy block, he was concerned that he could no longer support and guide activities in the groups that were reading particular novels:

I decided that I'd actually have my focus group as the production phase for each animation group. This worked really well and I was inspired by the motivation and problem solving skills of the kids. The difficult part of this was freeing myself to work with the animation group (including training) after having spent some real quality time with my novel groups… I was disappointed that I wasn't able to use the novel group as my focus group (the animation group took up the majority of my time). It's definitely important for me to work with each novel group to ensure that they get the most out of each activity. Without my full attention it is difficult for many children to work as efficiently as they might if I lead the group. This is a concern and I will have to redress this by allowing for each novel group as my focus group next week.

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(Bart, Journal, Week 3, Term 4, 2000)

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Gerry articulated a strong orientation to following a sequential process, the production of quality work and the development of effective group processes. Where students wanted to jump straight into the animation phase, she wanted them to work through each phase sequentially, first developing their ideas and storylines satisfactorily, then developing their group storyboard, followed by the development of sets and props before shooting the animation and presenting it.

The main difference noted in philosophical orientation was the degree to which the early stages of the task represented student interests and input. The degree to which teacher-determined parameters were provided in comparison to student negotiated parameters varied between different teachers. All teachers exhibited a significantly student-centred orientation to the animation process, compared to earlier ICT tasks which tended to be oriented more to curriculum outcomes or the technology itself.

Thoughtful Awareness and Response

Quality Work

Quality work was a common concern of teachers and the subject of their theorizing. Zoe theorized about quality as part of her reflection on what animators were about. She noted that "animators are editors" and:

> *Reflecting, editing, self-correcting, and re-reading are all skills that children need and, as a teacher, the most difficult to teach. I think this is because we value process and the finished product is never the focus. However if we change our focus to good quality product then the process would have to be efficient and thorough. We also need to see editing as part of the process. The editing process in animation is about making the product perfect. It is about having a polished piece of work to be proud of. When the children had the chance to edit their oil spill animation they were thrilled as they then felt it was complete, without mistakes. Editing can also be about improving quality not just taking out mistakes. Children can learn to ask could we have done this scene better? Editing will then link in with the planning process of the next piece of work.*
>
> *(Zoe, Animation Studio Reflection, Apr 2001)*

In this case the notion of quality is connected to critical literacy and aesthetics, with a focus on critique of the product.

Gerry also raised issues about quality, worrying that students were not using time effectively and requesting groups to re-work storylines to improve their quality. Gerry and Bart, who both used the ability group structure for teams, made quality judgments about the work of different groups, clearly identifying which group had come up with the best animation:

Group 4 were the next group to present. Gerry explained that these were her "strugglers". They described all the props and the scene they had set up. This group had used a torch for lighting effects (which looked very effective in the animation). Gerry congratulated this group and noted that after she sent them to rework their original animation idea, they had come up with one of the best animations in the class.

(Researcher observation, Classroom visit, Mar 2001)

The most impressive group was actually Group 3 who had balloons burst when they reacted to the heat of the sun. This looked fantastic and created a great sense of achievement amongst a group who haven't been known for their ability to 'get the job done'.

(Bart, Journal, Week 3, Term 4, 2000)

Further descriptors of quality were not elaborated but are indicated as a future area for action. In general, teachers used their structured development of process and design briefs as the main support to elicit a quality product from their students.

Theorizing and Problematizing

Throughout the course of teachers' work in developing their understandings about the animation process, a range of questions and concerns emerged:

- Process concerns: What is involved in the design process for developing a quality animation - drafting and improvement?
- Role concerns: What roles are required for the development of an animation - who does what (including student and teacher roles)?
- Product concerns: Design principles - what makes an animation work effectively?
- Metalanguage concerns: The language of animation - what do we need to teach our students so that they can better critique the animations they see and that they and their peers create?
- Multiliteracy concerns: What do school age children need to learn if we are to prepare them more effectively to understand, communicate with and create visual media?

Teachers also reflected on what it meant to be an animator, noting that they needed to be story tellers, planners, editors, team members and observers of movement. This shift in pedagogical focus to human roles rather than achieving specific measurable outcomes may have been a catalyst for the complexity of thinking that teachers developed around their use of animation.

One teacher used the real world planning process used by animators to compare and contrast ways of thinking normally encouraged in schools:

> *This way of thinking is not normally encouraged in schools as we tend to ask children to manipulate concrete materials first, then record what has happened. Most story telling is a recount and children are usually drawing on previous experience. I think it would be beneficial to begin children scripting stories that they have experienced. I also think it is an excellent skill to learn and would be one to work towards.*
>
> *(Zoe, Animation Studio Reflection, Apr 2001)*

Although valuing the process she had observed, Zoe's beliefs and knowledge of how children learn took precedence in terms of how she planned to develop strategies with her class. Competing beliefs and values therefore are assimilated, with acknowledgement that the real world process is something to work towards with children.

Relationships and Interactions

The animation projects were characterized by significant shifts in the types of interactions that normally occurred in Gerry's and Bart's classrooms. The teacher-to-student interactions changed so that both teachers described themselves as moving into facilitation roles. The instructions given to students were far less didactic with students engaging in markedly increased decision-making and negotiation.

Student-to-student interactions also changed, moving from group work which was characterized by students simultaneously engaging in the same tasks to interactions which required them to plan, organize and execute differentiated roles in order to successfully complete their tasks.

Both of these interaction shifts demonstrated an increase in authentic and productive pedagogies (see Chapter 2, pp. 22-25). Teachers developed the animation process with their students so that there was a clear trajectory from conversation to production. Student learning took place in groups and teachers noted regular incidences of students learning from one another, with the process often allowing particular students' creative abilities to shine. Students were active in the production of the animation and its subsequent presentation to an audience. Although teachers reported that students demonstrated strong enthusiasm for and ownership of their products, the degree of usefulness of the animation to students is not clear from the data. Their participation in decision-making in terms of how they would respond to design briefs represented an increase in students' locus of control.

Relationships, talk and communication are indicators of authentic pedagogy, which in this case was illustrated by the degree to which teachers provided students with opportunities to plan, negotiate, discuss and decide.

Productive pedagogies (Luke et al., 2000) were also more strongly reflected in teachers' work with animation. The intellectual quality of the task required students to engage in higher-order thinking and problem-solving. Teachers began introducing a range of terminology or 'metalanguage' that enabled students to describe the process they worked through. In Zoe's case, students were asked to connect the topic of their animation to concerns they had in the world, while all teachers made connections with the real world roles of animators. Where Zoe's class was already characterized by high levels of student involvement in making decisions about their learning, the increase in student control, engagement and self-regulation was a significant change in Bart's and Gerry's classrooms. The animation process was structured in such a manner that previous hierarchies of difference, based on ability levels, did not hold true, with students usually characterized as 'strugglers' in print-based literacy tasks, producing work that was considered to be of higher quality than their peers. The recognition of difference' area of pedagogy took on new meaning, with higher levels of status being bestowed on traditionally marginalized students.

Influence of Contexts and Structures

Existing classroom structures determined the structure of teams and whether they were characterized by ability groups and multi-age groups. The ability group structure was

firmly embedded into the literacy block in Gerry's and Bart's rooms so that even when the learning task was not structured in such a way that required presentation of ability matched texts, students were still required to work in their ability groups to enable efficient group rotations. At times, some activities matched students to print-based text (e.g novel studies) while others did not. The impact of ability grouping on students requires more research, particularly from the perspective of their own identity and how they perceive the expectations that are placed upon them. Connell (1993) vehemently cautions that such practices as streaming and tracking are an "affront to equal provision of education" (p. 15).

Time structures were an issue for all of the teachers. Gerry provided her students with full 2-hour literacy block times to develop their animations but felt that despite this, students did not always use the time wisely. This may have been because they normally worked in groups in a parallel manner, whereas this task required them to collaborate in significant ways that were new to them. Her desire to engage students in the animation process meant that she made significant changes to the structure of her literacy block, dispensing with rotations on several occasions.

Zoe also felt that the normal time allowed for rotations within her literacy block was insufficient to develop an animation, as she felt students needed concentrated time over several days to be successful:

> *We had different animations earlier, though I've been having trouble with that structure as well. As far as the setting up and the amount of time that it takes, you almost need to be there with one group of children for two or three days, you have to keep that motivation happening. If you're doing a rotation, you can't just set up and go. It's actually very time consuming to do a quality animation. But still they did it and they pestered me about it, which is good. That's what you need.*
>
> *(Zoe, Interview, Dec 2001)*

The time structures of schooling have been mentioned elsewhere as problematic in terms of enabling innovations and restructuring to occur in schools (Atkin, 1991; Burniske & Monke, 2001; Cooper & Henderson, 1995; Dede, 1998; Kruger et al., 2001; Middleton & Hill, 1996; Peters et al., 1996). Fullan (1993; 1999), Hargreaves (1992; 1994) and Apple (1996) all stress the importance of changing the ways teaching and

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learning are organized, together with organizational changes in structure and culture if educational reform that benefits all students is to occur.

Conclusion

Teachers' use of animation in the classroom reflected significant literacy concerns:

Operational literacy

1. Technical: learning to use hardware and software associated with stop motion animation;

2. Communication: learning to communicate through the genre of animation.

Sociocultural literacy

1. Social Practices: connecting knowledge and experience to construct meaning through animation. Simulating real world practices;

2. Context and purposes: developing understandings of appropriate opportunities, contexts and purposes for using animation.

Critical literacy

1. Technology: developing a critical view of the strengths and shortcomings of the technology;

2. Social practice and product: developing a critical view of the process and the product through reflection and evaluation;

3. Metalanguage: learning the language to engage in critical conversations about the technology, the social practices engaged in and the cultural product produced.

Their work can also be firmly situated within a multiliteracies agenda, highlighting the importance of design and developing facility with multiple modes of communication and how these can be integrated to construct effective messages. Teachers required students to draw on their understandings of the world, both in terms of how to communicate through new media and their decision-making in terms of what to communicate about.

Teachers' work also revealed the importance of developing students' facility with metalanguages that address the different design phases of the animation process. Such metalanguages are needed beyond the literacy or multiliteracies agenda, and need to include language which describes social practices, teamwork, thinking and learner roles. Only with such language facility will students be able to effectively engage in discussion, critique and refinement of their work.

Links with the real world and the professional craft of animators proved to be beneficial in developing teachers' understandings of the animation process. Just as the authentic and productive pedagogies agendas recommend student learning be connected to the real world, so too did teachers learn from observing professionals at work and engaging with them in discussion about their own work and the implications for future action. As well as increasing teacher knowledge, such opportunities also increased teachers' sense of engaging in relevant and worthwhile practice.

Furthering a multiliteracies agenda that may include the use of animation and other multimodal forms of communication requires connecting schools with the community. Kozma and Schank (1998) support this notion suggesting that:

> *Change of this magnitude cannot depend on the skills and efforts of teachers alone; the entire community must elevate the importance of education in everyday life by developing a strong social commitment to the educational endeavour shared by students, teachers, parents, business, and community leaders. (p. 4-5)*

The development of a multiliteracies agenda would benefit from teachers being provided with opportunities to observe and engage in discussion with professionals who excel at using the different modes of communication. This includes such people as linguists; visual, fine and performing artists; graphic designers; composers and choreographers; architects, systems analysts; media presenters and critics.

Any reforms in education must tackle social questions, which is supported by a multiliteracies agenda that aims to prepare students for personal, public and working lives (Cope & Kalantzis, 2000).

Chapter 8: Using ICT in the Early Years

Introduction

Teachers are increasingly aware of their role in preparing children for a world that is changing rapidly, partly in response to rapid technological innovation. This has necessitated reconceptualization of the role of technology in the education of young children (Bowman & Beyer, 1994). Bowman and Beyer suggest situating children's use of ICT within three interconnected theoretical/philosophical perspectives to support this reconceptualization.

The first, drawing upon Piagetian and Vygotskian traditions, emphasizes developmental appropriateness and child-driven curricula in which "children interact with authentic objects that they can understand and control directly" (p. 20). Learning involves children recognizing and constructing relationships, so the implications for computer use are provision of hardware and software that "places children in control and permits them to confront problems understandable and of interest to them" (p. 20). Through relationships with others, human mediators of experience, language, thought and feelings, children are supported to construct knowledge and understandings.

The second perspective highlighted by Bowman and Beyer (1994) draws on the work of multiple intelligences proponents (Eisner, 1985; Gardner, 1983), which values different kinds and ways of thinking. This theoretical position implies that computer experiences "should tap children's potential for imaginative, creative, and emotive as well as logical and empirical thinking" (p. 20). This view also raises questions about the kinds of thinking that are more consistent with technologies, "linear and sequential organization of ideas, expression of symbolic and abstract thought, and discrete categorical systems" (p. 29) in particular. Thus caution is recommended to ensure that other modes of thinking and ways of organizing and representing experience are not rendered less valuable as a result of the reification of technology, and that children have a variety of opportunities to grasp and construct meaning "through their emotions, their sensory perceptions, and their bodies" (p. 29).

The third perspective situates technology use within social and cultural contexts, arguing that technology is a social phenomenon with "meaning drawn from and created by people" (p. 20). This suggests that young children must come to understand ICT in

relation to the values and beliefs of their communities, and begin to make connections between the social, the cultural and the technical if they are to be genuinely 'competent'. When these perspectives are considered, together with the work of Lankshear, Snyder & Green (2000), Lankshear et al. (1997) and Bigum (1995), consideration of the operational and critical dimensions of children's technology use must also be highlighted.

Rationale for Selecting this Issue

This chapter focuses mainly on P-4 teachers' use of ICT in relation to their teaching of numeracy. These teachers formed two loosely connected inquiry teams. The Prep and Year 1 (P/1) and multi-age teachers brought a strong thinking agenda to their research intentions. This was integrated with the Year 3 and Year 4 (3/4) teachers' interests, to better incorporate use of ICT into their numeracy curriculum. Although teachers' research interests broadened from the singular curriculum focus of numeracy, this chapter selectively focuses on the teaching of numeracy in the Early Years, teachers' thinking about children's thinking, and pedagogy and practice in relation to children's learning and use of ICT to support these agendas. This decision was a response to teacher recommendations that it was beneficial to begin with a narrow inquiry focus, and because there is currently a dearth of research that connects use of ICT and numeracy in the Early Years of schooling.

Context, Influences and Beginnings

The Early Years Inquiry team involved teachers from four different schools. A range of year levels were involved in the study with one teacher from each of the following teaching arrangements:

- single teacher Prep (P) class
- team teaching multi-age class of Prep/1/4/5 with dominant responsibility for P/1 students
- team teaching composite P/1 class
- single teacher Year 4 mathematics instruction only (Assistant Principal)
- single teacher composite Year 3 /4 class

Starting Points

Teachers described their use of ICT at the beginning of the project as limited and felt they lacked both the confidence and knowledge to integrate it into their curriculum:

> *Robin: Prior to this project, students used one computer on a rotational basis exclusively with prescribed software that reinforced concepts. Students attended the computer lab one time per week with a computer teacher. The work that was done in the lab was not integrated with our classroom studies. I was not informed about the ICT lessons, outcomes or assessments. I felt scared to use ICT in my classroom as I had no experience and no ideas as to how to implement ICT across the curriculum.*
>
> *Zoe: Twelve months ago, we had five computers in a double classroom that were predominantly used by the Year 5/6 students for word processing and games. I did not plan for ICT nor did I integrate it in my classroom program. The computers were mostly used for publishing stories, typed by me, and as a reward for children who finished their work early. I did not monitor students' use of the computer but was aware that the students' skills and expertise were beyond my own and therefore saw myself as redundant as a teacher of ICT. I knew that I needed to integrate technology and saw it as important but lacked the personal confidence, experience and knowledge as to how to go about this.*
>
> *Nina: Twelve months ago, I was using computers in some aspects of the curriculum. I used ICT in literacy rotations and integrated studies. I did not use ICT in Maths, with the exception of making clocks and representing time or calendars. I did not plan regular ICT activities but used it as a student exploration learning centre. I was using some aspects of creative thinking techniques with my students in integrated studies. I was teaching whole group activities in Maths, with no small group work whatsoever. I was interested in using ICT and took my students to the laboratory weekly and taught them a range of software including Kidpix and Creative Writer.*
>
> *(P/1 Early Years Team, 12 month Action Research Report, Nov 2000)*

This lack of confidence and knowledge resulted in teachers initially allowing children to simply play with available software:

I have the computers as one of my tasks in the Early Years literacy program, but not with much direction. The children tend to play their favourite game. This is partly due to my lack of input, but also we have little software to accommodate the needs of the Early Years program.

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(Zoe, Snapshot, Feb 2000)

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Thus, at the start of the project, teachers used computers with their students in limited ways. They either provided little or no direction and let them play or explore, taught them the specifics of software applications but didn't use this in their numeracy programs, or used closed mathematical software that required students to respond to specific questions or prescribed problems.

Motivation to change

Teachers were highly motivated to take on the challenge of integrating ICT more effectively into their curriculum and classroom programs. For some, this arose from dissatisfaction with current practice which they felt did not realize the full potential of ICT. The limitations of only using ICT for reinforcement of concepts also led to the identification of a need to explore the possibilities of using computers for discovery and creative thinking.

Teachers were strongly influenced by Department of Education priorities, where use of ICT was strongly advocated and a new Early Years Numeracy strategy and research project had been announced. As both areas of practice (ICT and numeracy) needed to be addressed anyway, teachers felt it would be productive to focus on these areas in their action research.

Teachers' motivation to change also arose from looking outwards beyond the school to the changes they perceived happening in the world and the capacities they felt students would need to operate effectively in the future:

I want the children in my class to be critical and thinkers, not servants to instruction…I want to prepare the children in my class to be life long learners where they are skilled enough to be able to cope with the changes ahead and able to make choices about their futures…We live in a rapidly changing world and we need to think about the impact that this must have on educators. It is not enough that we teach the same way we were taught. Children today are faced

with many issues that need to be addressed by educators, and the integration of technology is probably one of the most significant changes in our society. If we wish to create schools that reflect society, we need to carefully look at ICT and how it is being used in the class. Is it teaching children to follow instructions and give shallow answers to irrelevant questions or can we ensure technology is used as a tool to guide children to develop as independent life long learners? I would like to include aspects of this into my research. I am keen to find out how ICT can encourage children to become active, not passive, learners.

(Zoe, Snapshot, Feb 2000… Journal, October 2000)

One teacher noted that her initial motivation to use ICT came from a fear of being 'left behind' or being 'out of date' and she had enrolled in a short ICT course to improve her chances of employment.

Thus the motivation to change was due to both intrinsic and external factors, high interest coupled with varying levels of confidence and feelings of competence, and strong desires to do the best for students in terms of preparing them for the future.

Early Concerns

All teachers began the project with software concerns, wondering what was suitable and available. Teachers noted that much young children's mathematical software used the method of "drill or rote learning" and were designed to "consolidate skills rather than introduce or encourage problem-solving skills" (cited in Teacher Journal reflections). Teachers were also concerned that many of the available software programs were American, and wanted to find programs with Australian content that was culturally relevant. Thus teachers initially looked to software for solutions, but were also cautious and critical in relation to potential possibilities:

Part of my project is looking for programs that enhance children's thinking skills in the Early Years. I will try not to be limited by recommendations re age appropriateness, but focus on the skills I am looking for. I can work around the other problems by being flexible with groupings and drawing on the other skills and support available in our class.

I will also try to set tasks on the computers that are open-ended and leave room

for the children to be creative and to extend themselves as much as they can.

(Zoe, Journal Summary, Feb 2000)

Early concerns related mostly to finding out what relevant resources were available (software, websites, articles etc.) and finding out what other teachers were doing in relation to numeracy and ICT use. Teachers wanted to extend their knowledge and skills in relation to computer use and how to use ICT more effectively to enhance the numeracy learning of their students. They wanted to integrate ICT more effectively into their class programs and improve children's decision making skills and capacity to select and use appropriate tools to assist their mathematical thinking.

Teachers were encouraged to maintain their interest and focus on children's thinking and to use this as a guide for decision making about the use of ICT in their numeracy (and other) curriculum programs. They were also provided with information in relation to software evaluation that recommended diverse use of a small number of open-ended software applications, which alleviated some of their initial concerns about not having a broad range of software applications available in their schools.

Pedagogy and Practice

Educational Intentions

Teachers' intentions for their numeracy sessions could be classified similarly to those identified in relation to literacy: technical/operational (learning to use the technology and learning basic numeracy skills and concepts); sociocultural (the kinds of interactions teachers wanted students to engage in and ways of connecting conceptual and procedural development to real life purpose); and the critical (encouraging students to engage in critical thinking about their strategizing and process, and problematizing the role of technology).

Technical/Operational

Learning to Use Technology
Three main approaches to teaching young children to use ICT were identified. The first involved direct teaching of general operational skills and procedures and the development of related vocabulary and factual knowledge about the machine. The

rationale for this was connected to this teacher's desire to enable her students to work independently on interesting tasks:

> *I had some great ideas of how to begin incorporating the computer across the KLA's but what was stopping me was that I had to do so many steps for the kids. I had to turn the computers on, logon, locate the software on the desktop, open the software, save it, shut it down, and so forth. These tasks took me away from the rest of the class where I was needed. I ended up taking small groups for guided computers much in the way guided reading is directly taught.*
>
> *(Nina, Reading Response: The Trouble with Checklists, July 2000)*

This teacher developed a checklist of operational skills and procedures, and in addition to small group, guided instruction, provided her whole class with explicit instruction in a computer lab. Nina generally demonstrated a few steps at a time on a data projector, then instructed students to move to computers to practice each sequence of procedures. The skills she identified included logging on to the network; locating, opening and closing applications; creating new documents; saving work on the student drive of the network; relocating and adding to saved work; accessing particular CD's; discovering and using the various tools available in open-ended applications; and shutting down the computers.

Nina noted some conflicting feelings about the above process:

> *The students had a mixed response to these sessions. I am still confused about how I feel and think about it all. The process was difficult, laborious and time consuming for me, boring for them and I turned my excited little chaps right off. They started asking me when they could go back to our classroom. However, I don't have to do most of those steps for them now. It has saved me from spending hours on technical support that I now spend teaching and supporting the students' learning. The computers in our class are safer from incorrect usage.*
>
> *(Nina, Reading Response: The Trouble with Checklists, July 2000)*

In this case, the drive to use a particular classroom organization strategy (Early Years focused teaching and group rotations) created the need for high levels of technical independence to be exhibited by the students. Lack of such skills was perceived to be

getting in the way of the 'real business' of teaching and learning. Nina confronted the pedagogical dilemma of working with children in a time efficient manner that caused them short term 'pain', versus the long term gain of enabling students to engage in enjoyable and challenging activities as part of her rotational numeracy activities.

A different approach to teaching children technical/operational skills and procedures involved teaching on a 'need to learn' basis, with technical skills and procedures identified in the context of particular activities that children were asked to do:

> *In another session this week I made up a cloze activity where the kids had to drag the correct word into the space provided and drop it. I was amazed at how many of the children did not know how to drag and drop. It didn't take very long for the children to learn how to do it. I think this is the best way to teach these skills anyway. I think it would be beneficial to have some type of list of skills needed to be taught in each year level, just so we make sure the children are progressing and have learnt new and different skills. But the way in which we teach these skills should be integrated into Language, Mathematics or Integrated Curriculum and taught in a way that the children feel they have a need to learn them. The children remember so much more.*
>
> <div align="right">*(Robin, Journal, Nov 2000)*</div>

In this case, the teacher's intention had strong technical and operational literacy interests and was geared to develop particular curriculum outcomes. The need to know, although established, was more strongly connected to the teacher's interests and curriculum agenda than to the students' interests.

The third approach utilized by teachers involved play, exploration and experimentation. Prior to asking children to perform specific tasks using particular applications, teachers provided children time to familiarize themselves with software. Sometimes teachers taught one or two children key features of the software, then discovered an 'osmosis' effect as children rapidly learnt from each other and the designated 'experts':

> *I felt that this evidence confirmed my feeling that children do not need formal instruction from a teacher to learn how to use a computer. The children got to this stage by spending a lot of time playing and experimenting with the Paint program. They have generally worked in twos where one child is more*

experienced with the program…It has been interesting to watch the progress the children have made through little input from myself. Yet the progress has been significant.

<div align="right">

(Zoe, Journal, July 2000)

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After sharing and discussing these different approaches, Early Years teachers recommended teaching operational technical skills by:

- allowing students exploration time when introducing a new piece of software, encouraging them to discover different aspects of the program and sharing their learning with other class members;

- creating a context for learning ICT skills and procedures by proposing a challenge or problem that engages student interests;

- providing explicit instruction when a need to know/learn/use was identified;

- providing a small number of children with explicit instruction in technical operation of hardware and software and encouraging other children to refer to them in peer tutoring/student-as-expert arrangements.

Teachers concluded that a checklist of skills was more for the teacher's benefit than the students. Such lists could help teachers develop their understandings, so that they could quickly make needs assessments in relation to what children needed to know, and intervene to extend their learning.

Learning Numeracy and Thinking

Teachers' intentions in relation to the teaching of numeracy were strongly influenced by the Curriculum Standards Framework II (CSF II). Most teachers selected an outcome or group of outcomes to address within topics such as space, volume and capacity, number, place value, length, symmetry and directionality. One teacher linked some of her numeracy teaching to an overall integrated topic e.g. children were asked to design gardens and represent the number and types of vegetables planted. This also created a meaningful context to teach the technical concept of 'cut and paste'. In general, numeracy intentions focused on developing children's conceptual understandings, and ICT was used as an alternative way to experience, represent and/or model the concept.

Professional readings prompted teachers to clarify their approaches to numeracy learning, and led to teacher theorizing:

Teachers now need to extend children to be able to think with and about mathematics, rather than the set procedures and directed solving of straightforward problems. Children will need to be taught how to analyse the problem, explore mathematical knowledge and understanding in order to come up with the best possible path to solve a problem. As problems need to be returned to and examined in detail on more than one occasion, teachers and students need to realise that time limitations and the external reward of a teacher's mark is no longer a measure of success.

(Robin, Reading Response: Thinking Mathematically, April 2001)

Teachers' intentions in relation to the development of children's thinking focused on ways to "make thinking visible" with children asked to "create, compare, make, draw and portray" (Extract from mid-year Action Research Reports). Teachers emphasized the importance of children engaging in inquiry and investigation and developing the language to explain their thinking and strategising.

Teachers interests in children's thinking were not limited to the area of mathematics learning and they were also influenced by more general articles, in particular those that explained creative thinking:

I am going to try and employ the techniques mentioned in the article in my own teaching and to teach these techniques to my students:

- *Divergent thinking: my Prep students haven't yet been infected with the notion that there is only one right answer in our Maths discussion.*

- *Deferring judgment - this is where I may be the weakest because I tend to respond to situations and ideas intuitively and quickly. I don't want to pass this bad habit to my students.*

- *Extending effort: have lots of ideas. Active listening and strategic questioning will help promote this technique.*

- *Allowing time: this is difficult in discussions but with persistence and commitment I can allow my students time to think, to reflect and to return to their work after an incubation time.*

- *Encouraging play: in my team's planning and teaching we are striving to encourage play to applying and extending ideas, testing hypothesis.*

The idea of making thinking visible is helpful to me. It is something that my partner and I do already but in articulating it I feel surer of our direction. We keep lists of students' ideas, we draw maps, we use children as models, and we write drafts for students to see. To put all of these together to show the thinking process could be a powerful tactic. Another section of the article gave me good ideas of how to stimulate the creative thinking skills of fluency, flexibility, originality, and elaboration.

<div align="right">(Nina, Reading Response: Teaching Children to Think, Ch. 2, May 2000)</div>

Professional readings broadened teachers' awareness of thinking, which in turn broadened their intentions in this area. Reflections then helped to integrate theoretical perspectives with ideas for reconstructing practice.

Teaching Practice

The following areas emerged during this study as key teaching concerns and approaches:

- Organization and planning
- Stimulating a 'need-to-know'
- Multiple modes of experience
- Sharing, reflection and strategic questioning
- Revisiting, repetition and reinforcement

Organization and Planning

All teachers used the organizational strategy of 'whole-part-whole', beginning with a whole group shared experience, then breaking students into groups for activity rotations, and finishing with whole group sharing and reflection.

Teachers used multiple methods of grouping children for learning activities, including one to one teaching, parallel and interdependent group work and peer tutoring or mentoring. All teachers stressed the importance of 'fluid' groupings, so that the composition of groups changed regularly in response to children's needs. Ability

grouping generally predominated the group structures, but some teachers used mixed ability groupings in their alternate rotational activities.

Teachers perceived the linking of thinking and ICT with key planning documents as a crucial turning point in moving the use of ICT beyond 'add-on' work:

> *I was in the class only two days this week and we didn't use the computers at all as we were doing a lot of work in response to the children's interest in the Olympics. Looking back I could have integrated ICT in many of the activities we did, although didn't. This shows me I need to maintain vigilance when planning to ensure I continue to include ICT. It is easy to slip out of using it again when I haven't consciously included it in my planner. I have already altered my Maths planner proforma to include ICT as a component, but need to do this with other KLA's .*
>
> <div align="right">*(Zoe, Journal, Oct 2000)*</div>

Once teaching ideas and approaches became embedded in daily, weekly and term planners, teachers reported shifts in attitudes towards ICT, and that it became much more 'natural' and 'easier' to come up with ideas that were an extension and development of curriculum. All teachers reported making several changes to their planners so that ICT was eventually planned for in all key learning areas. Some teachers also included a thinking strand in their planners. This kind of documentation also facilitated discussion with colleagues and opportunities for sharing ideas.

Stimulating a 'Need-to-Know'

Teachers generally began numeracy topics by stimulating a 'need-to-know' and creating or referencing various contexts for learning. Examination of teachers' pedagogical approaches revealed differences in the way children's interests were activated. One teacher led her children to identify a need-to-know by posing problems or challenges for them to explore and discuss, while simultaneously requiring them to draw on prior knowledge and experiences. For example, when introducing the topic of 'length', Robin engaged her Prep students in the following discussion:

> *Previously we had measured the length of objects by comparison and I now wanted the children to see the reason for measuring length using standard informal measurements. I posed the problem, " How big is that table?" The*

children came back with responses like, "It is big" or "It is bigger than the chair." I asked them how they could explain to somebody who wasn't in the classroom the size of the table. The children decided they could measure the table with their hands, and then they could tell their parents how many hands big the table was.

We measured the table with our hands and discovered that everybody's answer was different. The children thought this was due to two things. Depending on the size of the hand, the measurement differed and if spaces were left between the hands, the measurement wasn't accurate. We discussed how different people have different sized hands and therefore their measurement was different to yours, even though we were measuring the same thing. From this the children decided that we really needed to measure the length of things using the same unit. They were allowed to find something in the room to measure the table, door and chair and then tell the class how big each of these things were.

(Robin, Extract from lesson plan: Length, June 2000)

Robin began her lesson planning by referring to the CSF II and identifying two or three specific outcomes that she intended to address. When introducing the lesson to students, she reoriented the topic to actively engage children in 'conceptual wonderings' which led *them* to conclude that they needed to know or use mathematical knowledge or procedures. Her introduction of the lesson is similar to what Kalantzis and Cope (2001b) refer to as 'critical framing', a dimension of pedagogy that requires students to interpret what they are studying in relation to its social and cultural context and critically consider the purpose and rationale for what they are doing.

A second way that teachers introduced a need-to-know involved explicitly stating that they would be learning about a particular area of mathematics. Connie introduced the topic of symmetry to her Year 4 students by first asking them what they understood by the word 'symmetry', where it occurred and what examples could be seen in the environment and nature. A story called *The Magic Mirror* was introduced to the students and vocabulary such as *image, reflection, lines of symmetry, mirror, and copy*. This teacher oriented the concept of symmetry to the children's lives in a more formal manner, a pedagogical approach that Kalantsis and Cope (2001) call 'overt instruction',

involving the introduction of explicit metalanguage to describe and interpret the design elements of symmetry. Her intention for the task was an explicit cognitive purpose.

A third approach to stimulating a need-to-know immersed children in a range of focused and general explorations of a particular concept:

> *In Maths, we have begun to study position in space and to think about maps and mapping. To begin with, we all went out to the playground and climbed up, down, around, left, right, forward, backward, etc on the equipment. Then they were given chalk and boards and began to sketch the layout of the equipment. They are doing a range of activities to do with space and position including mazes, building layouts of the classroom using blocks and toys, a whole class drawing on the whiteboard of our classroom and drawing the layout of our room on paper. Then the students begin to use the computer to draft their ideas of our classroom layout. So that has been the students' thinking task on the computers this week.*
>
> *(Nina, Journal, Oct 2000)*

Nina's stimulus is illustrative of 'situated practice' (Kalantzis & Cope, 2001b), where children are immersed in experiences designed to help them make sense of a 'big mathematical idea' (Clarke & Clarke, 2002), in this case 'position in space'. After the initial stimulus and orientation through activity and play, Nina moved her students into activities requiring more abstract conceptualizations of the concept.

Stimulating a need-to-know through critical framing had the advantage of leading students to decide for themselves what they needed to know what they wanted to pursue through further investigation. In the following example, Robin stimulates students by creating doubt in relation to an obvious answer to a particular problem:

> *During the first lesson I showed the children three containers that looked very different (tall and thin, short but wide) and I asked them to tell me about the containers. I had comments like, "That one is bigger" and when I asked, "What do you mean?" they put the tall container next to the shorter one and said, "See!" I put the tall, thin container inside the wide one and asked the children if they still thought the tall one was the bigger container. Now the children were undecided. After some discussion we came to the conclusion that we had to*

decide exactly what we meant by bigger. I rephrased the question and asked
them which container did they think would hold more. Again this brought about
similar discussion and many different views. This led me into asking how they
could prove to their classmates that a particular container could hold more than
others.

<div align="right">

(Robin, Lesson Plan, May 2000)

</div>

Robin connected sociocultural purpose to her introductory lessons about a concept and framed such activities critically with her students by posing problems for consideration. Her practice successfully engaged student agency and ownership in relation to problem identification and solution finding, while fostering substantive conversation, characteristics of authentic learning (Kruger et al., 2001) and productive pedagogies (Luke et al., 2000). This appears to be connected to her use of critical framing to stimulate a need-to-know.

Multiple Modes of Experience

Teachers were cautious about reifying the computer and emphasized balance in terms of the types of activities students engaged in:

I don't want ICT to be my student's main source of work at school. I just want it
to be one of their tools. They still need to write, to hold, to build, to play, to
sing, to dance, to move about, etc. But I am trying to use it every day in at least
one area of the curriculum. Sometimes I include it in Maths but not everyday.
We have been introducing Maths rotational activities and at times including the
computer for number recording, writing, stamping, representation, etc. I'll need
to think how to extend this.

<div align="right">

(Nina, Journal, Mar 2000)

</div>

Rotational group activities provided students with a range of different ways to experience particular mathematical concepts, generally following whole group stimulus activities. A feature of teachers' planning for these activities was an increasing emphasis on providing students with open-ended tasks, investigations and inquiries, rather than skills practice:

Before I started this project I would have said I was happy with my current practices. But now I realize that too many of the activities were not open-ended or creative.

(Robin, Baseline data summary, May 2000).

Teachers were conscious of asking students to "portray things on the computer without being given a prescription", held back from telling children everything and encouraged them to explain their mathematical ideas and conclusions (see also Clarke & Clarke, 2002):

The topic for the week was congruent shapes. The intention of the week's activity was for the students to discover and investigate, and this would lead to problem solving and discussion. I did hint to the students what could be done, but I only gave them enough information to whet their appetites, as the point of the exercise was for them to investigate. It was important for them to know that there was no right or wrong response but a variety of approaches. I was pleased with the results, as this is indeed what occurred. Two students raised questions, wondering how to solve a problem to do with creating exact shapes and size. Rather than me solving their problems and coming up with all the answers, they came to their own conclusions and tested them. The discussion proved to be valuable for the sharing of ideas.

(Connie, Case Writing, May 2001)

At the same time, teachers were also conscious of their role in intervening when necessary to help children make explicit connections about the task or investigation at hand:

I realise that while it is beneficial to leave things open-ended and let the students experiment for themselves, there are still those who need more structure or guidance than others. It is necessary to be aware of those students and when to step in and offer that guidance. It can be a fine line, and one that means you have to be vigilant to the needs of all the students. As a teacher it gave me a sense that I was achieving what I set out to do, which was to instil a sense of interest and curiosity, the desire to rise to a challenge, and to work to achieve and complete.

(Case writing, Connie, May 2001)

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This is consistent with effective multiliteracies pedagogy identified by Cope and Kalantzis (2000), which points out that immersing students in experience did not necessarily result in conscious awareness and control (p. 32), thus requiring certain forms of explicit instruction if students were to make sense of their learning.

What stood out in relation to teachers' use of ICT in their numeracy programs was not simply the use of open-ended tasks, but how they situated these tasks in relation to other experiences related to particular conceptual learning objectives. Teachers provided children with opportunities to experience concepts through some or all of the following:

- Movement and whole body experiences
- Use of manipulatives or concrete materials for building, modelling, making, showing, proving etc.
- Pencil and paper tasks
- Open-ended computer based tasks
- Focus or target teaching.

Teachers of younger children used manipulatives and whole body experiences routinely, while selective use of these methods by teachers of older students was also sometimes in evidence. For example, when Nina, a P/1 teacher, introduced symmetry to her class she engaged them in the following rotational activities—pasta pictures that were created around a line of symmetry, paint pictures that were folded to create symmetrical pictures, and symmetrical building constructions using plastic and wooden shapes. Symmetrical group body sculptures were later suggested as another possible experience. Children were also asked to complete several activities at the computer:

> One was to use stamps on KidPix to create a symmetrical design. I showed them how to divide the screen page in half with a line and then explained how to alter the stamps to flip, thereby allowing symmetry to be formed. I then explained the next activity using Kidpix, which was to create a simple line drawing. First they had to draw a line down the centre of the screen, then draw a picture around, and incorporating, the midline. I drew a simple Christmas tree, which I decorated. Then I rubbed out half of the picture and asked the students to help me recreate the drawing. This was a serious challenge because it meant that the first student had to create something that was symmetrical and simple enough to be recreated, and the partner had to watch carefully to see

how the drawing was created. Then they had to talk each other through the recreation. It was difficult.

(Nina, Journal, August 2000)

Nina provided her students with a wide range of materials, representations and contexts for the same concept, each slightly different to the other, but with a clear mathematical focus that made the concept of symmetry explicit to children: two of the characteristics of highly effective teachers of early numeracy identified by Clarke and Clarke (2002).

In comparison, a Year 4 lesson on symmetry included only paper based or computer tasks, with the computer task an exact mimic of one of the paper tasks: students worked in pairs where one student drew half a picture on one side of a piece of paper and the other student completed it; pairs of student worked at computers, first drawing a line down the middle of the screen then each student completed half a picture; and a third group folded paper using two lines, then cut into the paper creating patterns. Thus expectations for the Year 4 students were similar to those held by Nina for her P/1 students, but with less modes of experience. The Year 3/4 teachers later identified the need to incorporate a multiple intelligences approach (Gardner, 1993) into their mathematics teaching, which they felt would better cater for differences in students' learning styles.

Robin, a Prep teacher, combined the use a wide range of multi-sensory tasks that immersed children in particular concepts, with challenges that required them to prove or justify. The following activities followed her stimulus activities (described earlier in this chapter), which focused on informal units of length:

We broke into four groups and measured various things within the class.
- *Use icy pole sticks to find out which part of the body is the longest, shortest or similar in length to other body parts.*
- *Use big blocks to see who is the tallest in your group. How much taller is that person to you? (The children were encouraged to use comparative language.)*
- *Measure the table with various things, such as scissors, pencils, shapes and Unifix and report to the group which is easier to measure with and why.*

- *Computer Activity: KidPix. The task on the computer was for both children to draw a line of similar length, one needed to be fairly straight, the other with a curve in it. Then they had to prove which line was the longest.*

In this case, Robin used the computer task to require children to abstract and generalize some measuring principles:

> *Most of the children decided straight away that they could measure their length using stamps, so I let them go for it. After a little while I joined the computer group who were discussing the length of their lines. Some of the children decided that it was very unfair that one child used a certain stamp to measure his line and that stamp was smaller than their own. It was terrific! This just reinforced the fact that when we measure things they need to be measured with the same unit i.e. the same sized stamps not just any stamp. The other discovery was that if we left spaces between the stamps then there were some parts of the line that were not measured. Some of the children had a little trouble making sure that there were no gaps between their stamps, as their mouse control is still not fully developed, but this did not spoil the activity as their understanding of using informal units to measure was still reinforced.*
>
> *(Robin, Lesson Plan, Action Research Report, May 2001)*

Robin's activities also illustrate high expectations in terms of children's mathematical thinking (Clarke & Clarke, 2002). She allowed her students to develop their own strategies and methods and come to their own conclusions by testing out their ideas. She then introduced further complexity requiring children to rethink and refine their understandings through a number of connected experiences, as can be seen during her teaching of a unit on volume and capacity:

> *The first lesson I let them explore some ideas with sand and later brought them back to discuss their findings. After some discussion the children came to the conclusion that if they filled one container then poured the sand into the other container they could see which of the two held the most. Only one problem arose, and that was if the two containers were of similar size and the child who was pouring the sand spilt some.*

The second session we discussed other ways to find out which container held more. The children decided that if they filled a container with cupfuls of sand and counted them, they would be able to compare the capacity of the containers. Most of the children had a go at this and were quite satisfied with their results.

The following week I asked the grade if they thought it would make a difference if they filled their containers with sand, water, rice or beads. They decided it wouldn't really make any difference. After trialling this, some children were concerned that the beads didn't touch all the sides and fill all the gaps and using something like water or sand is better to measure capacity.

My next question to the grade was, "What else can we use to measure which container will hold more?" At first the children only said cups, then they started thinking spoons, small containers and one child said handfuls. The others disagreed and stated that every one had different sized hands. We came to the conclusion that it didn't matter what we used to measure the capacity with, as long as it was consistent.

My four rotational activities were:

1. *Use a cup and water to measure which container holds more. Then use a smaller cup and estimate how many cupfuls it will take to fill the container this time. Test it.*
2. *Use three different sized spoons and guess how many pieces of pasta will fit into each one, then test it. Change estimations after testing each spoon.*
3. *Choose two to three boxes and put them in the order from the one that will hold the most to the least. Prove your theory using rice and a small container.*
4. *Computer Activity: Using KidPix, draw a container in the middle of the page then draw a container you think will hold less and one that will hold more. Now prove it.*

Robin used the specific characteristics of the computer software to deepen children's understandings about the strengths, shortcomings and limitations of their choices of

measurement units for capacity and 2D representation of a 3D concept. She was also very clear about the mathematical capacities she was trying to develop:

> *At first the children said they could pour paint in KidPix, but when we did that it didn't prove which container held more. I asked them what else they could put inside the containers they had drawn to show which held mor,e and they started looking around the room. One child commented that we couldn't fill them because they were on the computer screen and it couldn't hold water or rice, and that when we used 'paint' we couldn't put it into cups to count. I asked them to think about what else was on the KidPix program that could be used to put inside the containers and that they could count. Finally somebody said letters, and then others chimed in with numbers or stamps. They tried this during their small group rotations and had varying degrees of success. After the session we talked about the problems that arose in measuring the containers with stamps and these types of comments were made: the stamps didn't touch each other, there were gaps between the stamps and sometimes the whole stamp didn't fit inside the container and went over the lines. The grade decided that if we put the stamps in carefully we could get some idea of which container holds more but not as accurately as some of the other methods. Also, stamps needed to be placed closely together with no gaps and all the stamps needed to be the same. Later I saw some children move the stamp across the top and down the side of the container to try and figure out how many rows and columns of stamps they would have. I could see the children transfer some of these strategies to the other activities!*

> *The answer to the problem is not always the information I want them to learn. The strategies used, such as pouring from one container to the other, comparing size of containers using an indirect method, and coming up with reasons why the various methods are successful or unsuccessful are often the focus. From experience, during small group discussions and whole class discussions, children come up with their own set of rules to best measure the capacity of two objects. They experience, discuss, justify and can then transfer this knowledge to everyday problems regarding capacity. The progression, from filling a container and pouring it into another container to see which is bigger, to realising that we need to have formal units of measurement, is a natural one that*

makes sense to children who have discovered it for themselves. Children learn
best in environments where they can engage in activities that allow exploration,
language and socialisation from which they can make sense of complex ideas.

(Robin, Lesson Plan, May 2000; Reading Response: "Thinking
Mathematically", Apr 2001)

Robin's example of her unit on volume and capacity is illustrative of all five 'contextual teaching strategies' identified by Crawford and Witte (1999) as attributes of 'outstanding teachers'. These were i) relating: learning in the context of one's life experiences; ii) experiencing: learning by doing through exploration, discovery and invention involving use of manipulatives to model and use concepts, problem solving activities and laboratory activities involving data collection and sense making; iii) applying: learning by putting concepts to use in realistic situations; iv) cooperating: learning in the context of sharing, responding, and communicating with other learners; and v) transferring: using knowledge in a new context or situation (pp. 35-38).

Teachers discovered that the semi-abstract computer based tasks were generally of more benefit if they followed multiple modes of experiences. For example, during Nina's topic on shape and design with her P/1 class, she observed the following problem when children tried to create a model of the classroom on the computer:

One interesting comment made by a child was, "I can't turn the screen around."
He was frustrated because he wanted to look at the screen from a different
perspective and he couldn't physically move it or himself to look at it differently,
unlike the students using the paper or the models. It may be that the computer
should be used at a later date for this type of activity, AFTER they have built
and used concrete aids, after they have used a huge piece of paper and turned it
every which way to have a good look. The work that the children did was great,
the computer work was the weakest of all of the work. That doesn't mean that it
wasn't useful at all. Later, other children who had used the construction
material did go onto the computer and try and draw the room using KidPix.

(Nina, Journal, May 2000)

Teachers in the Early Years inquiry team came to see use of ICT in numeracy as a way of 'bridging' children's understandings about a concept from the concrete to the

abstract. Activities on the computers were more abstract than 3D tasks but less abstract than responding to printed text or writing:

> *The last activity was using the computer to represent numbers bigger than ten. I wasn't sure how they would go with this as I only gave them that instruction. Automatically all of the children went to KidPix. A few struggled with how to set out their work, but again it didn't take long for some children to make a start in one direction and many of the others to follow. At the end of the session I showed them a couple of examples that various children in my grade had done and asked if they thought they could improve on their work if they did it again. The next day we did the computer activity again with two other activities and I could see the children who weren't confident yesterday do a much better job. I liked doing it on the computer as it was almost a step between using concrete material and pen and paper. I sometimes find with place value that when you ask the children to represent it on paper they find it difficult.*
>
> *(Robin, Journal, Oct 2000)*

This suggests two dimensions are necessary when providing students with multiple modes of experience. One is to provide a broad range of sensory experiences that account for different forms of intelligence (Gardner, 1993). The second is to go beyond simply experiencing to target children's thinking by asking them to:

- tackle a challenge

- pose or solve a problem

- investigate and make sense through data generation and analysis

- plan and model

- test an estimation or prediction

- evaluate a variety of strategies and approaches in terms of effectiveness and efficiency

- describe, explain and justify

Teachers' emphasis on open-ended activities and multiple modes of experience enabled different possibilities, strategies and products to emerge (Clarke & Clarke, 2002) and be valued. Teachers of younger children, who emphasized creative as well as mathematical

thinking, held high expectations for their students and designed activities that required effort and persistence, all necessary for effective numeracy learning (Clarke & Clarke, 2002).

Use of ICT to bridge concrete and abstract conceptualizations was a significant finding by teachers. Although computer based tasks were sometimes similar to concrete tasks, they provided children with opportunities to develop visualisation skills, an important mathematical capacity. The semi-abstract nature of the modelling and problem solving, engaged in by students during computer based activities, was also a stimulus for them to refer back to the concrete models to check for reasonableness and accuracy of their representations. Sometimes the computer task gave students ideas for other measurement strategies that they could apply when using concrete or paper and pencil materials and vice versa. Teachers still highlighted the importance, however, of remaining vigilant in terms of decision-making to use ICT that added value and extended learning opportunities for students, rather than simply replicating other activities.

Sharing, Reflection and Strategic Questioning

Sharing, reflection and strategic questioning of students during and after open-ended tasks were identified by teachers as crucial links in developing students' mathematical understandings. Teachers placed strong emphasis on developing children's thinking and their ability to articulate and communicate mathematical ideas and strategies in conjunction with promoting mathematical conceptual development:

> *I am spending more time in Maths sessions listening to children and trying to understand their thinking behind their working. I spend a lot of time sharing during class sessions, where children are required to articulate their work, as well as their thinking.*

> *(Zoe, Snapshot, Feb 2000)*

They facilitated this process by asking students 'strategic' or 'probing' questions (Clarke & Clarke, 2002; Australian National Schools Network in partnership with the Coalition of Essential Schools (USA), 2000; Cooper & Boyd, 1996; Peavey, 1994), which asked 'what, why and how' and required students to analyse, plan, act, test, reflect, compare, contrast, prove and evaluate the efficiency of the strategies they had used:

To solve a problem, we must be able to analyse it and delve beneath the surface level of understanding. Students need to be aware of strategies they can use to solve a problem. Instead of just teaching a strategy in isolation, they need to be discovered by the child as a necessary tool and then taught or clarified to the student. If a student really understands what a problem is asking of them, then checking their answer to see if a possible solution is reasonable is a simple matter. This reflection is a very important process and one that continually needs to be done throughout the exercise.

Children need to be given the time, before starting, to discuss with their peers what they perceive the problem to be and later to discuss the attempts they made and justify their approaches. After I set a problem for my Prep grade, we usually have a class discussion about what it is we need to find out and some ideas children have about solving it. I don't give a yes or no answer to any suggestion, but I sometimes question their responses to make them think about their idea in more detail. During our learning centres, where children try to solve the problem using various materials, including computer and concrete materials, I will often stop small groups and facilitate discussions within the group about what they are doing and what they have discovered. I also sometimes encourage groups to talk to the rest of the grade before other groups reach their activity. At the end of a session the whole grade comes together to discuss what action they took and how successful they were. This discussion is often the basis for our next lesson. Quite often an answer is not found, but discoveries are made to help us work through the problem another time.

<div align="right">(Robin, Reading Response: "Thinking Mathematically", Apr 2001)</div>

Teachers concluded that this sharing and discussion led to deeper understandings, confidence, greater learning connections and increased capacity to transfer and use new learning by their students.

Encouraging students to view each other's work and build upon the ideas they saw was also a strong characteristic of teachers' practice. As recommended by Crawford and Witte (1999), teachers encouraged numeracy learning "in the context of sharing, responding, and communicating with other learners" (p. 37). Clarke and Clarke (2002) also identified the establishment of a learning community, classroom interaction and

provision of opportunities for reflection as part of a framework of characteristics of highly effective teachers of numeracy (p. 8). The following reflection by a P/1 teacher after a session on symmetry illustrates facilitation of such a sharing and reflection process:

> *During reflection time I was careful to use open-ended questions when I spoke to the group. I was careful not to ask questions to which I knew the only answer. Of course, I did have my own ideas but I asked questions in such a way that a range of responses were appropriate. First, we showed the different kinds of work. I asked students to discuss any problems that they had encountered. Then I asked students to describe how they had solved their problems and what they knew about symmetry. We examined work together. Students were asked to select work that was not symmetrical and to discuss more than one way to change the work to be symmetrical. I was delighted with the depth of the responses. They were showing a deep understanding of the concept. It reminded me that less paper work and more hands-on is what is required. I was able to integrate the Arts, Mathematics and Technology with creative thinking.*
>
> *(Nina, Journal, Aug 2000)*

Teachers noticed that students' conceptualizations of concepts increased in 'complexity and depth' during the course of the week's numeracy rotations. Successive groups of children, having listened to and observed the work and reflections of other children during share times, built upon the experiences and work of these earlier groups. Students also noticed this was the case:

> *One child felt that always being the first group at the computer wasn't good, because they didn't get to see other people's work, before they worked at the computer. Interesting point.*
>
> *(Connie, Journal, June 2000)*

'Copying' was not perceived as a negative in the culture of the Early Years classrooms, as learning from one another was highly valued.

Teachers critiqued their own practices, constantly thinking about the impact of particular activities and practices in light of student response. At one stage, a teacher felt that children's reflections were amounting to little more than 'show and tell' and

immediately restructured her approach to encourage more in-depth thinking. She asked children to talk about how they felt about the activity, how their understandings had changed, how they could 'prove' their findings, what they could do differently, and she also encouraged them to speculate about possibilities.

This is consistent with recommendations by Siemon (1997), who states that the cognitive processes of "noticing, representing, describing, generalizing and abstracting" are central to both problem solving and learning with understanding (p. 46). She recommends greater value be placed on the construction of meaning, the justification of procedures and the development of classroom cultures where "students expect to elaborate, defend and amend or reject their ideas in a non-threatening, mutually supportive way", where sense-making is valued and students encouraged to "recognize, develop and make connections between conceptual and procedural knowledge" (p. 47). Siemon notes that generalization, conjecture and proof lie at the heart of mathematics and critical reflection through "discussion, elaboration and justification are needed to maximize what is learnt from the experience of solving problems and playing games" (p. 48). Learning mathematics therefore requires:

> *...conscious reflective discussion with oneself, and importantly, with one's peers and teachers in an environment in which the sharing, elaboration and negotiation of ideas is encouraged and nurtured. (p. 48)*

Teachers' adoption of the Early Years Numeracy structure meant that concluding Maths sessions with sharing and reflection became regular practice. Dialogue and group processes of "communication, observation, suggestion, discussion, analysis and reflection" (Crawford & Witte, 1999, p. 37) were valued and directly facilitated by teachers during this whole group share time.

One teacher used ICT with the express purpose of providing increased opportunities for these group processes to take place. Zoe set her class the challenge of covering a tabletop with a basket of wooden shapes as much as possible. She had identified both numeracy intentions, for the session in terms of learning about space, shape, form, function, orientation, and social intentions in terms of children working together in groups to "collaborate, discuss, reflect on process, compare strategies and give warm and cool feedback about group results" (Zoe, Journal, Oct 2000). She found that use of a

digital camera to record hands-on work provided new opportunities for comparison, reflection and sharing between groups:

Using the digital camera to instantly photograph, record and print a copy of the children's work proved to have many advantages. Firstly, the children were openly thrilled to have such an instant copy of their work and were encouraged to 'look again' at their results. Secondly, the children knew the table would be photographed, and therefore seemed to put a little more effort into their work, as there would be a permanent record shown to a wider audience. Thirdly the children were able to physically hold the pictures next to each other to compare which table was covered the most. They were able to discuss which shapes fitted together well and why. They were able to look at another group's work next to their own, and ask why one group was more successful at covering the table than the other. Lastly, the children had a hard copy of what would normally be hands-on work that is cleared away at the end of each session or rotation. I later saw children showing the displayed pictures to parents and friends, and heard them articulate the learning process they had been through. I also noted older children in the class looking at the pictures and talking about which group they thought was most successful and why. So the activity, although short and one of many, generated a lot of interest, I believe due to the digital image. The image also enabled children to critically reflect on their own and others' work.

(Zoe, Lesson Plan, Aug 2000)

Teachers connected their personal reflection processes to the reflection processes they implemented with their students:

We have discovered that reflection is a vital and essential component of teaching, learning and growth in higher order thinking. The students reflect with each other and we reflect with our colleagues and ourselves. This is another example of how our personal learning has transferred to our planning and implementation of educational delivery.

(Robin, Zoe, Nina, 12 month Action Research Report, Nov 2000)

Sharing, reflection and strategic questioning were identified by teachers as critical in facilitating and developing students' mathematical understandings and thinking. ICT activities, with the added capacity of forming a permanent visual record of students'

thinking through printing or digital photos of hands-on tasks, provided new avenues for prompting further analysis and comparison.

Revisiting, Repetition, Reinforcement and Connections

Teachers concluded that, in order for deep understandings to develop, children needed opportunities to revisit tasks, including those on the computer, so that they could use prior experiences to improve on earlier attempts, and draw on the experiences of their peers. This sometimes happened spontaneously as children chose repeat numeracy activities on the computer themselves, either at home or during free activity times, proudly showing their teachers their accomplishments. At other times these opportunities were prompted by teachers who asked students if they would like to tackle an activity again or if they could improve on an original attempt.

Teachers developed the confidence to make choices about the type of software experiences they provided children, even in terms of their wholehearted embracement of the desirability of open-ended tasks:

> *I tossed up whether to have the children use Kid Pix and draw a clock free hand, but I decided to let them use the CD ROM instead. I thought it revised o'clock in a more appropriate way for this session. I am thinking more about which program is better suited to a particular activity, instead of always thinking I must have the children working on open-ended, challenging tasks. I guess the real change in my teaching practice so far this year is to realise that I can give my children a bit of both depending on their learning needs at the time.*
>
> *(Robin, Journal, Aug 2000)*

Teachers concluded that children needed time for rehearsal and practice as long as this was part of an overall approach that used hands-on activities, was predominantly open-ended tasks and required students to use higher-order thinking. They discovered that students needed the opportunity to revisit open-ended tasks and investigations to consolidate and extend their learning. They also found that when given free choice, students increasingly chose to revisit open-ended tasks rather than play with CD ROM software:

> *Today a child had free time on the computer. He could have played with the drill and kill software (he chose to do that first) but then instead of using some other*

fancy software, he chose to go into Word and make a puzzle like we had tried in

the computer laboratory. I was chuffed.

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(Nina, Journal summary, Sept 2000)

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Becoming Critical

Designing activities and software choices

Teachers decided that they became "much more critical" about the activities and programs they chose for their students, encouraging open-ended tasks and active learning that required students to engage in "research, presentation, drawing, modelling, categorizing, recording, writing, rehearsing, practicing, consolidating, reading, problem solving and analysing" (12 month Action Research Report, Nov 2000).

The teachers with a focus on creative thinking frequently confronted their own practice in this area:

> *I am concerned that the activities I am doing are based on the children*
> *demonstrating their understanding and are not challenging them or encouraging*
> *them to take risks or further their understanding. I see real benefit in children*
> *being involved in long term projects where they are required to reflect on their*
> *work and make improvements and adjustments. I've felt the activities, although*
> *beneficial, have been one-off short term projects, that lack a need to reflect and*
> *improve.*

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(Zoe, May Journal Summary, 2000)

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Teachers initial concerns about needing to know more about mathematics software changed to recommendations that mainly a few open-ended applications be used, with one or two CD ROM programs occasionally accessed to support revision and consolidation. Teachers became very conscious of the limitations of some software applications and made discriminations in terms of when ICT was or wasn't appropriate to use.

Beyond an 'Alternative to the Pen'.

Teachers noticed their tendency to initially design computer activities that mimicked paper and pencil tasks and began to question this in the course of their reflections:

As the term moved on I was discovering that many of the activities were just as effective done with pen and paper. In fact, I found that sometimes the technology blocked the children's ability to express their knowledge and understanding fully. I found a couple of times that children produced less work on the computer than the children working in their books. I saw the need to differentiate between activities that were simply using the computer as an alternative to pen and paper activities and those that actually enhanced children's learning through the unique qualities that a computer offers. For example, a shapes activity which required the children to build a town using drawing tools in Paint, enabled them to be very accurate. The children doing this activity with pen and paper struggled more with the task. This led me to differentiate between activities, and to be very aware of whether the computer would enhance the outcomes or not. As I was exposed to more varied uses of ICT, I started to feel that there was a potential that was specific to ICT. I started to look at the ICT first rather than the outcome and to ask "What can this equipment do that is beyond the regular class program?"

(Zoe, 6 month Action Research Report, July 2000)

Critical thinking, in relation to the characteristics of ICT, moved the role of computers beyond simply providing students with another way to experience a concept, to one where characteristics of both the medium and its potential were evaluated in terms of what might be achieved.

Pedagogy and Authenticity

Questions about 'authenticity' in relation to the mathematics curriculum did not surface to a great degree, although teachers identified the importance of connecting mathematical knowledge with real world experiences and examples:

Problem solving needs to be real to children. They need to be able not only to understand the problem, but also see how the problem relates to life and when the problem may occur. If they are able to relate the problem to life they have more opportunity to understand what it is the problem is asking of them, instead of just trying processes or strategies that are irrelevant to the problem and the solution.

(Robin, Reading Response: Thinking Mathematically, April 2001)

Numeracy intentions were almost always shaped by standards and outcomes frameworks, rather than initiated by student interests. Teachers value-added by incorporating thinking and social capacities into their sessions and using stimulus activities to hook student interest and engagement.

Mathematics has traditionally been seen as a particular discipline and described in terms of content, procedures and uses or applications (Booker, Bond, Briggs, & Davey, 1997), which may have contributed to the irregular emphasis on the authenticity of tasks. Variations in teachers' practice were observed in the degree to which students were asked to apply their mathematical concepts in realistic situations. Some activities and approaches made strong connections e.g. the example of Robin introducing the need for regular units of measurement. Her approach stimulated student motivation to find out, work out and need-to-know, and created a reason for learning particular concepts that connected with real world interests.

Teacher and curriculum interests characterized other approaches, with a need-to-know announced to the class, followed by activities designed to further understandings. Transferring, where children used knowledge in new contexts or situations (Crawford & Witte, 1999), and transforming or creatively designing in different contexts (Kalantzis & Cope, 2001b) were valued and sometimes targeted during rotational numeracy activities but not always systematically planned for:

> *The other rotational Maths session during this week was looking at mass. We were looking at how to weigh things using scales, instead of hefting, and how we can measure the weight of things using informal units. I could not think of a way to measure using informal units on the computer so we did an activity requiring the children to simply draw a set of scales that were balancing. I had a parent helping and she noticed how much her son really had to think about which way the scales tipped. Most of the children transferred their knowledge from the previous session, drawing a triangle as the base of the scale, then a line on top. They had to put themselves at one end, most of the children used their initial from the stamp mode, some wrote their whole name using the typewriter function and some drew a quick picture of a person. Then they had to find something or draw or write something at the other end of the scale that would make the picture true. A lot of the children used the stamp mode to put a picture that was heavier, lighter or about the same weight as them on the other end of*

the scale. I could see some of the children looking at others in the grade who were using the scales to try and remember which way the scales tipped when something was heavier and lighter. One child I spoke to was trying to remember if they needed to put something heavier or lighter on the top part of the scale and I asked them how they could find out. She replied, "When I put the glue stick in one side of the scale and that roll of paper in the other the glue stick went up because it was lighter so I need to put something lighter in there." I was really impressed that this particular child was transferring knowledge from a hands-on activity to the computer.

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(Robin, Journal, July 2000)

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Transfer of skills and knowledge beyond the numeracy class also occurred spontaneously:

Another student showed me work that she did at home on the computer. This work was related to theme work and an article for our school magazine. I noticed that she had been influenced by the work I had modelled in class, and had developed confidence from the Maths sessions. What is being learnt, developed and encouraged during Maths is spreading to other areas of the curriculum.

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(Connie, Journal, Dec 2000)

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Booker et al. (1997) recommend a shift in how mathematics is considered, to a way of thinking concerned with using, communicating and making sense of mathematics (p. 29). Mathematics teaching must be broadened to embrace the concept of numeracy or "an ability to think with and about mathematics" (p. 29). Booker et al. argue that:

The essence of mathematics as a way of thinking that involves conjectures, argumentation, justification and negotiation of meanings can come to the fore and equip students with the tools to work mathematically in a range of contexts in and outside of mathematics. This conception of numeracy, the mathematics we need to teach and learn to come to terms with the needs of a rapidly changing society can then be summarized as…content + problem solving + sense making + communication. (p. 30)

This emphasis has resulted in a repositioning of the importance of problem solving and sense making as central to all mathematical activity with recommendations that mathematical ideas be built up through "describing, questioning, predicting, arguing and justifying ways of thinking" (p. 30). The need for mathematical communication abilities has also increased in prominence in order to assist learners to "understand and assess the proposals of other learners, to convey arguments and justifications to a broader audience, and to analyse and interpret information" (p. 30).

When teachers' numeracy practice was analysed in relation to Luke et al's productive pedagogies (2000), intellectual quality was clearly enhanced in classrooms that had included creative and critical thinking and problem solving with a numeracy focus for their action research. All teachers reported increases in the substantive conversations they observed both between and with students, and improvements in the depth of understandings that emerged during reflective processes. They also found that students' ability to talk about their learning and thinking improved:

> *My students are beginning to be able to discuss their own learning, which has become one of the major aims of my action research project. This aim has only revealed itself to me in the reflections that I have been doing in the last few weeks.*
>
> *(Nina, Professional Learning Evaluation, July 2000)*

Students became increasingly competent at articulating and evaluating the processes they used:

> *I have interviewed several children and have found them very competent at articulating the processes they went through to achieve their finished product. The children were able to define blockers and problems they came across during the process and the action they took to solve them.*
>
> *(Zoe, 6 month Action Research Report, 2000)*

Although all teachers made attempts to connect their mathematical practices to the real world and relevant student interests, either by problem identification or reference to examples, differences were observed in terms of the dominance of student or curriculum interests. Teachers who introduced a topic through critical framing (Cope & Kalantzis, 2000) were successful in engaging student agency and ownership in relation to problem

identification and solution. Teachers' open-ended activity structures increased opportunities for inclusivity with a diversity of approaches, strategies and solutions valued and encouraged. Students generally had some control over strategies and materials used and were actively encouraged to make decisions in these areas. All teachers demonstrated high levels of concern about students' affective response to mathematics and ICT:

> *I work hard to make them feel comfortable and not threatened by Maths. This week I noticed that one of these students was very responsive and asked for help and tried to do well. If they can feel comfortable and try to enjoy Maths this is a positive. I tell the students 'Don't panic, don't worry. I do that for you." I believe some of the children who stress are beginning to feel more at ease.*
>
> *(Connie, Journal, June 2000)*

Teachers struggled with conflicting desires to 'cover' the curriculum and at the same time respond to children in ways that were thoughtful and mindful of their needs (Kruger et al., 2001; van Manen, 1991):

> *I have a concern that the children are taking longer to grasp new concepts than I would hope and I don't want to rush them. I do feel pushed however to work through the curriculum. I will have to consider this for next term.*
>
> *(Connie, Journal, May 2000)*

Pedagogical thoughtfulness (van Manen, 1991) was also observed as some teachers confronted their taken for granted assumptions while in relationship with students:

> *My students' perception is different to mine. Given a set brief they will respond to it in ways that I would never have imagined. This I like and find most interesting. I am learning to let go of preconceived notions of student products. There have been times when I have approached students working at the computers and have made an internal judgment that they were not on task or that they didn't understand the task. When I took time to ask them what they were doing I found that they were right on task and addressing my challenge in ways I hadn't thought or even imagined.*
>
> *(Nina, 6 month Action Research Report, 2000)*

This characteristic, where teachers sought first to understand (Covey, 1990) was stimulated by the strong emphasis on thinking. As teachers broadened their intentions to incorporate thinking, social and conceptual goals, a stronger focus on students and their individuality emerged (van Manen, 1991) and pedagogy was characterized by 'recognition of difference' (Luke et al., 2000).

Evidence of authentic learning, where students moved from conversation to active production, learned with others and in groups, engaged in purposeful tasks that had usefulness and meaning, and participated in what should be learned and how (Kruger et al., 2001, p. 150) was observed, but not all the time in all mathematical tasks. More careful attention to the initial critical framing of tasks was suggested by the data as a way to increase authenticity in this area.

Bernstein's (1975) theories of visible and invisible pedagogy were also applied to the data. Teachers identified their capacity to be flexible and sometimes operate outside pre-determined plans as an important pedagogical consideration, consistent with Bernstein's views that invisible pedagogy implicates flexibility of boundaries:

> *Even though we have a 'tight' timetable, both Mia and I are willing to be flexible and run with an idea if the children show passion with it. We are prepared to let individuals or small groups branch off and follow their own projects or investigations.*
>
> *(Zoe, Snapshot, Feb 2000)*

Teachers confronted their own capacity to be flexible as a result of discussions and visits to other members of their inquiry teams:

> *I always thought of myself as very flexible but after talking to others on Friday I realised just how much Early Years has made me inflexible. I am still flexible in the way I plan Early Years and do not always follow the "suggested" way exactly. But I realised that I am fairly inflexible when it comes to adding things into my planner on the spur of the moment. I have been very conscious of that this week and have noticed a few changes for the better. One day a child bought in a witchetty grub, and in the middle of the reading and writing block we talked about it, had a look and then we wrote about the grub instead of the writing*

activity I had planned. The kids loved it and I found I got a lot out of the children.

Teachers were also more prepared to introduce technical skills to students as the need arose, leading to more impromptu teaching moments replacing formal instruction:

Last year I often taught the whole grade a skill, like printing, before a lesson where I wanted them to print. Early in the term during a free activity session, I told one of the kids that his work looked fantastic. He said he wanted to leave it on the screen so he could show his Mum and I told him we could just print it instead. I hadn't intended to show the children how to print for a couple more weeks, but this seemed an ideal opportunity. I showed this one child and within a couple of days I heard heaps of children helping others to print. I now don't need to teach this skill!

Flexibility of boundaries in terms of timetables, lesson plans and curriculum areas was raised by teachers as important considerations in terms of their capacity to respond to students and their capacity to foster their own learning through research and experimentation.

Change in Teaching and Learning

Teachers became significantly more relaxed in their approach to using ICT in the second year of the project, allowing children more time to play and explore. At the same time they also provided more focused and explicit structure:

Last year I was a little scared to use KidPix, because I thought the children would just play with it and it would not reinforce skills or help them discover new concepts. Well I have certainly come a long way from there! This year I am allowing the children to explore a lot more, but probably in a more focused manner. I am not overly concerned about their final product, whereas last year I felt this was much more important. I realise some children need a lot of practice with mouse control and children all develop at their own rate, just like they do in writing or reading.

Teachers increased their expectations of what they thought children could achieve:

> *It made me think about my expectations. Early in the year my expectations of what the children would know about the computers were very low. At the beginning of the next year, my expectations of what the children can achieve will be much higher. Not just skills, but being able to decide what program best suits their needs and to be able to use the computer as an aid to achieve a higher level of thinking.*
>
> *(Robin, Journal, September 2000)*

Teachers increased the amount of time they allowed for both students and themselves to reflect on their work and make improvements and adjustments. In one school, the school timetable was changed in response to concerns that a one hour numeracy block was too short for adequate sharing and reflection to take place, thus enabling hour and a half blocks of time.

Teachers own attitudes as well as their students' attitudes changed towards mathematics as a result of their research projects:

> *I have also become aware of a shift in attitude on my part toward Maths. Once upon a time it was just an area of curriculum to cover but now I am becoming 'protective' of my Maths time as well as personally being more interested… Sometimes I would like to be more inspired when it comes to some topics and the tasks that are set.*
>
> *(Connie, Journal, Sept 2000)*

Teachers' discovered that they only needed to know the 'basics' in relation to ICT and could learn alongside their students. They also saw broader roles for ICT in the learning process:

> *Twelve months ago I felt that I needed to have an answer to every problem that I might encounter whereas now I feel confident to let the children discover their own answer.*

> *I feel like I have made huge inroads in the way I teach ICT in the classroom and feel extremely comfortable trying new things now…I no longer just use ICT for reinforcement of concepts already taught. More importantly I use computers as a learning and investigation tool and as a means for co-operative teamwork.*

Teachers' confidence in themselves and awareness about student learning and pedagogy increased significantly as a result of their research projects:

I have tried new approaches, met people with new ideas, networked, developed and extended my skills with the computer and other aspects of info tech. I feel confident in tackling problems and in being able to assist others to solve problems. The difference between now and then is a greater understanding of programs, my ability to overcome technical problems and having developed a growing confidence with the technology. I am more aware of the different ways in which students learn, and feel comfortable in the learning environment, which ties in with Gardner's theory of Multiple Intelligences. I have encouraged critical thinking and have created open-ended tasks.

(Connie, Dec Evaluation, 2000)

Teachers changed the way they viewed the role of ICT and problem solving in the teaching of numeracy:

Teachers must view problem solving as a valuable, motivating and pedagogically sound approach for introducing, developing and applying mathematical concepts. Unfortunately problem solving is not being used enough to teach a concept and is more often used to consolidate or reinforce.

(Robin, Reading Response: "Thinking Mathematically", Apr 2001)

As well as changes to their practice and pedagogy, teachers identified significant changes in student beliefs, skills and attitudes:

We have also noted a change in the atmosphere in the classroom. We observed that children became more engaged in their learning and were selective of the appropriate tool to use for a specific task. They are more willing to discuss, share and watch. The end of year questionnaire had significantly more students indicating they felt happy, confident and relaxed. They also viewed their skill development as having progressed. At the beginning of the year a small group saw themselves as having poor skill development while the majority perceived themselves as having good skills. Now the vast majority see themselves as having very good skills. Socially and communicatively the students have

benefited as they have shared their experiences and learnt from each other. The students have become independent, use their initiative and have become risk takers. They no longer see the computer as a play tool but as something that has practical and versatile relevance to their learning.

(Connie and Brian, 12 month Professional Learning Evaluation, 2000; Robin and Connie, 12 month Action Research Report, June 2001)

Another teacher also identified cultural change in her classroom as children learnt to use the equipment safely and act as supportive technicians and problem solvers:

I have created, without even knowing it, a mini network of students interested in sharing their knowledge. Some of the Preps have talked about wanting to help next year's Preps learn how to use the computers in much the same way as our Year 1 students helped them this year. My Preps know more and are more independent than any Prep students I have taught in the past because of my studies, learnings and change of practice.

(Nina, Professional Learning Evaluation, July 2000)

The changes identified by teachers are consistent with the multidimensional changes characteristic of effective professional development: changes in teachers beliefs, attitudes, theories or pedagogical assumptions; changes in content knowledge and teachers' practices, strategies or approaches; and the use of new or revised materials, resources or technologies (Conners, 1991; Fullan & Stiegelbauer, 1991).

Conclusion

Teachers' use of ICT in the Early Years was characterized by learning that involved children recognizing and constructing relationships, encouragement of different modes of thinking and experience, and facilitation of the development of understanding between abstract concepts and real world meaning (Bowman & Beyer, 1994). High motivation to learn, reflective practice and inquiry team collaboration overcame initial low confidence in personal technical capacities and knowledge about computers. At the end of the data collection period, all teachers expressed confidence in their ability to use ICT in a critical manner across all areas of the curriculum. They were comfortable to see themselves as learners alongside their students and had increased confidence in their capacity to learn in relation to ICT use.

A significant study recently commissioned by the Department of Education into Early Years numeracy does not specifically address the use of ICT in developing children's mathematical understandings and thinking (Clarke & Clarke, 2002). This research both supports and extends findings from the Clarke and Clarke study. In particular, the following recommendations about ICT and numeracy learning are suggested:

- When teachers stimulate a need-to-know through critical framing they successfully engage student agency, purposeful response and real world connection in relation to solving a mathematical problem or challenge.

- ICT is best used in conjunction with balanced, multiple modes of experience designed to facilitate conceptual development. This includes multi-sensory and multiple intelligence modes. Situating ICT use in this numeracy context provides students with a point of reference for sense-making.

- Open-ended software applications that allow children to model and represent what they know and pose their own problems provide opportunities for children to bridge their conceptual understandings between the concrete and the abstract. The cognitive process of abstracting is central to problem solving and learning with understanding (Siemon, 1997). Rather than simply mimic another kind of sensory task, ICT tasks need to be conceived critically, with reference to the kind of thinking being targeted and consideration of the characteristics of the medium and value it adds to the task.

- Collaborative, open-ended, problem-based, computer tasks which require students to analyse, plan, organize, decide or model, predict, act or test, observe, judge and evaluate, support numeracy learning and the development of depth in mathematical understandings and thinking.

- Teachers' strategic questioning is critical to the development of children's mathematical understandings. This needs to occur on a 'just in time' basis as children are working (or in the pedagogical moment) and during whole group sharing and reflection times.

- Sharing and reflection need to be more than 'show and tell' with teachers prompting discussion that requires children to describe, explain, question, justify, compare,

interpret, analyse, prove, evaluate and negotiate meanings. ICT was found to have value in recording hands-on tasks that would normally be dismantled, with this record being used for later discussion, analysis and reflection. Share times need to be characterized by communicating mathematically and opportunities to make strategizing and problem solving explicit.

- Students need opportunities to revisit investigations and challenges, particularly after they have had opportunities to observe and listen to their peers.

- High expectations of students in relation to numeracy learning, thinking and use of ICT are desirable.

The use of open-ended software in Early Years numeracy programs can therefore play an important role in developing children's capacity for abstracting conceptualizations about big mathematical ideas. Its benefits are directly connected to the multiple modes of experience that accompany its use, as these provide a concrete reference point for children to move into more abstract conceptualization.

The multiliteracies pedagogy was found to be particularly relevant in terms of conceptualizing teachers' practice. In particular, beginning with critical framing and situated practice, sensitively intervening with overt instruction as necessary, recycling through activity and critical thinking, and providing opportunities and stimulus for transformed practice, are all indicated as worthwhile and beneficial pedagogical considerations. As data was inconsistent across practitioners in this area of the study, vigilance in terms of the following is indicated: critical reflection about authenticity and productiveness of tasks within the numeracy curriculum; applying, transferring and designing new meanings; and using ICT to reconstruct mathematics *curriculum* as well as pedagogy. These areas also warrant further research and investigation in the context of early numeracy learning.

Chapter 9: Reflections and the Way Forward

Introduction

I began this project by contemplating the challenge of productive collaboration and educational change in relation to teacher professional learning and ICT. Practically, this involved constructing a professional learning program that aimed for pedagogical, sociocultural and political change in classrooms, and went beyond technical skilling to develop a critical view of ICT. The literature clearly indicated that sustainable change involved both restructuring and reculturing, which should begin in the development of teaching and teacher relationships and the establishment of a collaborative work culture (Fullan & Stiegelbauer, 1991). Also indicated was a process that involved teachers becoming researchers of their own practice, with a strong emphasis on critical reflection, sharing, observing colleagues' practice and rethinking personal practice and pedagogy.

These recommendations influenced the choice of methodology and the focus of the analysis. One strand, based on the principles of participatory action research (PAR), involved the formation of a co-researcher relationship with teachers. This PAR process provided a structure for teachers to shape and drive the direction of their specific inquiries about the use and role of ICT in their classrooms. The participatory nature of this strand provided a collegial, yet critical environment to support teachers as they attempted changes.

As a result of the PAR strand, this study has contributed to understandings and recommendations in relation to use of ICT in the following five areas:

- ICT and literacy
- ICT and online collaboration
- ICT and creative innovation
- ICT and numeracy

The contribution by this study is both practical and theoretical, with practice, pedagogy and underlying theoretical premises identified and used as a basis for crafting recommendations for future development. Teachers' practice and pedagogical concerns were used as the starting points for developing planning and development frameworks to guide decision making in each of these areas.

The second strand of the methodology, the interpretive study, focused on developing understandings about the way teachers learn and change, their pedagogical interventions, the impact of different professional learning strategies in relation to the development of critical reflection and pedagogical change, and identification of some issues connected with the transition from personal learning to collegial and organizational learning. This strand also identified evidence of change and explicit awareness of the pedagogical, sociocultural and political dimensions of practice. Teacher theorizing, my own theorizing and current theorizing in the literature were connected in this strand, thus adding another layer of critical questioning to the analysis and further informing the planning and development recommendations for the future.

In this chapter, I make my role within the PAR process more explicit and discuss some implications in terms of how teachers' practice and pedagogy have been represented in this study, particularly in relation to trustworthiness, validity and reflexivity. I revisit the research questions and summarize the key findings and 'fuzzy' generalizations made possible by the study. I then review an early premise of the study that ICT is a catalyst for educational reform, in light of teachers' participatory research projects. Finally I look to the future and make recommendations based on my learning during this research project. The use of ICT, strongly implicated as both a cause and consequence of changes in society and education, provides a focus and catalyst for exploring change and learning with teachers.

Putting the Researcher Back in the Picture

Role and Relationships

Throughout this study, I kept in mind Kemmis's (2001) concern that practitioners' theories and theorists' research practices are often relatively unexamined in research literature. Although my efforts to represent teachers' theorizing were well received by the teachers involved and 'rang true', my own role, to this point in the reporting and reconstruction of our collective work, has remained relatively invisible. My goal was to operate as a facilitating researcher in a role that enabled me to "engage in, or facilitate, or cooperate with, or collaborate with, or at least support practitioners researching their own practice" (Kemmis, 2001, p. 4). In order to reflexively address this problem of invisibility, I have elaborated further on the facilitation role and the impact of other

roles and relationships affecting the study, particularly those involving power differentials.

Facilitation

The facilitation role in this project was complex, involving both the facilitation of the overall research and the coordination of the project in general (see Chapter 3, p. 68). Although teachers decided what issue they would structure their inquiry around, I developed the inquiry framework that guided their thinking and planning. As a result of this role, I was ascribed the status of 'expert' or 'authority' during the project. This is described in the following journal extract:

> *I find that I'm facing a dilemma. Despite my belief that we should all be equal in this participatory research process, we are not. The group ascribes me with position power and even expert power. I have to acknowledge that I am in a position of power. I get to call the shots even though we negotiate some of them—all the information comes to me, so I think it feels to the teachers like they are 'reporting in'. I am seen as the one in authority within the project as I call people together and organize the structure of our network days. I suppose I am also the link between them and the Department, and therefore privy to information that they don't get directly. The flip side of this is that the teachers have knowledge power and they are all truly insiders in this research, while I am an 'outside-insider'. I am not as far out as Department bureaucrats but I am not as far in as a classroom teacher.*
>
> *(Researcher Journal, Oct 2000)*

Heron and Reason (2001) state that:

> *There can be no absolute parity of influence between them (experienced cooperative inquiry researchers) and their co-opted inquirers. They can move from appropriately strong and primary influence to significant peer consultant influence; and on the way may degenerate into over-control or under-control…What undoubtedly can be achieved as the inquiry proceeds is a sufficient degree of inter-dependent collaborative reflection and management, for the research to be genuinely with people, and not about them or on them.*
> *(p. 185)*

My experience as a facilitating researcher caused me to identify strongly with Heron and Reason's (2001) statement. During my time with the project, I was frequently a dominant member of the group and operating in a leadership role. I was definitely a strong and primary influence at the beginning of the project, particularly in relation to overall organization and provision of structure/guidance for teachers to get started on their own inquiries. At times, particularly in relation to team analysis and collaboratively making sense of data and experience, I also felt a sense of 'under-control' and unsure of the best intervention that remained respectful of my participatory ideals. Flores and Granger (1995) suggest a revised role for the action research "collaborator", which should "stress ambiguity, individuality, and difference in order to keep the critical aspect of the community alive" (p. 179). On reflection, I believe that my times of under-control were exacerbated by a reluctance to over influence by confronting ambiguity, individuality and difference in a more direct manner. In future, it would be beneficial to make this aspect of the facilitation role more explicit with the group.

Reflecting honestly with myself, I would have to say that sometimes my role in the research drifted into being 'about teachers', particularly after I left the field and was involved in reconstructing our collective work. This resulted in a shift to focus on my personal learning, particularly as there were less opportunities to meet regularly with teachers. Also, despite respecting and encouraging teacher researchers to do their own theorizing, I did intervene at times as a "mediator of what is to count as social reality" and engaged in my own theorizing to "describe, interpret and (perhaps) explain practitioners' practices" (Kemmis, 2001, p. 3). This kind of intervention was not necessarily perceived as negative by the teachers, and was at times seen as helpful to the group, particularly in terms of 'naming' aspects of pedagogy and making links between teacher theorizing and the theorizing of other professionals, researchers or 'experts'. This was particularly apparent as teachers ventured into using animation in their classrooms, as my intervention situated their work in the broader educational agenda of multiliteracies development. This learning relationship was genuinely interdependent, as without my involvement with the participating teachers and their research agendas, I would not have seen the patterns and relationships that led to my own learning and theorizing.

In future, I would design a much stronger collaborative analysis strategy, which would involve teachers in more focused 'sense-making' associated with the shared and collective experiences. My role, in this instance, would be to provide more strategic prompts and stimuli to support the group to make connections between their lived experiences and the experiences of others beyond the immediate group, or to use differences in the experience of others to confront the self. Rather than 'sense-making' outside the group, I would channel that process back into the group recursively. This is not to discount my own efforts at sense-making, but identification of greater value if they had been continually channelled back as part of a group process and critiqued by the group as part of their own sense-making.

My role as an external facilitator was very tenuous and discontinued in the second year of the project. Changes in the project direction and objectives led to all of the reflective processes and learning strategies being discontinued as requirements for participation. This development raised questions for me in terms of dependency on outside facilitation and the fragility of the project structure as it moved into the mainstream. An over-dependence on 'outsider' facilitation reduces the likelihood of professional learning processes, no matter how valued, becoming a regular part of the mainstream culture of the school.

Although teachers came together in a collection of learners who gradually became a community of inquiry as trust and relationships developed, this community was an artificial creation and dependent upon my facilitation. The combination of dependence on facilitation and the resultant relationship development, meant that even when an experienced school-based facilitator was appointed to replace me, teachers were unhappy with the peremptory change:

> *It wasn't even the time—heaps of time I would have pulled out because the project takes a lot of work. You need someone up there that you know is a change agent and being really keen with it and I would have given it away heaps of time if it wasn't for Maureen. She has a different kind of expertise. We don't have that expertise, we have practical knowledge about our classrooms, but all the extra things that you need, we don't have that. You need someone to collect the resources and someone to drive it, we need a leader and she's the one that bonds us together. I would hope that someone up there would listen to us and*

What had been ignored, in the transition of the project facilitation and management to the mainstream, was the relationships involved—or more particularly the lower status relationships. Strong relationships, bonds and trust had been developed within the original PAR group and a mandated change from the top without consultation was poorly received. Time and space for transition to new leadership was necessary for new relationships and trust to develop based on mutual understandings. While it was an advantage for the project to move into the mainstream, the transition process was not strategically managed.

The newly appointed school-based facilitator went to great lengths to understand the project and to find out the recommendations of the original teacher researchers and myself for its continued development. However, when she tried to negotiate with Department of Education bureaucrats on the teachers' behalf, she found that her advocacy fell on deaf ears. During informal conversations that we had to transfer the project facilitation more effectively, she reported that she had been instructed not to visit the teachers without a Department of Education bureaucrat (the official project manager) in tow. The role of the facilitator was recast as someone to organize professional development based on instructions from the Department of Education project manager. Like the teachers, the new facilitator reported feeling quite powerless and of low status in relation to the Department of Education and the business partner. However, in time she did develop a relationship with the teachers in the project and gain their trust and respect, "Amy is great and trying to support us but the people in town just don't get it" (Teacher comment, July 2001).

In contrast, they felt that Department of Education bureaucrats didn't understand their work:

You know, I don't think they even realise what we've been doing because if you look at the email that the guy who's taking over sent and the "new focus on educational technology and educational change" and I'm thinking, what the hell have we been doing for the last 15 months? That's exactly what we've been

doing! So the people in the Department obviously don't have any understanding of what we've been doing.

(Teacher researcher, collaborative analysis meeting, March 2001)

Despite dependency on outside facilitation of the project, teachers' experiences external to the school had increased their status, confidence and expert knowledge base in relation to the use of ICT. Many had moved into positions of leadership within the school, taking on new responsibilities and chairing various committees.

However, each teacher's base school was the real life community they had to work in. Phase 2 of the professional learning strategy (as it was originally designed but not implemented), emphasized the role of the teacher researchers as change agents and leaders within their own communities. The external facilitation role during this year needed to shift the project focus from a personal learning and ICT focus, to address the implications of leading change and stimulating collaborative, critical reflection and inquiry in local settings. As teachers developed their own facilitation and leadership skills within their local setting, the role of the external facilitator should have become redundant. A concept of 'transitioning power' may be useful to consider in order to shift from outsider to insider facilitation.

Power, Dominance and Democracy

The reality of power differentials, whether intended or not, requires genuine commitment to strong participatory and democratic values if capacitation is to occur. Maguire (2001) notes that "promoting the approach of co-researchers in an effort to share or flatten power is at the heart of action research" (p. 65). Despite good intentions, however, this was difficult to achieve. Lather (1991) stresses the importance of self-reflexivity "that will enable us to look closely at our own practice in terms of how we contribute to dominance in spite of our liberatory intentions" (p. 150). In this project, the dual roles of project coordinator and researcher contributed to this dominance. Leadership of the group didn't ever become truly distributed, with the intensive demands of everyday teaching contributing to teachers allowing an outsider to coordinate, plan and mobilize the group.

The question that ultimately arose was not how to equalize power relations (given the context and realities of the group, this did not seem to be a path that would ultimately

benefit the group), but for whose benefit the power differentials were being put to use? My position power was strong in the first year of the project and the professional learning processes, while designed from a theoretical basis with a goal of fostering learning and productive change for all concerned, also benefited me in my role as a researcher. I had access to a huge amount of data generated by the teachers in pursuit of their own inquiries. At the same time, teachers clearly indicated that they felt they benefited from these processes. When asked by the new school based facilitator what support or processes they wanted continued, teachers replied:

> *R: You need to start by having a look at your own classroom, doing a bit of a snapshot and reflecting on what's going on in your room and where you would like to be by the end of the year. It's important that you begin by concentrating on one area too, so it's not overwhelming. It can evolve over everything naturally in time.*

> *Z: You need to think about what you value in teaching and learning and I think that needs to come out before you work out a question. I found that really valuable because that was where it really shifted from the software because all software isn't necessarily valuable in terms of the way children learn.*

> *G: You know it's interesting. These journals were a pain in the butt, but I think that that reflection helped a hell of a lot in just moving things forward. Being able to stop and think about what happened during the week, taking the time to actually think about what worked, not necessarily just the action research— it made you problem solve. Sometimes it wasn't until I was typing it that I realized there was a problem. And I'd go, "Oh I know what I could have done" and it just kind of flowed. I think we've really benefited from self-reflecting and doing our journals so we do that automatically now.*

> *C: Feedback from your own reflections was good and Maureen posting her own reflections on how things were going. Even the writing style was helpful, the modelling.*

> *Z: I really enjoyed the professional readings, they made me think and I think we need to do more protocols work where we analyse student work.*

It's been really valuable going to other schools and visiting classrooms and seeing what other people do in their rooms.

R: I found that the technical training came as we needed it. Just in the group, we'd be working together and Nina would show me something as we wrote up our reports. I found I picked it up in an ongoing way. Also the after school PD— that was where we learned some of the new skills based things, like how to make a web page and do animation. That sharing was really important.

G: Having time out as a group to discuss the things that worked and the evaluation and having the time to do those reports made a lot of difference. Maureen said don't just look at what happened, look at children's learning. You actually had to back up all your data with examples of student work.

G: The principals need to be kept informed. If they hadn't had the meetings with Maureen, we wouldn't have got the support. It still needs the meetings. It also makes a lot of difference if the leadership knows the value of the program from an in-depth perspective. Our Assistant Principal was originally part of this project so she really understands what we are trying to do, and that's the same as Jim. There's someone from admin who really values it and it's not just a paper thing.

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(Teacher comments, Collaborative Analysis Meeting, Mar 2001)

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Within the participatory research process, teachers did "recover the power of experts" to some degree as they identified and addressed their own research interests (Gaventa & Cornwall, 2001, p. 74). However, their work was also impacted by broader political decision-making outside the PAR group, to a point where they felt disenfranchised by the new project directions:

I feel there's this push from the business partner and it's gone right back to the technical stuff and I don't think it's healthy. And I think, with the business partner, there's this push to use the their software and I'm happy to look at it and see what it's got to offer but I'm not prepared to just say, "Great, great, we'll do that next year" when I have no idea. I mean if a Mathematics rep. came in and said, "You've got to have this thing in your classroom" I wouldn't buy it or use it unless I felt that it was going to be valuable. So I've been holding back

on my eagerness to use it. I'm eager to look at it and see what it's got to offer and then I'll make more decisions about whether or not to use it. I think it will be used, it's going to be compulsory actually, it's going to be our Intranet. So I actually see it as something separate to our teaching and learning focus. It's going to be helpful to send notices around but I don't really have a sense of its potential yet.

(Interview, Teacher Researcher, Nov 2001)

Conversations with a new Department of Education project manager indicated that for the Department, the priority in 2001 was to officially 'launch' the project and sort out the financial and technical issues associated with formalising the relationship between the Department and the business partner and the adoption of the business partner's 'software solution'. In some ways, the latter issue could be constructed as a solution looking for a problem.

Department of Education bureaucrats also imposed a mentoring model of professional development, despite the teacher researchers' resistance to this concept and their request that a learning community structure be continued. The teacher researchers had recommended that Phase 2 teachers be provided with the opportunities to experience similar professional learning processes to them and develop their own community, with support and input provided by the original project teachers:

Z: We can't assume that the Phase 2 people will be where we were in Phase 1. I look at our new people, really skilled people, and someone like Jenny, who's already integrating ICT into her classroom extremely competently. So it's not like repeating what we did. I think it's really important that Phase 2 people do have their own question that they want to explore, because if you have a question imposed from above then there's no ownership…I don't see that the Phase 2 people are going to be looking to me as the expert because I'm not. I see a lot of value in sharing and I know that I will be able to help and share some ideas and things that I'm doing, but I already know that they're doing some really fantastic things in their classrooms…that's what I see as the value, being able to get together and share and say I tried this and they can come and say I had a go at this.

R: I agree. The person I'm bringing on board was in Prep with me last year and is now in Grade 1 and she did a lot of the things that I did last year. It's the same the same with Daniel, who's in Grade 6 with Maryanne. So they're already steps ahead of where we were when we started.

G: It makes more sense to concentrate on whole school change next. You've got lots of people who are already seeing the work you're doing.

R: If you don't go whole school it will just be individual people and it will get lost. I found it valuable to get documentation on process, like when I visited New Lake primary school and they had information on where they've gone and how they've got there. It really made sense that we had some kind of procedure to start following on how to change our school. We now need to have all of those procedures in place, and have it all done, then other schools can come to us and we can explain how we've done that.

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(Collaborative Analysis Meeting, Mar 2001)

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Despite this analysis, and despite these recommendations being passed on to the new Department of Education project manager, an individualized mentoring model was adopted as the project structure. Teachers themselves were very mindful of the 'tall poppy' syndrome and went to great lengths not to present themselves as 'experts'. The mentoring strategy ignored culture, and teachers' preferences to view all participants as unique and worthwhile contributors. Instead, it was part of an accountability strategy of the Department of Education, which needed to demonstrate systematic increases in the number of teachers directly involved in the project. The cumulative mentoring strategy utilized in Phase 2 was easily measured in terms of participation. No mentor training was provided, however, and teachers reported that network meetings became technically oriented, focusing on the use of the business partner's software. The motivation to continue the professional learning processes in busy lives waned without opportunities to work collaboratively together or acknowledgement of the value and effort required.

The change in project direction after it was 'officially' adopted by the Department of Education clearly reflected a changed power differential. Stronger commitment to the project meant more control by the Department of Education personnel. Their priorities (formation of a successful relationship with a business partner) and the priorities of the

business partner (getting their software operational in schools) overtook the priorities of the teachers (improved teaching and learning). The original teacher researchers railed against this shift in project direction from pedagogy to technical solutions, and reported feelings of powerlessness, as what they had to say no longer seemed to matter.

At the beginning of 2002, a new project manager was appointed by the business partner. He visited all of the original teacher researchers in their schools and asked for their feedback and recommendations. All strongly advocated a return to the original project structure and a renewed focus on teaching and learning rather than technology, and reintroduction of reflection, sharing and action research. As a result of his advocacy and receptiveness by the relatively new Department of Education project manager, Phase 3 of the project for new schools was redesigned and aligned with the original project structure. This raises the question as to why teachers' voices remained relatively ignored until the more powerful business partner took up their interests. This trend existed throughout the project, with my own 'position power' in terms of shaping the project being strongly dependent on the degree to which my position was aligned with that of the business partner. In the first year of the project they were strongly aligned with a common commitment to effective professional development, but in the second year, as their interests shifted to the technical and financial and mine shifted to research, I noticed my influence waned.

One of the dilemmas I faced as a researcher was how far to delve into and report on the roles, relationships and influence of the business partner and Department of Education personnel. Initially I did not plan to involve their representatives as participants in the study, particularly as my focus was on teacher development and school change and I wanted the interests of teachers to dominate this work. As time went on, I realised that my focus on the teachers and schools needed to expand if I was to genuinely understand context. The activities of the business partner and the Department of Education personnel affected the socio-political contexts of teachers' work. This is an extremely complex and sensitive area and warrants further research. In particular research that documents and analyses who benefits, and how, from business/system/school/teacher partnerships is needed.

Action research always reveals new lines of inquiry and as a researcher, decisions need to be made in terms of which ones to pursue deeply. Although I made a decision to

remain focused on the work of teachers and their learning, ultimately school change cannot be considered without understanding the broader socio-political context. In retrospect, it would have enriched this study to have included interviews with both the business partner and Department of Education personnel, at the very least to contrast motivations, intentions and world views with those of the teachers and school personnel. Although I was privy to some of this information, I always felt an ethical caution in terms of how far I could go to reveal such views (these people had not been invited to be participants in this study and had not signed consent forms). Therefore I made a decision to confine my reporting of this aspect of the study to what could be verified by data from teachers and documented meetings. This is not to underestimate, however, the importance of research being conducted in this area, particularly as governments increasingly seek out business partners for educational pursuits.

Although this study was designed by drawing on the values and ideals of participatory action research, my final reflection is that a genuine participatory action research process was not achieved. My understandings in relation to participatory research have changed. They began as understandings based on values, but have resulted in understandings based on power. In relation to this study, the moment that *I* invited teachers to participate, I set up an immediate power differential. Genuine participatory action research would grow out of the concerns of a community and possibly invite a collaborator in to support the work of the group.

This study can at least be described as collaborative research, and at times 'critical collaborative research' (Lather, 1990; Le Compte, 1995), where teachers were supported to consider "life beyond the horizons of current experience" (Lather, 1990, p. 332). Is participatory action research a realistic goal in the context of organisations that are hierarchically structured with unequal distribution of power? I would suggest not in the context of everyday living in schools, but perhaps it might be possible to bring participatory ideals to a bounded collaborative and democratic process where a group agreed to set aside power differentials for a prescribed time in order to achieve a particular intention.

This raises the question of how broadly participatory the process needs to be, particularly in terms of including 'top-down' as well as 'bottom-up' support. As soon as funding becomes involved, there is the potential for those in power to engage in social

control (Giddens, 1984) by requiring compliance. Power differentials are a reality, and can only be put aside when those in power choose to do so. This requires increased conscious awareness and consideration of the question 'who benefits', particularly by those who have power and are in a position to benefit themselves *or* others by their actions. It is likely that those with power will only join a participatory or democratic process if the interests of those with less power matches their own, or those of their organisation. This therefore requires careful consideration in terms of who is invited to participate (e.g. Department of Education bureaucrats, school leadership, parents, teachers, students and other interested parties), and consideration of the implications of who gets to participate. A bounded process, that is aware of the realities of power differentials beyond the group, but is proactive about redressing this imbalance within the group, is a realistic possibility.

Summary Response to the Research Questions

Change

The changes documented by this study went far beyond changes in the use of ICT in classrooms. This can be attributed to the dominant focus on pedagogy, teaching and learning. The changes that were documented and reported in relation to teacher development included:

- increases in confidence, enthusiasm, morale and sense of professionalism;
- increased demonstrations of initiative and leadership within the school setting and beyond. Creation of opportunities to share, model and advise other staff members;
- extensive development in technical skills particularly in relation to use of multimedia, information and Internet applications, despite very few scheduled skill development sessions;
- integrated use of ICT within major key learning areas;
- changes in teachers' beliefs, teaching strategies, classroom organization and content knowledge;
- changes in the way teachers viewed, used and planned for learning with ICT;
- changes in classroom culture, particularly in the way teachers and students related to one another and the types of collaboration and roles in evidence;

- increases in time devoted to reflection by both teachers and students (the more teachers reflected themselves, the higher value they placed on the practice, and the higher priority they gave such practices when working with students);

- exhibition of a more thoughtful and critical approach to use of ICT and willingness to weigh up the benefits or shortcomings of using ICT for different types of activities.

- a stronger focus on students, their perspectives and particular learning needs, the capacities they would need for the future, and their ability to understand themselves and their peers as learners;

- more democratic classroom practices and opportunities for student negotiation, peer support and peer or self appraisal;

- changes in teacher and student roles in the classrooms, with teachers favouring facilitation and guide roles over didactic stances and students operating as "mentors", "experts", "group leaders" and spokespeople for their groups. (This is consistent with findings by Tinkler et al. (1996, cited in Meredyth et al., 1999), who reported that teachers implementing innovations using ICT found a shift from didactic teaching to a facilitation role with students was crucial to success);

- an increased emphasis on intellectual quality, both in terms of the tasks students were asked to engage in and the work they produced;

- a change in emphasis from technical use of ICT to focus on children's thinking, strategic questioning to prompt higher order thinking, and engagement in tasks that were considered 'rich' in that they were interdisciplinary and addressed multiple outcomes;

- changes in attitudes towards ICT and development of a willingness to try new activities and learn with students, rather than needing to know all beforehand;

- changes in attitudes to student learning and willingness to follow their lead at times or follow a path that had not been pre-determined;

- creation of new opportunities for collaboration with other staff members.

These changes are further emphasized in the words of teachers themselves:

> *We have been required to reflect much more about our teaching practices and to refine it. More student reflection has occurred regarding their learning styles*

and their attitudes towards the unit, which has been used in the planning and refining process. We have reflected more on productive pedagogy e.g. higher order thinking, effective questioning, rich tasks, De Bono Thinking Hats, etc…We are talking more about what we believe is important about student learning, with other staff members. We have genuinely worked together as a team of SOSE teachers in sharing individual lessons, approaches and resources.

(Liz and Donna, 12 month Action Research Report, Nov 2000)

From the beginning till now, I came in very green. But I thought, I don't know a lot here but I'd love to know. So anything I could glean along the way was good for me. Now in the past year I think I've come along in leaps and bounds in self confidence, in what I've learnt and doing things that I would never have done in the classroom through using the computers—it's also revamped my enthusiasm for Maths which wasn't my strongest or favourite point. Now I really love planning for it and thinking about it and trying to use the computer in a challenging and different way, using just a basic program rather than looking for the latest CD Rom.

We've tried to steer people away from. "Well we want to teach them this, so we'll find a CD for this and CD for that"… and I've seen that it actually works. You can use Word or Excel or whatever, still teach the children effectively and they acquire the skills and importantly, which I love, they're having fun with it. And I'm not swinging through hoops with them or anything, they're just enjoying what they are doing. And I can see with the Year 5's this year, it's paid off. My ideas changed considerably and my own skills and the children's have as well.

(Connie, Collaborative Analysis Meeting, Mar 2001)

Teachers' personal orientation to learning and change needs to be considered in relation to the gains made during the project. Teachers in the project were characterized by an openness and willingness to consider new possibilities in the context of their teaching. They also all exhibited high motivation to learn more about the use of ICT. Teachers' readiness and willingness to take on different professional challenges will vary at different stages of their careers and personal lives. Thus not all teachers will need access to the same professional learning opportunities at the same time.

This study also highlights implications for the targeting of potential change agents in schools. All of the participating schools had other staff members who would have been considered far more technically proficient than the project teachers. The emphasis on initially selecting teachers who were considered by their principals to be strong in a pedagogical sense, rather than a technical sense, was directly connected to recommendations in the literature to ensure a pedagogical focus accompanied technical skilling in relation to ICT.

Not all teachers demonstrated all of the changes reported. Again, this very much depended on their starting points and original pedagogical orientation. If teachers are to use ICT in creative and innovative ways, they need time to develop confidence and experiment in ways that cause them to confront their existing beliefs and values and reflect upon a way forward that is grounded in their personal experiences and theorizing.

During the project, teachers made connections between their existing beliefs and the new ways of thinking about ICT that they were developing. They didn't necessarily reject the old for the new but were able to make critical discriminations about the value of using ICT in particular ways:

> *Computer programs that allow for rehearsal and practice are valid in this process if they are combined with open-ended tasks that require higher order thinking. As teachers we are more critical about the programs that we are using and are making more informed decisions about the activities that children do on the computers.*
>
> *(Robin, Journal, Nov 2000)*

Although most of the readings and group discussions encouraged teachers to forego drill and practice software and to concentrate on open-ended applications, Robin was able to confidently assert a pedagogical basis for both kinds of applications. This professional confidence to make decisions from a pedagogical basis, as opposed to being socialized into particular norms of practice, is a key indicator of teacher capacitation (Weber, 1992 cited in Jurema 1998), when they confidently draw from within to craft pedagogical action.

The important changes that occurred during this project cannot be simply linked to the use of ICT. ICT provided a focus and catalyst for obtaining resources to engage in a participatory process to talk about, think about and redesign teaching and learning experiences in classrooms. Cultural change was sometimes a result of ICT resources being limited and needing to be shared by students. This necessitated new forms of organization and collaboration. Teachers valued the organizational, thinking, problem solving and people skills that students developed in order to make effective use of the available ICT resources, sometimes more than the technical skilling or content knowledge that was also in evidence. As one teacher noted:

> *Well it's not what you've got, it's how you use it that's really important. Initially it was, "I need more games and I need more software." And those things are very helpful, but I actually found that a few very simple programs enabled me to still do some very open-ended exploratory work. So not having access to the software and realising that it wasn't coming caused me to change focus. Then it was like, " Well what have I got and what can I do?" And realizing that I only had Word and Powerpoint and Paint, a few other things, really basic things, and thinking what can we do with those? What really helped was sharing with Nina and seeing what her kids were doing and then seeing what my kids could do and realizing that I don't really need other software at this stage. Now my focus is on the children's thinking and the thinking process rather than the software.*
>
> *(Zoe, Collaborative Analysis Meeting, Mar 2001)*

Teachers' beliefs in terms of the role of schools to prepare students for the future in a technologised society were a strong motivator for using ICT their classrooms. This sense of moral purpose (Hargreaves, 1995) and sociocultural orientation was important in terms of developing a critical view of ICT use, as it provided a point of reference from which to ask questions that confronted existing practice and to reconstruct new theories and practice. Teachers' pedagogical orientation also shaped the choices they made in relation to ICT use and student responses.

How Teacher Linked ICT and Pedagogy

A useful dichotomy for considering the way teachers linked ICT and pedagogy is simply a continuum between the past and the future. ICT was sometimes integrated into existing curriculum in a way that did not disturb the existing classroom culture to any

great degree. Although students were learning new technical skills and helping each other in different ways, and teachers were coming up with new ideas for increased use of ICT across the curriculum, socialization (Lankshear et al., 1997) into technology practice or adaptation into existing activity structures predominated. An example of this was the way digital information resources were introduced into classroom programs, often mimicking print based activities. This in itself is not problematic if it is considered as a starting point or foundation. Teachers recommended "modelling", "copying", "presenting", "sharing" and visiting other classrooms to get ideas, as part of an effective strategy to engage other staff members at their schools. They also noticed, however, that this sometimes created a situation of dependence, where others relied upon them for initial ideas, even though these were often modified to suit individual implementation.

When teachers considered their work in the context of preparing students for the future, it caused them to reflect upon existing curriculum, assessment and pedagogical practices. Sometimes these were found wanting and this dissonance created the motivation for thinking about creative use of ICT and new learning that had authentic links to preparation for the future. Teachers' use of animation in the classroom was an example of futures oriented learning.

Teachers' pedagogical orientation, particularly in terms of their philosophy, beliefs and orientation to students and curriculum, affected their educational intentions and influenced how they responded to students. In particular, a more dominant curriculum or student orientation was identified. When teachers prioritised curriculum concerns over student concerns, their response tended to focus on remediation and shortcomings in the student response. In contrast, when teachers prioritised student interests over curriculum concerns, their response looked first to their own actions and how these could be changed to benefit students and achieve their educational intentions.

In terms of educational intentions, teachers made strong recommendations that use of ICT should involve open-ended tasks that encouraged students to engage in complex thinking and reflection. Teachers reported that student intentions were often more strongly focused on using the technology. This highlighted the importance of teacher intervention to explicitly focus on the thinking and learning dimensions of the task.

Teachers' use of ICT was influenced by context, structures and norms operating within their schools and classrooms. Initially, they adapted use of ICT to this context, but as their confidence, experience and knowledge base grew, norms and organizational structures in their classrooms changed, so that new roles, relationships and types of communication emerged.

Teachers' existing philosophical orientation to students and learning guided many of the decisions they made in relation to ICT use. Beliefs about how children learn, what they need to learn and curriculum priorities, could all be linked to educational intentions and response to students.

As teachers read and learned more about pedagogy, particularly productive pedagogies (Luke et al., 2000), they used these concepts to reflect upon their own teaching practice and highlight areas they wanted to improve. In particular, all teachers in the project documented evidence of striving to improve the intellectual quality of the activities they asked students to engage in and the products that were produced as a result of such activity. When pedagogical models make sense to teachers, they enthusiastically use them to inform and improve their practice.

The impact of ICT on relationships and interactions warrants further exploration. Positive effects were identified as teachers relinquished the role of 'knower' or 'expert' and sometimes related to students as co-learners. The limited access to ICT, coupled with limited knowledge as to its operation, caused teachers to create new opportunities for students to relate to one another in cooperative team or leadership roles. Increased use of democratic and inclusive decision making practices led to shifts in the balance of power in classroom relationships.

Teachers' pedagogical orientation affected the way they responded to students. This orientation affected what teachers noticed in relation to students' use of ICT, the questions they asked themselves, the way they framed problems and interventions arising from student responses, and the personal store of strategies and curriculum knowledge they could draw upon.

When teachers had the opportunity to reflect upon their pedagogical orientation across the broad dimensions of pedagogy, such as those that guided this study, they often crafted a response to students that went beyond technical intervention. Teachers drew

on their beliefs, values and teaching philosophy, so the opportunity to make these explicit, then examine, confront and review their personal stances, led to more conscious and informed interventions. The opportunity to examine taken-for-granted assumptions and norms is also indicated as a desirable professional learning strategy. Some norms, particularly those advocated by the Department of Education (e.g. ability grouping), were adopted without broad critical questioning in relation to sociocultural implications.

Professional Learning Strategies

Professional learning programs, which develop teachers' skills, understandings and beliefs about ICT within broad pedagogical, sociocultural and critical/political contexts and emphasise preparing students for the future are strongly indicated as a result of this study. Such professional learning programs must 'confront the normal' (Dalmau, 2002) in relation to curriculum, assessment practices, teaching and learning strategies, organizational structures, and social relations within classrooms and the larger organization, if second order change effects are to occur. Individual professional learning must similarly be connected to sustainable organizational learning processes, if innovation or new teaching and learning practices are to become 'normed' and accepted as cultural practice.

Although teachers collaborate with their colleagues in the normal course of their work, this collaboration does not necessarily include critical reflection. As Diaz notes (2001):

> *What are the boundaries between tacit or unconscious practice and actual practices? We can think of this problem in terms of space. There is a fundamental space that creates tensions, contradictions, oppositions, and transformations between tacit/unconscious practice. This space is far from actual practice but acts upon this practice. It is a strategic space for acquisition, rejection, and transformation. (Diaz, 2001, p. 92)*

Critical reflection reduces the space between tacit and conscious practice. Despite benefiting themselves from engaging in critical reflection that involved describing, informing, confronting and reconstructing their practice and pedagogy, teachers mostly emphasised sharing, modelling and guiding as processes to support their colleagues. This project successfully engaged teachers in critical reflection outside their normal work environments, but did not result in such processes being successfully transferred

to the normal work culture of teachers. This was partly a function of time and partly due to the existing structures and culture in schools, which emphasised activity to such a degree that time for reflection was difficult to find.

This study has implications for the development of long-term professional learning programs that aim for whole school sustainable change. Such programs require two stages, preferably conducted over a two-year period. The first stage needs to ground teachers in their own pedagogy, innovative practice and theorizing while the second stage must tackle issues of organizational learning. Facilitation and collaboration need to be considered at both the local level and in terms of making external connections.

Cultural, Organizational and Curriculum Change

At the beginning of this study, it was identified in the literature that pedagogical, cultural, structural and curriculum change was necessary if ICT use was to go beyond adoption and adaptation of the technical. This study has been able to inform what is involved in such a broad based change process.

A starting point is to stimulate the professional learning of teachers that is inquiry based, pedagogical, collaborative, reflective and critical in relation to the sociocultural and political implications of practice. Teachers grow in confidence and motivation to lead change on a broader scale within their organizations if they first experience new learning themselves and engineer a cultural change process within their classrooms:

> *I feel really ready now, to move on to helping or working with the whole school, whole school change. I don't think I could have done anything before now and that first year was really important for my own knowledge and confidence in using computers in the classroom. When I look at where I was when I started…!! But I now have a really strong feeling of school community, that I'm not just interested in the children in my unit, I'm also interested in the kids in the unit next door and those I taught during the last few years and that I'm going to teach in the future. That's a really strong driving force for me. I want the staff to feel more confident because technology is really important, and it is the future of these children. If we just worry about our own little class then we're not really looking at the big picture for these children.*
>
> *(Zoe, Collaborative Analysis Meeting, Mar 2001)*

Hargreaves (1995) identifies 'desire' as a pivotal focus of teacher development and something that needs greater attention in the conditions and cultures of teachers' working lives. He sees technical competence, moral purpose, political awareness and emotional attachment/engagement with teachers' work as fundamental dimensions that need to be balanced and integrated:

> *Increasing competence and mastery both fuels and is fuelled by teacher desire. Moral purpose gives a focus to desire, can channel it in worthwhile directions. Political action and awareness can help combat the conditions of isolation, poor leadership, imposed and escalating demands, narrow visions, and disheartening working conditions that can otherwise dampen teachers' desire. Creating collaborative environments of continuous learning and working with "critical friends" can enhance this project of resistance and reconstruction even further.* (p. 27)

These dimensions 'ring true' in the context of this study. Teachers reported high motivation and desire as their confidence and technical mastery increased, articulated moral purpose (particularly in terms of their role in preparing students for an uncertain future and their pedagogical relationship with students), and placed high value on the 'bonding' and relationships they developed with teachers in the external learning community. The political was addressed in terms of local concerns but would benefit from further awareness raising and the development of a shared language for discussion. This language and awareness needs to be able to connect the local political concerns of teachers to broader political issues beyond the school.

If teachers are to be able to effectively develop use of ICT within their school organization, they also need a common language and framework for discussing pedagogy that makes sense in the context of their practice. Six dimensions of pedagogy were distilled from the literature and were found to be both relevant and useful in analysing teachers' practice:

- Educational intentions
- Influence of context, organizational structures and norms
- Philosophical orientation
- Teaching strategies, methods and technical knowledge
- Relationships and interactions

- Thoughtful awareness and response

By explicitly articulating these dimensions of pedagogy, teachers are able to engage in conversations about their practice that enable them to critically reflect in ways that both inform and confront theory and practice. This provides a strong foundation for reconstructing practice and making the structural changes that lead to cultural change in classrooms.

Stimulating cultural change at an organizational level proved to be a far more difficult and complex process than stimulating cultural change in classrooms. Teachers did not automatically transfer the processes they valued, and identified as instrumental in their learning and change, to their own local situations. Instead, they began with more gentle modes of collaborating with other staff that were based on sharing, modelling and instructing. It is important to learn from teachers' assessment of their own work cultures. In all there are six recommendations arising from this study:

Table 19: Recommendations for Sustainable Cultural Change in Schools

1. **Consciousness raising**
2. **Modelling and skill/content instruction**
3. **Assume diversity and difference**
4. **Distributed informal leadership**
5. **Forum for critical reflection, inquiry and talk**
6. **Broader based community collaboration**

Teachers clearly advocated the following starting points for an organizational change process:

1. **Consciousness raising:** sharing new learning and practice with colleagues and the school community in ways that emphasise a learning journey that others can join, rather than high level expertise. Mobilisation of interest and the 'need-to-know'.

2. **Modelling and skill/content instruction**: providing basic skill and content instruction to colleagues, which enables a shared basis of 'technical' or 'operational' knowledge to be established in relation to a change or new learning

initiative. Not all teachers will be ready to engage at the same time, so these opportunities need to be offered regularly over a long period of time, with voluntary participation encouraged.

The strategies identified in points 1 and 2 above were implemented in the project schools and were effective in encouraging other staff members to use ICT and integrate it into their curriculum. On their own, they did not result in the development of a critical view of ICT or the same levels of confidence and leadership capacity as experienced by the original project teachers. In one case, a new teacher did take a strong leadership role in relation to ICT development across the school. The original teacher researchers at that school reported that this leadership was characterized by uncritical adoption of the technical agenda being pursued by the business partner. Some teachers perceived this as being 'bullied' to use the software in a conformist manner e.g. individual class web pages were deleted and replaced by a standard template structure within the business partner's software, so that the representation of each class looked similar to parents.

Whole school change does not mean uniform change. Any sustainable change and learning initiative must take into account the diversity of individual teachers, students, school communities and school culture/organization (Guskey, 1995; Hargreaves, 1995). By assuming that people will engage in a change initiative differently, depending on their personal, professional and organizational circumstances, planning for change becomes more realistic. Just as individuals have different learning styles, so too will different school cultures favour a particular organizational learning style. Rather than favouring one style over another, planning a diversity of approaches (what Guskey calls an 'optimum mix') is necessary to maximize chances of successful, sustainable change.

Teachers recognized this reality of their working and organizational lives in their third recommendation related to whole school change:

3. **Assume diversity and difference:** colleagues who join a new learning or change initiative will have different starting points. Each will have different areas and levels of expertise, knowledge, interest and motivation; pedagogical orientation; and confidence. A whole school change initiative must acknowledge and use this understanding to determine process.

In particular, teachers recommended that colleagues have time to 'take stock' of their current pedagogical positions and classroom practice before planning for change. This personal awareness raising could then contribute to organizational awareness raising as individuals made connections between personal and organizational purpose. It also provides an opportunity for individuals to make connections with each other, identify commonalities, confront differences and forge deeper relationships as a result of such sharing.

A fourth recommendation in relation to organizational change emphasises that leadership may take different forms and needs to be distributed across the organization:

4. **Distributed informal leadership:** this should involve both informal and formal systems of support and development. Teachers worked through the existing team and committee structures in schools, created new meeting structures and opened the doors of their classrooms to colleagues.

Teachers discouraged upfront, didactic leadership in relation to their role in whole school change, and particularly emphasised that they should not be considered as experts. Principals corroborated this stance, noting that forceful, upfront leadership, particularly if it was too technically oriented, lost the support of the staff. Instead, most recommendations revolved around creating multiple opportunities to interact with and support colleagues and encourage them to pursue their own inquiries and experimentation:

> *Last year, when I first came in, one of the things that really scared me was looking around at these wonderful pieces of work on the computer. People were showing me things and I thought, 'I don't even know how to do that let alone me teach a grade!' And I think what scared me more than anything was looking at how wonderful everything you were all doing was. I had to adjust in my mind that Preps aren't going to do that and it doesn't matter what it looks like at the end. It's the process they go through. I really made a big deal about that with my Prep team at the start of the year. A few of them said, "But I can't do that" and I said, " But it doesn't matter. You give your kids a bit of a focus and say, now you go and try this. Don't worry about what they come up with, but question them about what they did and how they got there and what they've*

learnt and you'll see how quickly they move". And they've come back and
actually said that was the best thing that I said to them.

(Robin, Collaborative Analysis Meeting, Mar 2001)

Teachers' recommendations are corroborated by the literature. Both Fullan (1992; 1993; 1991) and Guskey (1986) found that changes in teacher attitudes and beliefs follow, rather than precede, changes in practice. Teachers' leadership initially focused on encouraging their colleagues to 'have a go', as they knew from experience that learning and confidence would develop from here. Teachers then acted as 'cheerleaders' for their colleagues, affirming their efforts and willingness to try new practices:

You'd never have thought one teacher would have taken it on, the group work
and everything, but she has. It's by inviting her into the classroom and she's
taken it on board and it's only by modelling. I never expected her to take it on
board, nobody did, and I said, "Barb, you're a marvel!" She was feeling out of
her depth a bit. She said, " I feel like a first year out student teacher!" And she's
been a teacher for a long time.

(Gerry, Collaborative Analysis Meeting, Mar 2001)

The challenge facing teachers in informal leadership roles was how to move the change process beyond adoption and adaptation. This meant creating new opportunities for teacher talk and collaboration:

5. **Forum for critical reflection, inquiry and talk:** Internal organizational structures must create legitimate time for focused critical reflection, sharing and talk by teachers. This should include opportunities to take stock and identify current beliefs and values, share written and verbal descriptions of practice, and obtain feedback and commentary from colleagues. Stimulus processes need to be introduced to move beyond describing to informing, confronting and reconstructing theory and practice. Such stimulus may need to come from outside the school at times. Systematic opportunities to review student work products (data) and discuss pedagogical implications of teacher practice (e.g. through the use of ANSN protocols), together with structured reflection in relation to student learning are also recommended.

Parallels can be drawn between effective personal learning and organizational learning. Just as teachers identified a question or focus for inquiry into the use of ICT, so too must organizations identify a focus for their change efforts. This focus needs to be framed broadly enough to encourage reflection in relation to the pedagogical, sociocultural and political implications of practice and curriculum, yet still connect directly to daily life in classrooms. Rather than simply focus on the integration of ICT, such questions will need to be linked to concerns about the future, particularly in terms of desirable human qualities, capacities, skills, knowledge and understandings. This helps to bring moral purpose (Hargreaves, 1995) into the public arena of teacher talk and increases opportunities to develop shared understandings and common purpose. This study has demonstrated that this kind of talk can result in teachers feeling a sense of 'bonding' with one another, which in turn increased emotional engagement in their working lives.

Shaw (1998) cites Cochran-Smith and Lytle (1992) who suggest that:

> *What is missing from the knowledge base of teaching are the voices of teachers themselves, the questions teachers ask, the ways teachers use writing and intentional talk in their work lives, and the interpretative frames teachers use to understand and improve their own classroom practices. (p. 9)*

Teachers in this study strongly recommended that interested colleagues identify a question for their own personal inquiry. Connection to a high profile change or learning initiative, particularly if school and/or Department of Education endorsed, helps to maintain motivation and commitment. A challenge facing the informal teacher leaders was providing opportunities for sharing and discussion that also enabled new leaders and innovation to emerge. Unless colleagues had similar opportunities in relation to resource provision, professional learning structures and relationship building, they sometimes experienced resentment or jealousy:

> *C: you know the staff's pretty good but when they see you getting the extra computer because you're in the project, and they're not, there's a bit of feeling there.*
> *G: Our staff don't think it's fair and get really peeved because I've got the extra computer. But look at how I've used computers! One teacher has been really antagonistic. They've got one and I've got four plus a laptop.*

The final recommendation in relation to a whole school change effort was to involve broader representation of the school community in awareness raising, planning, decision-making and evaluation of impact:

6. **Broader based community collaboration:** for change to be sustainable within a school community, involvement in the talking and rethinking must include other stakeholders such as principals, parents, students and possibly interested community members or Department of Education representatives.

Garnering the interest and support of the broader school community increases the likelihood of a change initiative being successful. Teachers and principals identified students and parents as change agents who were applying pressure to teachers within the school:

> *I'm finding that the kids I had last year are putting subtle pressure on their new teachers— I'm not very popular at the moment in a funny way because the kids say, "Last year we did this and that on the computer and why can't we do it this year?" And the teacher's saying " alright, alright" and she's saying jokingly that she's getting a bit cheesed off with me because she's sick of hearing about me. But it's positive in many ways.*
>
> *(Connie, Collaborative Analysis Meeting, Mar 2001)*

> *Students are really beginning to drive the project, there's very high motivation. Also the project is getting parents into school as kids talk at home and parents come and ask what's happening. Other parents are also seeing what's happening in the project classrooms and coming to other teachers and asking why isn't it happening in all classrooms. Teachers in these classrooms are now coming to us and asking for greater access to technology.*
>
> *(Principal, Mid-year Evaluation Meeting, July 2000)*

Johnson (1999) has proposed the establishment of 'professional learning teams' as a structural change that has "the potential to reculture a school and establish the type of relationships that support staff of a school as they strive to implement a change proposal" (p. 5). Although conceived as teams for teachers, broadening the conception

to include parents, students and community members, is indicated as a way of maximising the likelihood of cultural change. Johnson suggests 10 characteristics of a professional learning team. They generally:

1. Engage in a relevant and purposeful project;
2. Focus on collective responsibility for producing more effective learning for all students;
3. Use both outside-provided and work-embedded support;
4. Practise many forms of collaboration and systematic reflection;
5. Create a sense of 'personal productive challenge';
6. Involve a formal leader to support members to see the big picture;
7. Address tensions in personal and professional relationships within the team;
8. Consider every member as a change agent and leader;
9. Stay in control of the change initiative;
10. Implement change in different ways and rates. (pp. 5-10)

If change in culture involves changes in roles and relationships and 'the way we do things around here', this means creating new roles and relationships with parents and students in the school setting. Sometimes, this will be informal and subtle (as in the examples above), but perhaps it is time to give consideration to how new roles, relationships and opportunities for productive collaboration can be created within the formal or legitimised structures of an organization.

The next section summarises the key recommendations in relation to the use of ICT and productive educational change, and the implications for the development of professional learning programs in this area.

ICT as a Catalyst for Educational Change

ICT and Literacy

The use of ICT generally begins as a technical endeavour in classrooms. In addition to developing their understandings as to what this technical endeavour entails and the new literacy demands faced by students, a challenge facing teachers is how to move beyond the technical to critically address the pedagogical and sociocultural implications of practice.

The use of digital information resources is now commonplace in classrooms. This study suggests that greater attention to the educational intentions of tasks involving the use of digital information resources is warranted. Situating the use of such resources within information literacy (McKeown, 1999), technoliteracy (Lankshear et al., 2000) and multiliteracies (Cope & Kalantzis, 2000; Kalantzis & Cope, 2001c) agendas provides teachers with a broader frame of understanding from which to design research tasks for students and craft a pedagogical response.

This study went beyond the theoretical to analyse the everyday practice of teachers in the context of the above literacy agendas. Its contribution has been to translate these theoretical frameworks into recommendations for future action that are grounded in understandings of teachers' everyday working lives.

Teachers need time to come to terms with the implications of new literacies arising from the use of ICT. From a technical or operational perspective, professional learning programs need to develop understanding of the specific demands of working in a hypertext and multimedia information environment. Explicit instruction in the language and principles of design, both in terms of the content and presentation of the message, is necessary if students are to develop adequate foundational knowledge. The issue of high-level student engagement at a technical level would benefit from further discussion. This sometimes masked a lack of engagement with content and process, while at other times was harnessed to stimulate rich group process and student thinking.

From a sociocultural perspective, professional learning programs must give consideration to teachers' organization, roles and interactions in classrooms. In particular, emphasis should be placed on how to prompt students to justify the content, method and purpose for particular information products. Such programs should also emphasise broad based educational intentions that go beyond the functional and technical to consider wider literacy implications, cultural understandings and influences, and the development of human qualities such as persistence, problem solving, seeking alternatives and engagement. The sociocultural dimension of literacy practice is where students should be encouraged to make connections between ideas, harness their own social purpose and locate their understandings in meaningful social and cultural contexts. This is a challenge in school and curriculum cultures that encourage specialization and abstraction at the expense of sense-making and meaningful

application. There is a need to look at the implications of existing perspectives and confront taken for granted pedagogical expectations.

If professional learning programs are to promote the development of a critical perspective, they must problematise the medium of ICT, the appropriateness, quality and effectiveness of the messages or information accessed/created, and the influence on, or implications for, social practice. Becoming critical must be linked to social action where information is used to analyse and make connections between historical, social, cultural and political issues and engage in new or transformed practices.

Frames of critical reference differ between teachers, in terms of breadth and the locus of pedagogical influences. When teachers framed tasks that addressed the broader dimensions of literacy, they reported improved intellectual quality in student work. Some teachers are more strongly influenced by curriculum concerns and external structures, using these as a main point of reference in crafting action and response to students. Such responses were geared to obtain a particular learning goal or outcome and tended to focus on what students needed to do differently, with the teacher directing this process. Others are more strongly influenced by how students experience learning activities, and more likely to question their intentions, and the relevance and social purpose of the task from the student's point of view. These teachers tended to focus on what they themselves needed to do differently in relationship with the student. These differences provide a healthy starting point for examining the pedagogical foundations of practice. They affect the way teachers interpret student responses, the types of questions teachers ask themselves and judgment as to the best course of action. Teachers can only confront their existing pedagogy if they have a way of thinking about and describing their practice so that pedagogy is made explicit.

Critical reflection must also give consideration to both external and internal constraints in any new learning process. External constraints include existing structures, norms, preferred organizational models and the boundaries of time and physical space, necessitating confrontation of the 'normal' (Dalmau, 2002). Internal constraints refer to an individual's capacity to make explicit connections between their practice and theories, beliefs, values and personal philosophies. While such knowledge is tacit, it remains inaccessible to the learning or change process.

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Prior to this study, recommendations in the literature called for expansion of the dimensions of literacy to include technical/operational, cultural and critical, particularly in relation to the use of ICT. This study has expanded and modified this view to four areas:

- Technical/operational
- Pedagogical
- Sociocultural
- Critical

The recommendation is that all four areas of theory and practice must be addressed in professional learning programs.

ICT and Communication

If professional learning programs are to develop teachers' critical facility in relation to the use of communications technologies for online projects, they need to provide teachers with a framework for understanding the intentions of such projects. This framework should highlight pedagogical considerations, particularly in terms of the following:

Table 20: Framework for Developing the Educational Intentions of Online Projects

1. **Purpose (social, cultural, moral, political)**

2. **Process (characteristics of interaction)**

3. **Engagement (technical, intellectual, emotional)**

4. **Product or resultant action.**

Purpose

The purpose for forming an online relationship requires careful consideration. Intentions must go beyond process (e.g. telecollaboration) and content (e.g. quality information products) to address the social, moral and political dilemmas that could be raised in the context of the project. It is the addition of this value-based human dimension of online projects that contributes to genuine expansion of learning opportunities for students (the

nature of the ICT medium changes the way relationships are formed and mediated), and provides teachers and students with opportunities to take a personal stand and incorporate their own heart-felt interests and concerns. This is necessary if projects are to go beyond simple technical engagement by students to engage emotional and intellectual purpose.

Social purpose must take account of what constitutes meaningful purpose for students and expand beyond the norms of social purpose dictated by existing curriculum structures. Moral purpose needs to tap into the values of individuals, communities and society in general, while political purpose looks at the distribution of power, fairness, opportunity and equity issues. This automatically provides critical reference points within a project.

Process
The experiences of teachers in this study suggest that development of clear understandings as to the differences between 'telecommunication', 'telecooperation' and 'telecollaboration' would provide a stronger pedagogical reference point from which to develop educational intentions. Most projects in this study achieved telecooperation rather than interdependent telecollaboration. Clarification of the differences between these two modes of operation could inform planning and decision-making. If telecollaboration is the goal, projects need to be framed and scaffolded for students so that they go beyond simply sharing information and perspectives. Telecollaboration requires a partnership to form, conversations to take place, an area of mutual interest and value to be addressed, and interdependent sense-making and co-construction of shared meaning. Telecollaboration should involve deepening understandings of both the world and the self and require individuals to share something unique to themselves, such as feelings, thoughts and perspectives.

Online communication processes can be strengthened and supported more effectively if accompanied at times by real time, synchronous forms of communication. This is particularly warranted during the planning, organizational and design stages of projects, or when problems arise.

Boundaries of time, relationships, physical space and psychological space affect process. The physical and psychological learning space influences roles and

relationships. Changing the boundaries of the physical and psychological learning space, in terms of weakening or making them more fluid, creates opportunities for new forms of relationships, freedoms and processes to emerge. This also creates opportunities for new 'rules' to both shape social interactions and be used to make sense of a student's "pedagogic world and the modality of that world" (Daniels, 2001, p. 109). Professional learning programs must address what these new rules might be.

Engagement

Technical, intellectual and emotional engagement needs attention in the context of online projects. High level student interest in the use of communications technologies helped to maintain teacher motivation in the face of technical difficulties. However absorption in the practicalities inherent in online communication can be a deterrent to more complex engagement.

Emotional engagement, in the form of relationship building, needs to be attended to critically. Teachers particularly highlighted the development of etiquette and empathy, and the capacity of students to look through the medium and put themselves in the shoes of the person receiving the online communication. This is a value laden process with cultural implications, and differences between teachers and students as to what is culturally appropriate and emotionally meaningful are likely.

Consideration of what constitutes a meaningful relationship with others in an online environment warrants further exploration. Online communication did not necessarily lead to instant rapport when students met their telecooperators or collaborators in the flesh. The desirability of moving the virtual relationship into real life relationships, and understanding the development of online relationships from students' points of view and teenage culture would be worthwhile areas for future research. Questions that are indicated by this study are: How do participants see online relationships in the context of their social life worlds? What constitutes a 'quality' online relationship? What is the role of the teacher in supporting students to develop quality online relationships that lead to productive collaboration? What is satisfying or motivating about the development of online relationships from the perspective of participants?

Teachers advocated opportunities for face-to-face interaction to strengthen online relationship building and enable students to develop a 'real' connection with their

project collaborators. Face-to-face meetings that occur in the context of online relationships are still essentially contrived relationships, however. In some cases, such relationships can contribute to community building, while in others they highlight the deficits of the online environment for relationship building, stripped of the normal emotional connectors. Professional learning programs need to provide teachers with opportunities to attend to the implications of ICT mediated relationships.

Emotional engagement must address student purpose and individual interests as well as teachers' purpose and curriculum interests. This can be strengthened by connection to broader based community purpose.

Intellectual engagement was usually raised as an issue of quality, with many of the information products produced as a result of online interaction being judged as inferior in quality. Teachers and students made this judgment differently, with some using presentation as a measure and others looking more closely at content. Both teachers and students need time to engage in discussion to determine explicit criteria for quality work and clarify the intellectual demands or thinking processes associated with the task. This requires a shared metalanguage if common understandings in relation to rich tasks and complex thinking are to be developed.

Attention to the emotional and intellectual dimensions of online communication is a crucial area for awareness raising in professional learning programs. Teachers reported that these were the areas where they saw the benefits of projects realised. This was particularly apparent when the online communication prompted complexity in student thinking and discussions that addressed moral purpose.

Action and Production
If online projects are to have meaningful purpose, they must result in the production of new learning, cultural products and/or social action. Telecollaboration necessitates shared responsibility and distributed leadership in an effective process. It also requires the development of organizational, self-management, interpersonal and communication skills.

Social purpose implies an authentic audience for what is produced, an authentic rather than a contrived relationship to develop and/or application of the new knowledge, skills and understandings in a real life context.

ICT, Animation and Innovation

This study goes part way to describing the conditions for creative use and innovation with ICT. It also describes the changes that are possible when pedagogical, rather than simple technical interventions are implemented. When teachers developed the use of animation in their classrooms, their pedagogical focus shifted to human roles and meaningful purpose, rather than achieving specific measurable outcomes. When teachers adopted a complex pedagogical focus, complex outcomes in relation to student development were observed. The following 'fuzzy' generalizations (Bassey, 2001) are offered as practical indicators likely to move ICT use into creative and innovative use, based on teachers' experiences with animation.

- The process incorporates and addresses student interests, feelings, ideas and concerns, with connections to the world beyond the school. This is further enhanced when ICT is used to make a meaningful communication about an issue of significance;

- Complex educational intentions are in evidence, with technical intentions supporting, not overtaking, social, cognitive and moral intentions. Tasks are rich, with such richness derived from the complexity of the planning, design, production, fine-tuning, presentation and reflection processes engaged in;

- The use of ICT reflects a real world process;

- ICT is used in the context of a genuine team collaboration with differentiated roles, democratic decision making and shared organizational responsibilities;

- Teachers provide explicit support and structure to prompt student thinking, process and product development. Teachers introduce students to new 'metalanguage' to assist them to gain greater control over the design, technique and production process;

- Power and status are redistributed as a result of the overall process and new roles and relationships are in evidence;

- Flexible boundaries in terms of time, learning space, curriculum demarcations, and roles are in evidence.

Because the use of animation was a new practice introduced into classrooms, rather than an existing practice adapted to be conducted using ICT, new forms of social practice and organization developed. Teachers made connections between the past (linking their existing understandings about narrative development to the new context of animation), and the future (preparing students to use and make sense of multimodal forms of communication). By observing professionals at work, they were able to recontextualise their own work, integrating theory and practice to both inspire and address the learning needs of their students in a culturally relevant manner.

An important learning from teachers' experiences with animation is that it was only when the work was understood in the context of a multiliteracies agenda (rather than an innovative or integrative use of ICT agenda) that strong moral and cognitive purpose emerged. Use of ICT was then clearly linked to preparing students for the future and the new forms of literacy learning and understanding they would require to make sense of, and communicate with and about the world. Teachers' pedagogical orientations and values added social purpose to their agenda, emphasizing more democratic practices and redistribution of power and roles in the classroom. This constituted cultural change.

ICT and Early Numeracy

Technoliteracy and multiliteracies are not generally considered in the context of early numeracy learning. This study has demonstrated that these concepts can be applied to help inform practice and pedagogy in the area of numeracy, as well as literacy, and have broad application across the curriculum. Teachers were able to make this generalisation as was evidenced in their practice.

Teachers intentions for numeracy learning were found to encompass the three dimensions of technoliteracy: technical/operational (learning to use technology and learning basic numeracy skills and concepts); sociocultural (the kinds of interactions teachers wanted students to engage in and ways of connecting conceptual and procedural development to real life meaning and purpose); and the critical (encouraging students to engage in critical thinking about their strategising and process, problematizing the role of technology).

The pedagogy of multiliteracies framework was applied to teachers' practice as they developed related numeracy and ICT practice. This led to further clarification and

elaboration of the ideas proposed by the New London Group (1996), Cope and Kalantzis (2000) and Kalantzis and Cope (2001c). Their language (situated practice, overt instruction, critical framing and transformed practice) has also been reworked to more closely match the language of practitioners. A multiliteracies pedagogy for numeracy learning involves:

1. **Stimulating a need to know**: establishing meaning, authentic context and purpose for inquiry. Activating and tapping into students' interests. (This incorporates early critical framing and sets the scene for addressing educational intentions);

2. **Multiple modes of experience**: providing multi-sensory experiences, explorations and mini-investigations that cater for different learning styles. This might include physical body, interpersonal, artistic, concrete manipulation and more abstract paper and pencil or multimedia representations of concepts;

3. **Target teaching and the introduction of metalanguage**: language is power—introducing students to language that opens opportunities for increasing their levels of control over a concept. Moving beyond vocabulary to principles of design, and ways of representing relationships. Identification of skills needed to pursue particular inquiries and direct teaching of these where necessary. This might involve students in the role of tutor as well as teachers, or allowing students to discover strategies and relationships in controlled investigations guided by teacher questioning, as well as direct instruction by the teacher. It might also involve asking children to make their process and thinking explicit so that they can examine this further;

4. **Critical and creative thinking, inquiry, strategising and reflection**: developing a community of inquiry that enables active investigation to grow out of earlier shared experiences in light of students' interests and concerns. Providing time to revisit previous investigations and tackle new challenges, pose and solve problems, investigate and make sense through data generation and analysis, plan and model, test and predict, strategise, describe, explain, discuss, justify and evaluate. Engaging students in the use of metalanguage and metacognition to make sense of complex ideas and of themselves. Broadening contexts to sociocultural and political considerations (such as practical and

authentic application, a culture of sharing, examining, discussing, giving feedback, evaluating, suggesting and building upon the work of others, and raising issues such as 'fairness' and 'appropriateness').

5. **Creative design and application in authentic real world and community contexts**: Problem posing, solving and application of new learning that engages social, cognitive, moral and authentic purpose.

Michaels and Sohmer (2001) state that teachers and researchers in their study found the critical framing feature of multiliteracies pedagogy both "vague and problematic" (p. 76). This study has contributed to understanding what critical framing might look like in classrooms, with examples in the very first year of schooling. Critical framing is not only consideration of political power in a context, but can be represented by the very actions that engage learners and cause them to reflect upon their world, what they know and what they want to investigate.

Recognition of difference, through multiple modes of experience and exploration of numeracy concepts and issues, has the potential to readdress the political playing field. As children come to school with their different cultural and background experiences, shared investigations that cater for different learning styles and starting points can help to lessen the disparities and disadvantage that will be experienced by some groups. Instead of highlighting difference in ability (as occurs in skill teaching by ability group), shared experiences and investigations promote and value sharing, collaboration and differences in perspective and strategy.

When classrooms are reconceptualized as learning communities with distributed leadership and democratic decision-making, roles such as 'teacher', 'learner', 'leader', 'investigator', 'helper' and 'thinker' take on new meaning and also become dispersed and distributed. The expanded multiliteracies pedagogy thrives in such a learning environment.

Authenticity in numeracy learning warrants further investigation. As a discipline, mathematics has a history and learning culture of abstract thought and disciplined thinking, with practical application somewhat removed or delayed until higher levels of complex thinking are developed. As a result, the teaching of numeracy largely revolves around the curriculum concepts that have been identified as necessary to learn.

Numeracy learning often takes the form of school learning, even when open-ended and investigative. The challenge for further investigation is to explore the relationship between the more purist pursuit of mathematical thinking for its own sake vs. learning mathematics in authentic contexts with meaning, connection and purpose that assists understanding of the world through the lens of mathematics.

The use of ICT can easily be applied to the first view, particularly when its use bridges understandings between the concrete and abstract. The second view suggests that even stronger discriminations about the appropriateness of ICT related tasks are warranted, particularly if its use is to engage teachers in reconstructing mathematical curriculum as well as their pedagogy.

The Challenge for Further Research

Part of the rationale for this study was to learn more about the role of ICT as a catalyst for educational change. This study has found that although a link with investigating the use of ICT in classrooms was a motivational factor for teachers to change their practice, a singular focus on use or integration of ICT is actually somewhat limiting. It is possible to have high level technical skills without changing the basic structure of the organization and relationships in classrooms. Simply changing the type and use of ICT in classrooms left teachers feeling somewhat dissatisfied unless it was accompanied by a changed or strong pedagogical focus.

Teachers in this study believed that students needed to learn to use ICT in order to prepare them adequately for the future. It was this moral purpose that was the underlying motivator for teachers—they wanted to improve their students' life chances. This is also a form of political purpose. When the development of ICT in classrooms was shaped by moral and political purpose and a strong pedagogical focus, its use occurred in the context of establishing a new culture in classrooms, with changes in roles, relationships, organization, power distribution and the status of individuals possible. In this instance, teachers confronted their values, beliefs and rationale for use in terms of sociocultural, cognitive and localised political benefits. This type of critical reflection then influenced the teaching strategies they chose, the way the responded to students and how they crafted future action. Teachers reported increased morale, confidence, motivation and leadership capacity as their professional learning went

beyond simply being socialized into new practices and involved describing, informing, confronting and reconstructing their pedagogical orientations and classroom practice.

This study has identified an approach to developing teachers' understanding and use of ICT in classrooms (or other innovations) that expands and develops existing approaches in the literature. This approach addresses teachers' pedagogical, social and practical work lives and uses this to guide technical skilling. Although previous studies had identified the importance of addressing the technical, cultural and critical, this study has added the pedagogical dimension and expanded cultural considerations to also address the social. This expanded view can be used by policy makers and designers of professional learning programs to develop programs that lead to productive and sustainable educational change in classrooms.

This study stopped short of whole school sustainable change. This is clearly an area of research that needs further exploration. The lessons learned from supporting a cultural change process in classrooms now need to be considered in terms of broader based school community change. The roles of school leadership and those with legitimate power in an organization are clearly indicated as determinants of the potential to develop leadership capacity and distributed leadership within the overall organization. When not present, teachers' drive, interest and motivation to work for the good of others beyond their classroom diminishes. When present, teachers develop an interest in and drive to work for the overall good of the school community.

If structure, culture and the opportunities for new collaborative and productive working roles and relationships are at the heart of classroom change, then a possible generalization to consider new roles, relationships and working partnerships within the overall school community is a possible avenue to explore in future research. The experiences of this study led to the recommendation that broad based participation by all stakeholders affected by an innovation is likely to strengthen the sustainability of that innovation. When opportunities are created for normally silent voices to be heard and for the redistribution of power through democratic decision making processes, cultural change is likely. The distribution of power at an organizational level is very different to that experienced in the classroom. In the classroom, teachers still maintain a position of authority.

Who is viewed as 'authority' or 'knower' will have implications for any community change effort and will require close attention to the political, both localised and beyond the school. At the very least, a community will need to have established a culture that values diversity and difference and be willing to invest in developing leadership, decision-making, communication and conflict resolution skills as a part of the overall innovation and change process. Critical reflection requires a willingness to both confront the self and to respectfully confront others. A broad based community change process must be managed respectfully, with due consideration given to personal, practical, pedagogical, sociocultural and political ramifications. If a community works hard to establish shared understandings from this basis, they are likely to be capable of growing in understanding together. The unique world view that each stakeholder group brings to the process must also be seen as privileging them with the role of 'knower'. This study has also identified the importance of staying close to the moral purpose of the work of schools, the intentions behind what students are asked to do and the views of students themselves in terms of how they experience the learning environment.

This study began with a focus on change in individual classrooms, then broadened to begin focusing on school wide change. Further research is also needed to identify how this type of work can be integrated with systemic change facilitation. As a learner, I see this as my next challenge, working in conjunction with organisational change processes in schools. Systemic change facilitation cannot be conducted from a low status position within the Department of Education. Consequently school reformers and facilitators of change within systems must consider such issues as status, influence, positioning of roles and development of relationships.

This study has also raised questions about the role of business partnerships in education and the relative benefits for students that accrue from such partnerships. As governments increasing seek the economic benefits of such partnerships, sound critical research that identifies the relative influences of those involved in such partnerships and their underlying intentions is clearly warranted.

In this study, ICT was the catalyst for mobilizing energy and commitment to change and innovation, but any innovation could be substituted as long as it has whole school community support and involvement or genuine collaboration. A self-regenerating change model is perhaps a way to build upon what has been learned to gradually re-

culture a school as a learning community, so that sustainable change is managed. The following organizational change strategy is suggested as a follow-up proposal for the next stage of research in this area.

Reflective Action Circles

The success of teachers in terms of cultural change in classrooms suggests that a model based on their collaborative learning and research experiences is worthwhile to pursue. The challenge is to move from special project model to a self-regenerating change model. Reflective Action Circles (RACs) are a possibility, providing teachers with an opportunity to seriously inform, confront and transform their practice through collaborative learning that both inspires and re-energizes a new group of leaders.

Figure 14: Reflective Action Circles—5 Year Development in One School
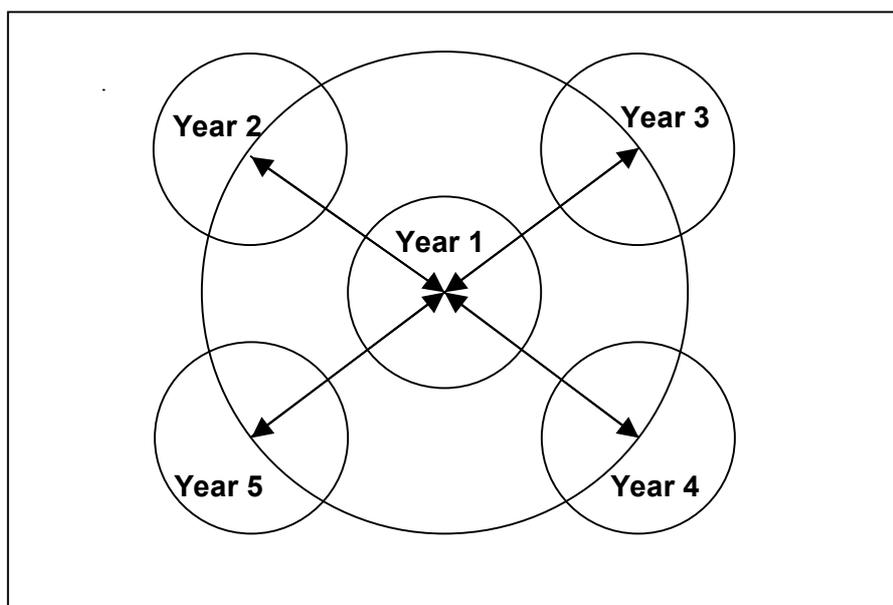
Beginning with a single RAC in Year 1, consisting of approximately four volunteer teachers, and a small number of representatives of other school community groups (e.g. parents, leadership and students), a collaborative learning and research process would begin. This group would receive additional resources, time in particular, to engage in productive collaboration and critical inquiry around an area of innovation and change. In the second year, this group would move into a satellite role and a new voluntary group would be selected for the intensive or central RAC. Although a separate group, they would still connect with the first team periodically throughout the year, to share experiences and ideas and to engage in critical reflection. Each year a new group takes

the central position and the previous group moves to a satellite position, still involved, supportive and connected, and growing or consolidating their own year of intensive learning.

If a number of schools 'cluster' together to implement this model, then a stronger web of connectivity is created:

Figure 15: Reflective Action Circles—Developing Community Connectivity
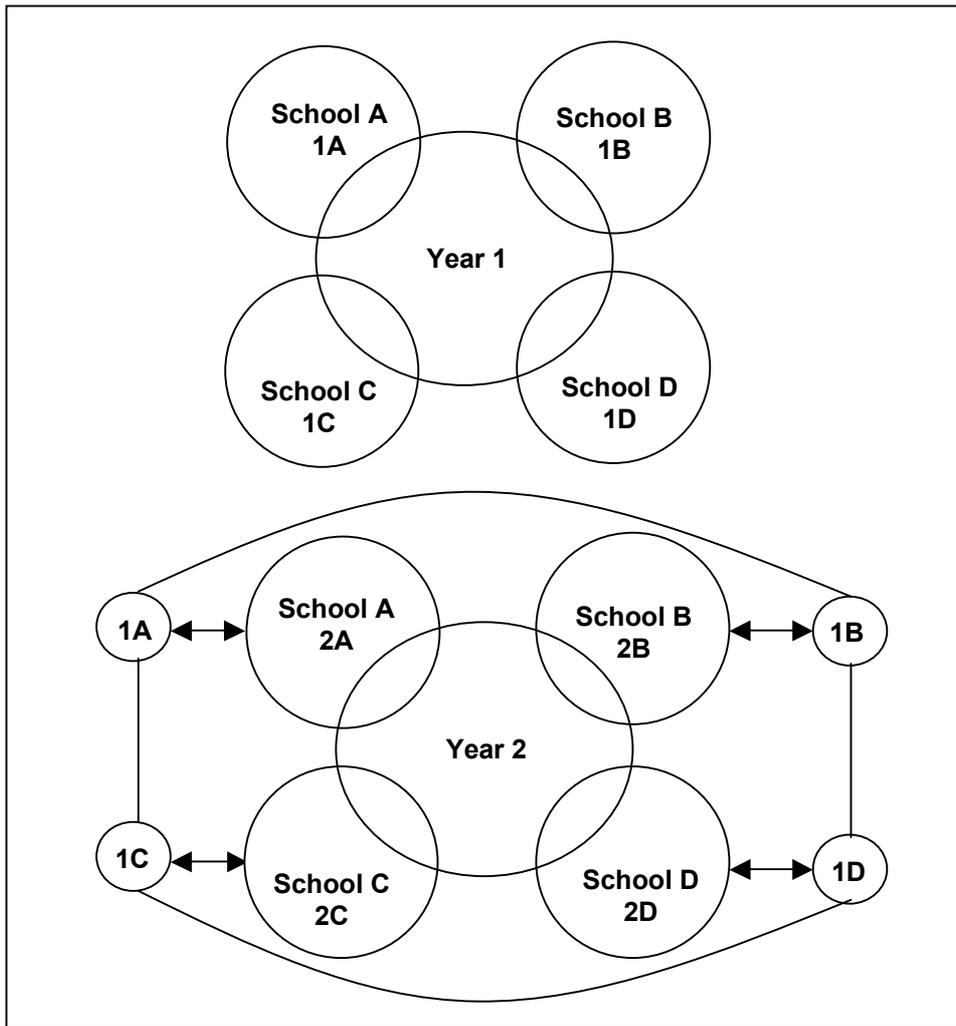
This model addresses teachers' cultural preference not to set themselves up as experts, suggests a way to share resources equitably (yet not all at the one time) and acknowledges the diverse capacities and value of each individual to any professional learning process. After five years, leadership capacity, motivation and morale of a school community should be strongly distributed and broadly based.

Cultural and structural change that genuinely reforms schools for the future will require new forms of productive collaboration. This should involve different combinations of principals, parents, students, teachers and community members. As new working partnerships evolve and gain legitimacy, the power differentials currently experienced by different groups should also shift. Student voices and the voices of the various groups of school community members need new forums for expression and opportunities to learn together.

> *To learn is to be excited. To learn is to be energised. To learn is to be fully alive. To have time to learn is one of life's most wonderful gifts.*
> *(Nina, 6 month Professional Learning Evaluation, August 2000)*

Appendices

Appendix 1: Action Research Planning Proformas

Background Planning

Name:..

School: ....

Address: ....

Phone: ....Fax: .... Email: ....

Stage 1

Issue or Problem: What is the issue or problem you want to improve or explore?

Describe the context or circumstances associated with the issue or problem. How is it related to your current practice?

What do you already know about the issue or problem?

What else do you need to know? What questions do you have? Who else might be interested or be a resource?

What do you think is possible—your vision of the future in relation to this issue?

What are the "blockers" that are preventing you from getting to where you want to be now?

How can you find out more? What kinds of information do you need?

Are there any risks you can think of? Who should be notified? What permissions should be obtained?

Describe any resources that will be required (e.g., funds/ colleague support/ student support/ etc).

Describe an action oriented time-line for the project

Stage 2: Refining

What is/are the main question(s) you have decided to investigate?

What methods will you use to obtain information about your issue/problem?

How will you use the information you gather?

How will you manage this project in conjunction with your current workload?

Stage 3

Six Month Action Research Report

What was your initial problem or issue?

What information did you gather?

What action did you take as a result of this information?

What did you discover? (What did you do that worked? How do you know it worked? What didn't work? What did you learn? etc)

What interesting or unexpected outcomes occurred?

What is your initial hunch / interpretation of the situation?

What did your students think of their experiences in relation to your project? What did they learn?

What new questions emerged as a result of this process?

Where do you think you need to go from here?

Think about what you have learned in the course of your project that would be worth sharing with other teachers. Please attach a short and clear description of successful classroom strategies or activity structures which can be shared on our website.

Stage 4

Twelve Month Action Research Report

Describe the cycles of planning that you have engaged in and how your problem or issue has developed.

What actions have you taken in relation to the project in the latter half of the year?

What did you discover?

What evidence do you have to indicate student learning or change?

What interesting or unexpected outcomes occurred?

What new questions emerged as a result of this process?

Where do you think you need to go from here?

How have you influenced others in your school?

Compare your teaching now to 12 months ago or the beginning of the year. What's different? What's better? What do you still wonder about?

Appendix 2: Reflection Proformas

1. Snapshot

Alias:	
Date:	
Year Levels:	
General description of my class structure and how I organize my students to work.	
What are my current practices in relation to my research interest?	
What is the student reaction to my current practices:	
How do I feel about my current practices?	
Who or what has influenced me to do things this way?	

Why do I want to change	
Who else do I currently talk to or work with in relation to my research interest? (Are there people beyond the inquiry team?)	
What are the ways I currently use ICT in the teaching and learning process?	
What impact do I see ICT currently having on my students and their learning?	
Who or what has influenced me to use ICT in this way?	
What is my current vision as to how I think ICT should be used in the teaching and learning process?	

2. Walk and Talk (Process introduced by the Australian National Schools Network).

Read through the following questions, then leave them behind while you "walk and talk" with a partner (someone you don't know well) for 20 minutes. Each person takes 10 minutes to respond as the wish to the thoughts that have been prompted by the questions. While one person talks, the other walks alongside and does not speak—you simply give the other person the gift of listening. After 10 minutes, swap roles. Stay within the protocol until 20 minutes are up. You may then debrief and talk together as you make your way back to the room.

- Why are you the teacher that you have become?

- Who has influenced you?

- How did you form the values that guide your teaching?

- How would you articulate these values?

- Are there times when you experience value conflict?

- Why do you think this occurs?

- What might you do about it?

- Why are you the teacher that you have become?

- Who has influenced you?

- How did you form the values that guide your teaching?

- How would you articulate these values?

- Are there times when you experience value conflict?

- Why do you think this occurs?

- What might you do about it?

3. Notes on Keeping a Professional Journal

This consists of a weekly record of the events that have impressed themselves most vividly on your consciousness. It helps to reveal our assumptions, the values we actually live by. Focus on critical incidents that caused you particular pleasure, stress, or puzzlement. Try to spend 15-20 minutes a week writing your entries. What will go into them are details of events that are remembered with particular vividness. Jot down some brief responses to any of the following questions that seem appropriate:

1. What was the moment (or moments) this week when I felt most connected, engaged, or affirmed as a teacher—the moment(s) I said to myself, "This is what being a teacher is really all about"?

2. What was the moment (or moments) this week when I felt most disconnected, disengaged, or bored as a teacher—the moment(s) I said to myself, "I'm just going through the motions here"?

3. What was the situation that caused me the greatest anxiety or distress—the kind of situation that I kept replaying in my mind as I was dropping off to sleep, or that caused me to say to myself, "I don't want to go through this again for a while"?

4. What was the event that most took me by surprise—an event where I saw or did something that shook me up, caught me off guard, knocked me off my stride, game be a jolt, or made me unexpectedly happy?

5. Of everything I did this week in my teaching, what would I do differently if I had the change to do it again?

6. What do I feel proudest of in my teaching activities this week? Why?

Don't feel constrained by these questions. Add your own as you see appropriate. As you read your entries over weeks and then months, try to note patterns emerging in your responses. Look at the frequency of situations which occur that give you pleasure/pain. Be alert to energy-draining situations that need changing or kept to a minimum.

Note your responses to what took you by surprise. These may alert you to possible assumptions you have about teaching that you might need to question.

If you are comfortable, share your log with a colleague or arrange to talk in general terms about what you have written. Colleagues can act as useful mirrors: they can spot patterns in our behavior or assumptions about our practice that are too close to our experience to be clearly visible to us.

(Adapted from Brookfield, S. 1995. *Becoming a Critically Reflective Teacher*. San Francisco: Jossey-Bass, pp-72-75).

4. Revised Journal Prompts

This consists of a weekly record of the events that have impressed themselves most vividly on your consciousness. It helps to reveal our assumptions, the values we actually live by. Focus on critical incidents that caused you particular pleasure, stress, or puzzlement. Try to spend 15-20 minutes a week writing your entries. What will go into them are details of events that are remembered with particular vividness. Jot down some brief responses to any of the following questions that seem appropriate:

1. Something new that I tried this week that went particularly well?

2. Something new that I tried this week that didn't go as well as I hoped—what I hope to do about this or what would I do differently?

3. Something I do regularly that characterizes my practice– what causes this/maintains this?

4. How did my students use ICT this week—what did I notice, how did the technology influence their learning?

5. What did I learn this week? Where do I go from here?

6. Ways I worked with other teachers this week. Changes that happened at school.

7. Problems or constraints that I had to deal with this week?

Don't feel constrained by these questions. Add your own as you see appropriate.

If you are comfortable, share your log with a colleague or arrange to talk in general terms about what you have written. Colleagues can act as useful mirrors: they can spot patterns in our behavior or assumptions about our practice that are too close to our experience to be clearly visible to us.

Alternative Journal Prompts

What?	What have I tried this week?
So What?	So what do I think this means?
Now What?	Now what will I do as a consequence of this?

(Source: Australian National Schools Network and Coalition of Essential Schools).

5. School Visit Planner and Reflections

School Visit Planner	
Name:	
Site of visit:	
Class:	
Teacher I will visit:	
Date:	
Time and duration of visit:	
Purpose of Visit:	
How will I engage with the class I am visiting?	
How might I support my partner in their inquiry?	
What would it be helpful for me to see during this visit?	
What do I need to know before I visit?	
What do I need to do before I visit?	

School Visit Reflection:

Record the Research Question:
Record the Teacher's Goals for the Visit:
VISIT

Observations:	Reflections/Questions:

DEBRIEFING THE VISIT: Record key ideas and reflections (This section is for the person you visited to comment on your reflections.)
IMPLICATIONS FOR PRACTICE: Record ideas for changes in practice.

(Adapted from Coalition of Essential Schools: A teacher's tool to observe peers in the classroom : http://ces.edgateway.net/cs/resources/view/ces_res/36

Appendix 3: Professional Learning Evaluation

Think about and comment on any changes the project has influenced you to make in terms of:

- Your beliefs and understandings about teaching and learning

- The type of questions you ask yourself about your own or others practice

- Your content knowledge

- Your classroom management and organization

- The activity structures, practices or teaching strategies you use

- Use of new resources, materials or ICT

- Curriculum planning

- Student roles and responsibilities

- Ways you work with other staff (sharing, collaborating, planning etc)

What student development have you observed in relation to these changes?

What changes have occurred at a school level as a result of your involvement in the project? How would you describe the impact of your school leadership on the project?

What ideas or practices have you shared with others during the last six months?

How would you describe your feelings and attitudes about the journal writing?

If the journal writing wasn't successful for you, what other ways do you think would assist you to record, share and reflect upon your practice?

What changes did you make as a result of classroom visits (Project schools, Navigator schools etc)?

What was the main motivation to make these changes?

How could the project further support you in your professional learning—what would you like to see more of, less of or done differently?

Appendix 4: Professional Readings for Teachers

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Appendix 5: ANSN Protocols

The Tuning Protocol

(Developed as part of the Coalition of Essential Schools' National Re-learning Faculty program, and further adapted and revised as part of the Annenberg Institute for School Reform's National School Reform Faculty Project).

The **Tuning Protocol** (as in 'fine tune') is a useful tool for allowing a variety of voices and perspectives to be shared, while focusing intently on a specific presentation. The time frame may vary, but generally adhering to a strict time for each segment is advised. We will use the following:

INTRODUCTION   (2 - 3 minutes)
Facilitator briefly introduces protocol goals, norms and agenda.

PRESENTATION   (5 minutes)
In this segment, the presentation is made. This includes the context for student work (or whatever the document is) and the samples of student work (or the planning instrument etc). There is **NO** questioning at this time.

CLARIFYING QUESTIONS   (5 minutes)
Participants have an opportunity to ask 'clarifying' questions - to get pieces of information that may have been omitted in the presentation and that they feel would help them to understand the context of the presentation. The facilitator should be sure to limit the questions to those that are 'clarifying'.

PAUSE FOR REFLECTION   (2-3 minutes)
This is to allow participants to write down feedback items they would like to share - generally, no more than one example of each.

WARM FEEDBACK   (3 minutes)
Participants reinforce/call attention to aspects they think are especially strong; recognise the acknowledgement of problems and issues by the presenters; ask for more detail on something they think is important. This is not about saying 'good presentation'. It is about being descriptive and helping the presenter see value they might not have seen, themselves, in their presentation.
Presenters take notes, but **DO NOT** respond.

COOL FEEDBACK (NOT CRUEL)   (3 minutes)
This is an opportunity for participants to pose questions that make them wonder, want to know more about, are confused about. They may also share concerns, raise issues or other ideas that they think are worth exploring etc.
Presenters take notes and **DO NOT** respond yet.

RESPONSE AND OPEN CONVERSATION   (5 minutes)
This is an opportunity for the presenter(s) to respond to the questions and comments. During this segment, other participants are quiet.

REMAINING TIME   (If applicable)
Additional questions, comments and open conversation.

FEEDBACK ON THE PROCESS (2 - 3 minutes)
The full group provides feedback (debrief) on the process.

The Consultancy Protocol

(Developed as part of the Coalition of Essential Schools' National Re-learning Faculty program, and further adapted and revised as part of the Annenberg Institute for School Reform's National School Reform Faculty Project).

TIME: At least one hour

ROLES: Presenter(s) - whose work is being discussed by the group
                    Facilitator - who also participates

PROCESS:

1. The presenter(s) give an **OVERVIEW** of the work they are presenting for feedback, either in writing or orally. They might highlight major issues or problems with which they are struggling, or successes they have had. Then they **frame a question for response**. The framing of this question, as well as the quality of the presenters' reflection on the work being discussed, is a key feature of this protocol.
(10 minutes)

2. The group asks **CLARIFYING QUESTIONS** of the presenters—that is, questions that have brief, factual answers.
(5 minutes)

3. The members of the group then ask **'PROBING' QUESTIONS** of the presenters— these questions should be worded so they help the presenters clarify, deepen and expand their thinking about the issues. The goal here is for the presenters to learn more about their thinking and about the work/issue they have presented. The presenters respond to the question but there is no discussion of their responses by the larger group. The group simply continues asking the questions.
(15 minutes)

4. The members of the group then **TALK WITH EACH OTHER** about the work and issues presented. "What did you hear?" "What didn't you hear that you wanted to know more about?" "What did you think about the issues?" The discussion should be about both the strengths and gaps (warm and cool feedback). The presenters are not allowed to speak during this discussion, but instead, listen and take notes.
(15 minutes)

5. The **PRESENTERS THEN RESPOND** to the discussion (first in a fishbowl if they prefer), followed by a whole group discussion.
(10 minutes)

6. The facilitator leads a **BRIEF CONVERSATION** about the group's observations of the process.
(5 minutes)

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