A STUDY

OF

SUCCESSFUL IMPLEMENTATION AND MANAGEMENT OF EDUCATIONAL TECHNOLOGY IN THREE NEW SOUTH WALES PRIMARY SCHOOLS.

Submitted by

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A thesis submitted in partial fulfillment of the requirements of the degree of

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18TH APRIL, 2005

STATEMENT OF SOURCES

This thesis contains no material published elsewhere in whole or part from a thesis by which I have qualified for or been awarded another degree or diploma. No other person's work has been used without due acknowledgement in the main text of the thesis. This thesis has not been submitted for the award of any degree or diploma in any other tertiary institution. All research procedures reported in the thesis received the approval of the Australian Catholic University Ethics Committee.

Douglas Anthony Ashleigh

18th April 2005

ABSTRACT

The main purpose of this dissertation is to analyse why three New South Wales primary schools were successful in implementing and managing educational technology. Responding to this research focus four specific questions were considered:

1. Why have these schools been successful in implementing and managing educational technology?
2. What factors have helped and/or hindered the successful implementation and management of educational technology within the selected schools?
3. What are the indicators of successful implementation of educational technology?
4. What were the particular contributions of leadership to the successful implementation and management of educational technology within the selected schools?

This qualitative research study is based on the assumption that valuable data are gathered by studying schools that have been successful with the implementation and management of technology. In particular, the study provided a description and analysis of the *best practice* in three New South Wales Primary schools that had successfully implemented and managed educational technology.

An interactive and cyclical process of data analysis was employed with data collection, data analysis and theory development proceeding simultaneously. To reduce and display data gathered from in-depth interviews, document study and non- participant observation the qualitative data analysis program QSR NUD*IST was utilised.

The development and validation of the study’s conceptual framework shaped the study leading to the formulation of the SupportIF Model of Implementation. This model posits that success with implementation and management of educational technology is closely related to the level of interdependence between the implementation factors. The study results also endorsed the prime importance of a supportive work environment in each of the studied schools and linked this environment to the level of success realised with the implementation and management of technology and the utilisation of educational technology to enhance the achievement of student learning outcomes. The study

contends that the sustainability of a school based technology initiative rests with a school's ability to dynamically balance the key implementation factors and to redesign in light of shared practice. Tantamount to this process is a supportive work environment in each school which is the critical variable that facilitates interdependence between leadership, resources, relationships and teaching and learning factors.

ACKNOWLEDGEMENTS

This dissertation represents eight years of challenging and rigorous work. The final work would not have been possible without the support of people who have contributed to the dissertation and to the quality of my life over a stimulating period of academic work. I now wish to extend my gratitude to so many of you who have helped me.

My principal supervisor, Professor Patrick Duignan has been a constant source of knowledge and wisdom. His personal expertise, experience, constructive critical comments and undying patience are highly valued by me. Likewise I acknowledge Associate Professor Charles Burford, my co-supervisor, who provided significant support and advice throughout the eight years.

My appreciation is also extended to the Directors of Education, Michael Bowman and Dr. Wayne Tinsey and the many colleagues in Catholic Education in the Diocese of Lismore and Maitland – Newcastle for their professional support.

During the past years I have been nurtured by the love and care of my family. Without their interest and support for me the total doctoral exercise would have been impossible. To my wonderful wife, Bernadette for her endless encouragement, support and belief in me I will be forever grateful. For the understanding and patience shown by my children Conor, Liam, Niall and Siobhan I am thankful.

Finally, I thank my mother, Maureen and Father, Ash, for the educational pathway they set me on many years ago.

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CHAPTER ONE

INTRODUCTION

> *”The whole is characterised not only by its parts, but by the relations between the parts as well”* (Aristotle, 1024a).

The purpose of this research is to develop an understanding of how educational technology can be successfully implemented and managed in primary schools. This study is based on the assumption that valuable data can be gathered by studying schools that have been successful with the implementation and management of technology. This study will provide a description and analysis of the best practice in three New South Wales Primary schools that successfully implemented and managed a school-based technology initiative. This study was formed through the development and validation of a conceptual framework that will identify, describe and analyse the factors that influenced the successful implementation and management of educational technology within each of these schools. Studying examples of best practice in education, argues Cuttance and Stokes (2000), can inform the efforts of schools to “put in place educational practices based on their understandings of best practice” (p.1). Contributing to this understanding within the study will be the stories of the staff involved with the implementation and management of educational technology within each school. Learning from the experiences of these people provides opportunities for the reader to inform his/her understanding of the factors that contribute to the successful implementation and management of technology in the primary school setting.

The focus of this study is on educational technology. In terms of the context of this study educational technology will be explored from a global, national and school perspective, with particular emphasis placed on the twenty-first century primary school and an examination of the relationship of educational technology to teaching and learning within the classroom. Each of these will now be discussed

CONTEXT OF EDUCATIONAL TECHNOLOGY

A broad view of technology using the term ‘educational technology’ was adopted in this study. One of the challenges in this research was that the term educational technology has different definitions and meanings including the use of terms that are regularly interchanged within literature, such as, eLearning, online learning, information and communication technology (ICT), computer assisted learning (CAL), and computer based instruction (CBI). While all of these terms apply to educational technology, they do not fully explain its complexity. In essence, educational technology refers to an integrated process, whereby the tools of technology interact and complement the process of learning, creating meaning and providing skills and strategies for continued learning by the learner. Defining educational technology for this study was a difficult task, as a range of definitions existed in the literature. Two definitions that were influential in the development of this study's definition of educational technology highlighted the complexity of educational technology. The Handbook of Educational Technology considered educational technology as "the application of research, learning theory, emergent technologies, and child and adult psychology to solving instructional and performance problems" (Department of Educational Technology Handbook, 2004, p 1), while the work of McLafferty (2000), described educational technology as "a tool, a series of instruments that can be used to enhance and expand the learning process" (2000, p. 23).

The implementation and management of educational technology in primary schools is, therefore, complicated by different understandings of the complexity of educational technology. In this study, it was decided to adopt the definition proposed by Roblyer and Edwards (2000) that educational technology was a "combination of the processes and tools involved in addressing educational needs and problems, with an emphasis on applying the most current tools: computers and their related technologies" (p. 6). This definition of educational technology evolves as new tools are introduced into the classroom, but what will remain constant is the need to meet educational needs and solve educational problems.

The focus on educational needs and problems is explored in the work of Rodney (See figure 1) who provided valuable insight into development of this study's conceptual framework. Rodney (2002) argued that educational technologies provided the bridge between the teacher, the learner and instruction for the purpose of meeting educational needs and solving educational problems leading to enhanced student learning. This bridging relationship effects the development of an interdependent relationship between the learner, teacher and instruction, and in so doing, works as a catalyst augmenting the achievement of learning outcomes.

In highlighting the interdependent relationship between educational technology, the learner, teacher and instruction Rodney acknowledges that the future of education will be profoundly influenced by educational technology.

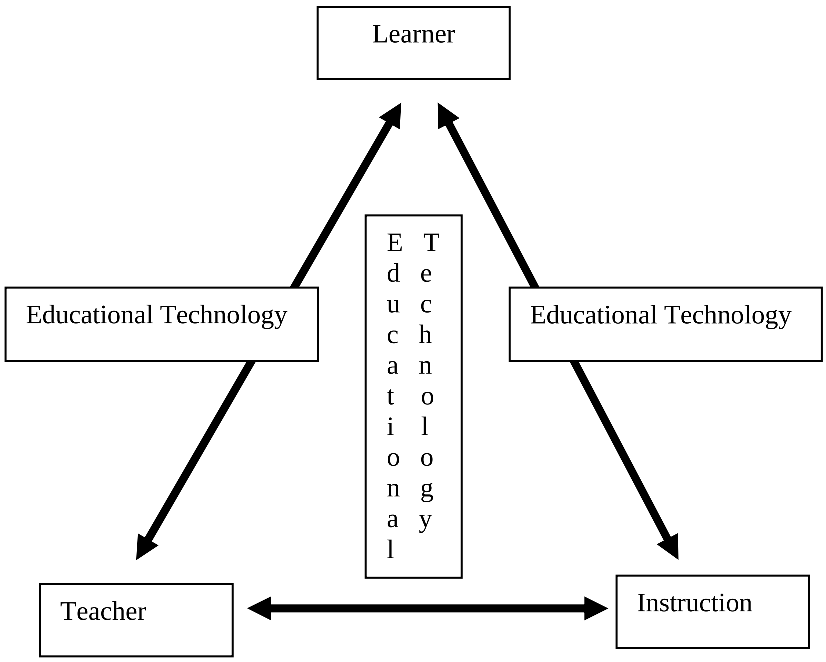


Figure 1:
Educational Technology – The Future of Education (Rodney, 2002)

Rodney (2002) also argued that this relationship is crucial to the future achievement of learning outcomes, as the tools and processes of educational technology are applied to educational problems and needs. This relationship will become increasingly significant as technology is integrated into the primary classroom and is linked to the student learning required for the achievement of key learning outcomes. Therefore it is argued that the achievement of student learning outcomes and the implementation and management of educational technology are closely linked and are an important focus of this study. Taking a meta view of educational technology trends and developments reinforces the significance of educational technology to the twenty-first century classroom and supports the close relationship between the achievement of student learning outcomes and the implementation of educational technology.

Global Perspective

Understanding educational technology from a global perspective has particular implications for schools of the twenty-first century. Within this study, educational needs are seen to be closely linked to the achievement of learning outcomes for students, with educational technology being linked in the literature to the success of learning and to the achievement of student learning outcomes (Rodney, 2002). The achievement of effective learning outcomes in the twenty-first century is further complicated by education entering a new age, one which Negroponte (1995) has termed the ‘digital age’. This age, argues Thornburg (1999), is characterised by exponential change where new possibilities and potential for learning are omnipresent. An age where MUDs, MOOs, virtual worlds, 3D worlds, micro-worlds, intelligent environments, simulated environments, global networks, adaptive systems and hypermedia environments are reflective of the dynamic digital landscape for learning. These developments have created a situation whereby ‘digital age' children have grown up regarding technology as a part of the natural landscape (Hasselbring, 2001), and "for the first time in history are more comfortable, knowledgeable and literate than their parents about an innovation central to society” (Tapscott 1998, p. 1).

The resulting changes brought about by the digital age have occurred predominately because of advancements in technology in the latter part of the twentieth century and the early years of the twenty-first century. These developments have seen information grow at an unprecedented rate (Thornburg, 1999). This rapid increase in information access has been largely driven by a convergence of modern computer and communication technologies. The convergence of these technologies is highlighted in the three schools involved in this study, with each of these schools using technology to support learning initiatives undertaken.

This growth of information has been most pronounced through the development of the Internet. Data gathered by Neilsen/Net Ratings (NNR) (2004) confirms the global significance of the Internet with 757,530,737 people or 11.7% of the world’s population having access to the Internet (NNR, 2004), and in excess of 55,000 new sites added to the Internet daily (Whois Source, 2004). Evidence from around the world (IWS, 2004), shows that the pervasive growth of the Internet, and the subsequent proliferation of web-based information and resources combined with the ability to communication globally in real time, has placed increasing pressure and expectations on schools to use this technology in ways that will support the type of learning considered most effective for twenty-first century classrooms (Dede, 1998; Fulton, 1998; Hawkins and Collins, 1999; Markauskaite, 2003)

A development of note for this study, in applying current Internet technology to support classroom learning, has taken place through a number of large-scale Internet-based projects focused on the development of digital learning objects (MERLOT, 2004; MIT, 2003; TLF, 2004). These projects have been designed to explore the delivery of digital learning objects to support the achievement of enhanced learning outcomes within the classroom. The projects highlight the view that learning and teaching in the twenty-first century classroom will be closely linked to educational technology and the delivery of digital learning through the Internet. The integration of digital learning objects into the classroom, argue Bratina *et al.*, (2003), will support the identification of need-specific knowledge and provide learners with content that will meet specific and narrowly defined purposes consistent with the diverse learning needs of twenty-first century students. Downes (2003) maintains the delivery of such digital learning objects has significant potential to enhance the achievement of learning outcomes in the classroom as the number of learning objects increase and learning object repositories are developed.

Innovative developments in the delivery of learning technology resources through projects such as the Learning Federation and MERLOT, and findings from the review of literature in this study, highlight a growing expectation within society for schools to better use the available technology to support learning. This expectation will increasingly shape the classroom of the future, resulting in, “work and learning being closely aligned with each other” (Thornburg, 1999, p2). The alignment of work and learning will be reflected in the changing demands of the twenty-first century workplace in schools, with Evensen and Hmelo (2000) maintaining that schools will require professionals with more advanced and flexible skills than their twentieth century contemporaries with schooling “extending beyond the traditional preparatory goal of establishing a knowledge base” (p. 1).

Such global developments are of considerable interest in Australia, particularly, when the increasing level of technology adoption occurring within Australian society is considered (NOIE, 2002).

Australian Trends

In Australia, the relatively low cost, compared to the once almost prohibitive cost of computers, has made technology more affordable and accessible both at school and in the home. It is now expected that the vast majority of students have access to computers, and a growing number to the Internet, either from school or home (CSO, 2004). This expectation is confirmed when the rate of technology adoption in Australia is considered, with recent estimates indicating that 13.5 million or 66 per cent of Australians have access to the Internet (Nielsen/NetRatings, 2004).

On the world stage, Australians have also been identified as major users of new technology with The National Office for the Information Economy (NOIE) (2002) reporting that Australia was one of the leading countries in the world, ranked third behind the United States and Sweden, in terms of Internet infrastructure, penetration and use. The report also confirmed that Australians were major adopters of information economy-enabling technologies, such as the Internet, computers and mobile phones. The level of adoption of technology within Australian society, therefore, places increased expectations and pressure on classroom teachers to use the technology that many have access to at home to support and enhance the learning taking place in the classroom.

While the adoption of new technologies and the development of infrastructure have seen the level of access to technology increase significantly within Australia, Dede (1998) has argued that this increased level of access to technology has created inherent difficulties for classroom teachers as they are challenged to revolutionise traditional learning and teaching. The difficulties associated with the integration of technology into the classroom have been further intensified as the use of ICT in education has matured, and the focus of interest has shifted from an overriding concern with skills and competencies towards an engagement with the potential for ICT to act as a catalyst for the development of new styles of teaching and learning, consistent with the demands of the twenty-first century learner (Roschelle *et al.*, 2000).

In Australia, noticeable developments have taken place in assisting teachers to prepare for the learning demands of the twenty-first century classroom by providing resources, training and research through the creation of national curriculum organisations, such as, the Curriculum Corporation (www.curriculum.edu.au), Education.au Limited (www.education.edu.au) and EdNA Online (www.edna.edu.au). The EdNA initiative, in particular, has been established to facilitate the use of Information and Communication Technologies (ICT) for learning, education, training, research and scholarship in Australia, and provides strong links between research and practice with the integration of technology.

While the primary schools included in this study have ready access to the curriculum resources outlined, they also operate within the New South Wales curriculum framework and, therefore, are subject to syllabus requirements. This is particularly the case with the testing of computing skills in year 6 (CSA6) and the integration of ICT skills and content into the Key Learning Areas within primary syllabi. Within the Key Learning Areas of study, many of the learning outcomes are facilitated or focused by the appropriate use of technology. Such technology is seen to be supportive of, and a catalyst for the type of learning required for the twenty-first century classroom.

LEARNING AND TEACHING

For the twentieth century classroom the relationship between successful implementation and management of educational technology and the achievement of high quality student learning outcomes has particular significance for learning and teaching in the classroom and is a strong focus for this study. The integration of technology into the teaching and learning life of the primary school classroom, and (in an increasing number of studies) has been found to transform the teacher's role from being the traditional 'sage on the stage' to also being a 'guide on the side', where student roles can also change from being passive receivers of content to being more active participants and partners in the learning process (Alley, 1996; Repp, 1996; Roblyer, Edwards, & Havriluk, 1997).

The transition from teacher-directed to more student-centred instruction has coincided with the shift from predominantly behaviourist to more constructivist approaches to learning. Constructivists, like Seymour Papert (1980), envisioned a new role for the computer, that of partner in the active knowledge building and problem solving learning processes of the student. The changing roles of teacher and student do not rely on technology entirely, however, the integration of computer technology into education, and the proliferation of computers in society, appears to both demand and require changes in the teaching and learning process (Bennett, 2002; Clifford, Friesen, & Jacobsen, 1998; Picciano, 1998).

The types of changes occurring in teaching and learning demand new skills that Ridgeway and McCusker (2002) claim will require the learner to work as part of a team, knowing how to solve problems and learning new things through the location, evaluation and application of information. Furthermore, the literature highlights the significance of the internal interactions and relationships within schools to the ongoing success of educational change focused on teaching and learning (Fullan & Hargraves, 1991).

Fullan and Hargraves (1991) argue that the relationships between learners were often of greater importance than the skill development of the learner in the creation and maintenance of the type of learning climate required for students of the twenty-first century. Learning for students of the twenty-first century, argues Hasselbring (2001), requires the creation of a school environment where the cultures of teaching are the prime focus for educational change, and teachers are supported to make changes. A number of authors developed a strong link between this environment and the development of a supportive work environment (Hasselbring, 2001, Lamson & Barnett, 1994; McKenzie, 1998; Rosenholtz, 1989; Schlager, Fusco, & Schank, 1998; Sherry, Lawyer-Brook and Black, 1997; Talbert & McLaughlin, 1994; The Boulder Valley Internet Project, 1997).

These developments are significant for this study and strongly influenced the development of the conceptual framework because they established a link between future learning and teaching, educational technology and the relationships among learners. Developing an understanding of how a primary school successfully implemented and managed school-based technology initiatives may provide models and strategies to support the future integration of technology into the classroom. Given the challenges confronting primary schools, it is important to gain a better understanding of why selected primary schools were successful implementing and managing educational technology. This study, therefore, seeks to learn from the experiences of schools that had achieved success with the management of school-based technology initiatives.

PURPOSE OF THE STUDY

The purpose of this study was to develop an understanding of how educational technology can be successfully implemented and managed in primary schools. This is achieved through studying three schools considered by reputational experts to have achieved success with the implementation and management of educational technology. The extensive review of literature included in this study found a lack of research into the implementation and management of educational technology in the primary school setting in Australia. This study, therefore aimed to describe and analyse how the three New South Wales primary schools successfully implemented and managed educational technology.

The study focuses, in particular, on four factors of implementation, identified in relevant literature as being key to the successful implementation and management of educational technology and that form the basis of the conceptual framework for this study. These four factors are relationships, leadership, resources, and the learning environment. Through a study of each of these factors and the interdependent relationships that concomitantly developed among these factors, an understanding of what happened in the three successful schools with the implementation and management of educational technology is explored.

SIGNIFICANCE OF THE STUDY

The lack of research into the implementation and management of educational technology at the primary school level within Australia, and more particularly within New South Wales provides the potential for the findings of this research to make a significant contribution to the current body of knowledge that exists, while providing data that may assist primary schools with the implementation and management of school-based technology initiatives.

While the breadth of this study is limited to these primary schools, there are potential implications for primary schools throughout New South Wales and Australia in relation to the management of technology. These implications are highlighted in the fact that the study has its foundation in the context of the New South Wales education environment and, more particularly, on the processes applied in three New South Wales primary schools that allowed for the successful management of a school-based technology initiative. Studying the implementation and management of educational technology in these schools required a detailed understanding of the school-based process undertaken to manage technology. Developing such an understanding provided the basis for the testing and exploration of the study's conceptual framework and the answering of the research questions. These understandings would have significance for all primary and elementary schools not just those located in Australia and New South Wales.

The significance of the study is captured in the research questions which were developed from a review of literature and research, the findings of a pilot study which preceded and informed this study, and the researcher's own experience with the implementation and management of educational technology over a period of fifteen years.

RESEARCH QUESTION

What factors have contributed to the successful implementation and management of educational technology in three primary schools in New South Wales?

Research Sub-questions

Why have these schools been successful in implementing and managing educational technology?

What factors have helped and/or hindered the successful implementation and management of educational technology within the selected schools?

What are the indicators of successful implementation of educational technology?

What were the particular contributions of leadership to the successful implementation and management of educational technology within the selected schools?

METHODOLOGY

The study adopted a qualitative methodology employing a multi-site case study approach with the data collected and the types of data used to answer the research questions. What is important to the choice of the qualitative approach for the current study is that the qualitative data focuses on naturally occurring, ordinary events in natural setting of the primary school. As well, qualitative data have the potential for “richness and holism” revealing complexity and “providing thick descriptions that are vivid, nested in a real context” (Miles & Huberman, 1994, p. 10). The qualitative data in the present study will provide a helpful research text that invites “completion by the reader and acceptance by him or her, of the text’s message and the construal of the meaning of the thesis” (Barone, 1998, p. 154). A detailed description of the methodology is presented in chapter 3.

ORGANISATION OF THE DISSERTATION

This dissertation is divided into nine chapters. Following the introductory chapter the second chapter reports on the literature review. The review examines literature that is related to the focus of this study and provides a comprehensive account of recent empirical research related to the research questions. The chapter concludes with an outline and exploration of the conceptual framework through detailed discussions of the factors of implementation, namely, relationships, leadership, resources, and the learning environment.

The research design and methodology, including discussions on data collection techniques and the data analysis method used, are discussed in chapter three. Chapters four, five, six and seven are used to present, analyse and discuss data related to the implementation factors identified in the conceptual framework.

The specific research findings related to the four key research questions and general research findings are presented in chapter eight. The conclusions and recommendations for further research, as well as, possible professional application of the research are presented in chapter nine

CHAPTER SUMMARY

The focus of this study, educational technology, was defined and explored from a global, national and school context. Within this exploration, particular emphasis was placed on the twenty-first century primary school and an examination of the relationship of educational technology and teaching and learning within the classroom.

In this chapter it was proposed that an understanding of the implementation and management process of educational technology can be effectively gained through the study of key implementation factors. The multi-site case study of three New South Wales primary schools is used to examine this proposition. In doing this, the central research question and sub-questions are identified and explored at each school through a range of data gathering techniques. The data were analysed with the factors contributing to the successful implementation and management of educational technology identified.

In the next chapter, a review of the literature related to this research is undertaken.

CHAPTER TWO

REVIEW OF LITERATURE AND RELEVANT RESEARCH

The purpose of this research is to investigate the factors that contributed to the successful implementation and management of educational technology in three New South Wales primary schools. In determining these factors, a range of research related to the implementation and management of educational technology was reviewed, including a variety of meta-studies that explored the effect of technology on student achievement. This chapter outlines this review, highlights the major findings from recent research and literature, identifies questions to be investigated within the study and develops a conceptual framework for the study.

In the literature there emerged a number of key factors considered significant in the successful implementation and management of educational technology. These factors were identified in this chapter as: learning environment factors, resource factors, leadership factors, and relational factors. The literature review is organised around each of these key implementation factors. Each factor will be described together with the relationship that factor has to the successful implementation and management of educational technology in the primary setting explored in this study. The exploration and discussion of each factor, and the interdependent relationship among the four factors, form the basis of the conceptual framework for this study which is presented at the end of this chapter.

LEARNING ENVIRONMENT FACTORS

A review of relevant literature revealed a large number of studies reflecting the significance of learning environment factors for the successful implementation and management of educational technology (Bangert-Drowns, 1985; BECTA, 2003; Bialo and Sivin-Kachala, 1996; Blok, Oostdam, Otter, & Overmaat, 2002; Christmann *et al.*, 1997; Cotton, 1997; DFEE, 2001; Fletcher-Flinn Bialo 1994; Kulik, 1994; Mann, Shakeshaft, Becker & Kottkamp, 1999; Niemiec & Walberg, 1987; O’Donnell-Darling, 2000; Ryan, 1991; Sinko & Lehtinen, 1999; Publishers Association, 1996; Rowe, 1993; Sivin-Kachala & Bialo, 2000). These factors are predominantly concerned with the learning environment in each school and, more specifically, with the learning and pedagogy required to enable educational technology to be successfully integrated into the life of the school. Underpinning these factors, and intimately related to the development of learning environments for the twenty-first century, is an implicit recognition within education and society of the effectiveness of educational technology for enhancing student learning. An argument emanating from this review highlights the realised and potential effects of educational technology in shaping the learning environment within primary schools of the twenty-first century. The effect that educational technology has on student learning is significant to this study, the aim of which is to provide qualitative and quantitative data outlining a broad range of educational and social effects of educational technology within school. Many of the findings from research literature reviewed in later sections of this chapter provide strong support for the implementation of a school-based technology initiative within the primary school setting. The first factor identified in this literature review was the learning environment factors. These factors appear to be symbiotically related to the pedagogical beliefs and the approach to learning adopted within the school, which, in turn, appear to be enhanced by the strategic planning that occurs within the school (ACOT, 1994; DETYA, 2000b; Jones, 2002; Picciano, 1998; Schiller, 1999; Roschelle *et al.*, 2000).

Measuring the effectiveness of educational technology on Student Achievement

In a comprehensive review of the literature, meta-analysis studies seemed to provide the strongest evidence of the relationship between educational technology and student achievement. Determining the effect educational technology has on student achievement, required a comprehensive review of meta-analyses focused on computer-based instruction (CBI) and computer-assisted instruction (CAI). While educational technology includes numerous modes of delivery and support mechanisms, the computer, and in particular CBI and CAI, are recognised as major components of educational technology.

These two areas contained the most comprehensive research findings relating to the effect of educational technology on student achievement (Ryan, 1991). In determining the effects of CBI and CAI, the utilisation of a common measurement scale known as the effect size (ES) is frequently utilised (Ryan, 1991). Effect size refers to "the proportion of the experimental scores that are greater than the average score in the control group…..with an ES of 0.30 meaning that 62 percent of the experimental group scored higher than the average student in the [control] group.” (Sivin-Kachala & Bialo, 2000, p. 15).

Using this ES proportion the effects of educational technology on student achievement will now be explored from the literature. A comprehensive overview of the literature pointed towards the importance of meta-analysis studies which have already been conducted in this area (Bangert-Drowns, 1985; Christmann *et al.*, 1997; Cotton, 1997; Fletcher-Flinn & Gravatt, 1995; Kulik, 1994; Kulik & Kulik, 1991; Kulik, Kulik, Sivin-Kachala & Bialo, 1994; Software Publishers Association, 1997). The first stage of this review will be an analysis of these meta-analyses. These studies, while predominately conducted in the 1980-1990's, still inform and contribute to our understanding of the effects of educational technology on student achievement.

Early Research Findings on the Effects of Educational Technology on Student Achievement

The findings of research related to the effect of educational technology on student achievement, while not conclusive, generally suggest that educational technology has a positive impact. This finding is borne out in extensive studies focusing on CBI and CAI undertaken by researchers such as Bangert-Drowns (1985); Cotton (1997); Fletcher-Flinn and Gravatt (1995); Kulik (1994); Kulik and Kulik (1991); Kulik, Kulik and Sivin-Kachala and Bialo (1994) and the Software Publishers Association (1997). According to Kulik and Kulik (1991), when analysing the results of research on the effectiveness of educational technology, an ES of 0.3 is considered to be a moderate but significant effect. This is confirmed in their meta-analysis of 254 controlled evaluation studies covering students from kindergarten through to higher education, where Kulik and Kulik (1991) found that CBI had an average ES of 0.3.

A similar effect of 0.32 was shown by Kulik (1994) who also reported that students usually learn more in less time and enjoy classes more when they receive computer-based instruction. While Kulik conceded that these results were not definitive and that computers do not have a positive effect in all areas studied (Kulik, Bangert & William, 1983; Kulik, Kulik & Bangert-Downs, 1985; Kulik & Kulik, 1991; Kulik & Kulik, 1986), he argued that computer-based instruction had a positive record in evaluation literature. He reported that:

> At least a dozen meta-analyses involving over 500 individual studies have been carried out to answer questions about the effectiveness of computer-based instruction. The analyses were conducted independently by research teams at eight different research centres. The research teams focused on different uses of the computer with different populations, and they also differed in the methods they used to find studies and analyse study results. Nonetheless, each of the

> analyses yielded the conclusion that programs of computer-based instruction have a positive record in the evaluation literature (Kulik, 1994, p. 11.)

Similar findings have emerged regarding the effect of CAI on student achievement. In particular, the work of Fletcher-Flinn and Gravatt (1995) is noteworthy with the findings of their meta-study of 120 studies conducted between 1987 and 1992 showing an average ES of 0.24, with later studies conducted between 1989 and 1992 showing an ES of 0.33. Their research generally supported the efficacy of CAI in formal education environments and was, overall, found to be effective in education environments for a broad range of student ages. Further support for the positive effect of CAI on student achievement was also found in the earlier work of Kulik, Kulik, and Bangert-Drowns (1985) who analysed 28 studies that examined the effectiveness of CAI with elementary students. Their findings showed that CAI appeared to improve student achievement resulting in an average ES 0.47 over students receiving conventional instruction. Findings within the secondary school environment, while not as conclusive as Kulik, Kulik, and Bangert-Drowns (1985), have shown support for CAI (Snowman, 1995; Christmann, Badgett & Lucking, 1997).

Overall results from meta-analyses indicate that educational technology in the form of CAI and CBI had a moderate effect on student academic performance, with the average effect size ranging between 0.20 and 0.47 standard deviations (see Christmann *et al.,* 1997; Fletcher-Flinn & Gravat, 1995; Kulik & Bangert-Drowns, 1985; Kulik & Kulik, 1991; Kulik, 1994; Niemiec & Walberg, 1987; Ryan, 1991). While broad in scope, the findings highlight a number of specific curriculum focus areas where educational technology was considered to have a positive effect on student achievement. Such findings were significant for this study because they provided consistent support for the need for integration of educational technology into the learning environment of the school. This was most noticeable with the findings on writing, reading, mathematics and online communication.

Writing and Online Communication

Research conducted by Cotton (1997) highlighted the positive effect that computers and word-processing software had on writing achievement. She found that students using word-processing software produced superior writing products when compared with traditional pencil-and-paper. This approach resulted in longer written samples; greater variety of word usage; more variety of sentence structures; more substantial revision;

greater responsiveness to teacher and peer feedback; better understanding of the writing process; and better attitudes towards writing (pp. 35-36). Similar findings were also noted in the earlier work of Owston, Murphy, Wideman (1991). More recently, Sivin-Kachala and Bialo (2000) established in their studies that students with English as a Second Language (ESL) and special needs students produced higher quality writing products when using word processing software.

The positive effects on writing achievement were further reinforced within online communication, with Nix (1998) finding that fourth grade students who had been exchanging e-mail regularly with partners at another school performed better in persuasive writing tasks both on and off the computer than students who had not been using e-mail. Online communication technology was also found by (CAST) the Centre for Applied Special Technologies (1997) to improve academic achievement. Studies undertaken by CAST revealed that fourth-grade students with online access scored significantly higher on two of nine learning measures, while sixth-grade students with online access scored significantly higher on four of nine learning measures. The CAST researchers argued that the study provided evidence that online access helped students become independent, critical thinkers, able to find information, organise and evaluate it, and then effectively express their new knowledge and ideas in compelling ways. Such findings, while not conclusive, provide support for the adoption of a technology initiative within a school. This is further enhanced when the impact on reading and mathematics is considered.

Reading

Educational technology was reported in a recent study by Blok, Oostdam, Otter, and Overmaat (2002) to positively affect student achievement in reading with a small ES of 0.19 being found for computer-assisted beginning reading instruction compared to instruction without CAI. While Sivin-Kachala and Bialo's (2000) report on an unpublished study by Foster, Erickson, Foster and Torgeson that showed:

> In two separate studies and five different measures of phonological awareness, the computer-based approach was found to be significantly more effective than regular instruction. The average ES of 1.05 is considered significant. (p. 19)

The earlier work of Stone (1996) also provided support for the positive effect of educational technology on reading, finding that second grade students who had received

CAI in reading and other areas since kindergarten scored significantly higher in both reading comprehension and vocabulary than students with no CAI.

While the effects of educational technology were shown to impact positively on achievement in writing and reading, the greatest effect on achievement was reported in mathematics.

Mathematics

Fletcher-Flinn and Gravatt (1995), highlighting the effect of CAI, reported that "the greatest effectiveness was obtained in the teaching of mathematics" (p. 242). This conclusion was further reinforced by Robyler (as cited in Thompson, Simonsen & Hargrave, 1996) who found, through in-depth meta-analyses that computers were more efficient in teaching mathematics than reading and writing skills. The significance of educational technology in mathematical achievement was also reported by the Department of Further Education and Employment (DFEE, 2001) where positive correlations were found between mathematical achievement and the implementation of educational technology at Key Stage 3 (Standards Assessment Task taken at age 14). Positive effects were also present for younger students, with research findings showing that at-risk four-year-olds who used computer based mathematical activities achieved higher results in the Test of Early Mathematical Ability (TEMA2) than students who did not have access to such activities (Elliott & Hall, 1997). Stone (1996) showed a similar situation occurring with second- grade students who had access to mathematics and reading software programs since kindergarten. These students scored significantly higher in mathematics problem-solving on a standardised test than students who did not have mathematical and reading software.

These findings provide data outlining the effects of educational technology on student achievement that predominately utilised CAI and CBI. While such findings are valuable and can provide schools with direction and focus areas for the integration of technology into the classroom, they have to be considered in the light of the limitations of meta-analytical studies and the rapid changes being experienced in the design, speed and delivery of educational technology.

Limitation of Meta-Analytical Studies

The use of meta-analyses to determine the effect of educational technology on student achievement highlights a number of limitations, in particular, the reality that a large amount of this research was conducted in the 1980s. Even more recent meta-analysis, such as that of Fletcher-Flinn and Gravatt (1995) and Christmann *et al.,* (1997) included a preponderance of studies from the 1980s and early to middle 1990s, where much of the computing was text-based and non-graphical. In considering the resulting trend of lower effect sizes for the early 1990s, as reported by Christmann *et al.*, (1997), more contemporary studies, including meta-analyses, are needed to examine whether or not this trend has been maintained and to explore possible causes of such trends.

Further to these discussions, many research findings do not take into account changes to the available technology and processing speed of the computer processor since 1990. This is significant considering that the standard personal computer of 2004 can store 2000 times more data and process information 700 times more quickly than the standard personal computer of 1990. This rapid growth and improvement in technology exceeds current knowledge of how to use technology effectively in schools (Allen, 2001) and suggests that the impact of technology is different today from the past. This is particularly the case when the enormous processing and storage capabilities of the twenty-first century computer, coupled with developments in the technical infrastructure and the explosive growth of digital technology, are considered. These developments have made possible a broad range of potential educational benefits for the learner. Such benefits raise further issues that need to be considered when implementing and managing educational technology within the primary school setting.

The above mentioned technological setting and context is based on a rationale focused in the late 1990's, therefore there is a need to look at the impact of educational technology in the contemporary context of the twenty-first century classroom. This study on the successful implementation and management of educational technology is significant because it focuses on a range of benefits of educational technology in the contemporary twenty-first century primary school.

Range of Benefits of Educational Technology

A range of benefits of educational technology was highlighted in the work of Bialo and Sivin-Kachala (1996), who reported that "technology has a positive effect on student achievement (both in regular and special education) from preschool through high school" (p. 11). This is further confirmed in a large study conducted by Sivin-Kachala (1998) where the effects of educational technology on learning and achievement across all domains and all ages of learners was studied. Analysing two hundred and nineteen research studies from 1990 to 1997, he found that students in technology-rich environments experienced positive effects on achievement in all subject areas, with the achievements for both regular and special needs children also improved. A more recent study conducted by the Department of Further Education and Employment (DFEE, 2001), also supported the earlier findings of Sivin-Kachala indicating that academic results were much stronger for students when technology was extensively used across the curriculum. This was particularly the case when Information and Communication Technologies (ICT) were integrated directly into the classroom (Jones, 2002).

Information Communication Technology

Research findings on the effects of ICT [a term often used interchangeably with educational technology], show that educational technology when integrated into the classroom can positively influence student learning. This point was emphasised by Sinko and Lehtinen (1999) who examined 795 studies of ICT in education and concluded that ICT had a positive effect upon student learning ranging from an effect size of 0.28 to 0.5. Such positive effects were further reinforced and magnified by the findings of Mann, Shakeshaft, Becker and Kottkamp (1999) and The British Educational Commission and Technology Agency (BECTA, 2003). The BECTA findings reported a strong relationship between the use of ICT and subject results.

> 61% of schools in the sample with good use of ICT in mathematics are at or above national standards in mathematics, against 38% of schools with unsatisfactory use of ICT. The equivalent figures for English are 62% and 36%, and for science are 68% and 37%. (p. 9)

Clarkson, Dunbar and Toomey (1999) argue that the research about ICT's capacity to improve learning and teaching shows that it can play a key role in the complex task of better engaging young people in the learning process. They go further, pointing out that when combined with effective teaching, the use of ICT helps young people develop already widely valued skills and abilities such as literacy and numeracy. ICT and good teaching, argues Cradler (1997), also combine to produce generic skills, such as team work and problem solving that are so important for life in the information age and for lifelong-learning. The significance of these findings is reflected in The Education Network Australia (EDNA) Schools Advisory Group publication *Learning in an Online World* (2000). This publication presents a school education action plan with two specific overarching school education goals for the information economy:

> All students will leave school as confident, creative and productive users of new technologies, including information and communication technologies, and understand the impact of those technologies on society. All schools will seek to integrate information and communication technologies into their operations, to improve student learning, to offer flexible learning opportunities and to improve the efficiency of their business practices. (p. 5)

These goals reinforce the implicit relationship that exists between the twenty-first century learning environments of schools and the implementation and management of educational technology. While the above-mentioned studies provide an array of findings relating to the effectiveness and potential of educational technology to improve student learning outcomes within the learning environment of the primary classroom, they are not conclusive, according to a number of researchers, (e.g. Cuban, 1986, 1988, 1993, 1998; Mandinach & Cline, 1998; Kirkpatrick & Cuban, 1998; Sinko & Lehtinen, 1999).

In fact, it has been suggested (Software Publishers Association, 1996) that the most conclusive findings relating to the benefits of educational technology for students are not present in academic achievement but in the affective domain. Despite the fact that the effects of educational technology on student academic achievement remain somewhat conjectural, the concomitant effects of educational technology on the affective domain are less suppositional and are well supported in literature. This point is highlighted by Gregoire, Bracewell and Laferriere (1996) in a meta-summary of relevant research:

> New technologies manage to develop students' interest in learning activities, at least for the time being, and to lead them to devote more time and attention to these activities than in regular classes. Moreover, it is not surprising that they also increase their confidence in their abilities. In turn, this confidence of the students in themselves undoubtedly explains, in part, their spontaneously receptive attitude that a large number of them adopt toward an activity in which technology plays a role and the perseverance that they show in accomplishing this activity. Of course a high level of motivation generally facilitates learning; but it is especially important in situations like the new technologically based learning environments where students are more active in directing their own learning. (p. 33)

The associative development of self-esteem, motivation and interpersonal relationships among learners identified in the literature are key to the development and maintenance of new learning environments and are, therefore, included within the parameters of this research study. This study will give further insights into the question of this broader area of learning and attempt to describe the concomitant effects on teachers involved in a school-based technology initiative.

Technology and the Affective Domain

A strong relationship between educational technology adoption and the development of positive attitudes to learning and improved self-esteem is reinforced in the literature (Cotton, 1992; O'Donnell-Darling, 2000; Publishers Association, 1996; Rowe, 1993; Sivin-Kachala and Bialo, 1994). The development of such positive attitudes and self esteem, it would seem, strongly influence the evolving learning environment within the school. The relationship of educational technology to the evolving learning environment in the primary school is significant for this study, and is particularly important when it is considered that writers such as Ruddock (2000), Tierney (1996) and Travers (1996) have pointed out that improvements in motivation, positive attitudes and increased student control over learning are closely linked with the integration of educational technology into the classroom. The earlier findings of Cotton (1992) recognised this relationship, finding that higher levels of self-efficacy, higher school attendance rates, increased time on-task, and increased social behaviour in schools were evident in schools where technology was integrated into classroom learning. Studies commissioned by the Software Publishers Association (1996) in primary and secondary schools provided further support for the effect of technology on the affective domain finding that student attitudes towards learning and self-concept became most evident in technology-rich environments (see also Sivin-Kachala & Bialo, 1994).

It is highlighted in the above literature that the school learning environment within a primary school is strongly influenced by the integration of technology within the classroom, particularly when it is considered that this technology when used as a learning tool can "make learning more student-centred, encouraging cooperative learning and stimulating increased teacher/student interaction" (Sivin-Kachala & Bialo, 1996, p. 11). Such a learning environment can individualise instruction and provide instant feedback to students (Coley *et al.*, 1997), and lead to a situation in which students will have increased motivation for learning, increased self-esteem, more active control of their immediate environment and the opportunity to work at their own pace (Underwood & Brown, 1997).

The approaches associated with the implementation and management of educational technology have the potential to support the learning environment within a primary school setting, while the level of success achieved with a technology initiative within the school has a direct relationship to the learning environment established. This interdependent relationship is central to an understanding of the learning environment as a core factor of implementation of educational technology in a primary school and is crucial to the conceptual framework of this study which is outlined later in figure 2.

There is, therefore, considerable support in the literature for a connection between educational technology and improvements in student learning outcomes within both the cognitive and affective domains. It is predicted that continued improvements in the achievement of student learning outcomes in the emerging learning environment of the twenty-first century classroom will be significantly impacted by the level of technology integration adopted by the classroom teacher (DETYA, 2000).

The relationship between the learning environment and improvements in student learning outcomes are clearly significant to this study as the research has suggested both have links to the level of success realised with the implementation and management of educational technology within primary school classroom. The question of a school-based educational technology initiative being inter-reliant with the learning environment within the school and the proposition that the teaching beliefs and practices in evidence within the school will shape the learning environment will be of particular focus within this study. Another factor identified within the literature that is related to the learning environment is the nature of pedagogy.

Pedagogy

The central importance of pedagogy to student learning has received considerable attention in the literature. Recent research has established strong links to a range of areas of school life including the nature of the curriculum (Teese, 2000; Teese & Polesel, 2003), organisational practices employed to group students (Lamb & Fullarton, 2002) and educational technology (Markauskaite, 2003). The emergence of new learning environments supported by educational technology has brought to the fore the need for organisational change, in particular, change driven by the beliefs espoused and the practices adopted regarding pedagogy and learning. Such changes, according to Fulton (1998), are grounded in the need to change the education provided for students to match the changes taking place in the global economy and the society to which students will be contributing. This point is emphasised in the work of Dede (1998), Hawkins and Collins (1999) and Means (1994) who believe that the learning environments of tomorrow will look very different from those of today.

There is evidence in the literature to support the view that new learning environments will demand a move away from traditional pedagogical approaches involving the transmission or broadcast of information in which, ‘teaching was telling and learning was listening’ (Greene, 1998). Such a move, Greene points out, will have been influenced by a growing understanding of brain theory and a more specific understanding of how humans learn. This has led to the development of divergent pedagogical approaches that challenge the effectiveness and appropriateness of a knowledge-transmission pedagogy. Of particular interest in this study is the emergence of constructivism, a pedagogy that emphasises the construction of knowledge and acknowledges the active involvement of students in the construction of meaning (Cognition & Technology Group at Vanderbilt, 1996; Darling-Hammond, 1997; Pea, 1994; Resnick & Klopfer, 1989). Such a pedagogical approach is relevant to this study because it is closely linked in literature to the effective use of educational technology as a learning tool in the classroom.

The influence of constructivism and the spread of information and communication technologies (ICT) in classrooms have been viewed as changing the role of the teacher in the classroom from the expert dispensing knowledge to the facilitator of student learning (Dwyer, Ringstaff & Sandholtz 1991; Hadley & Sheingold 1993; Ravitz, Becker & Wong 2000). Tam (2000) explains that educational technology, when used in a constructivist learning environment, offers new levels of versatility and accessibility that “may help to shift the foci from knowledge-as-possession to knowledge-as-construction, and from learning as outside-guided to learning as self-guided” (p. 10). To realise this potential, Markauskaite argues that “The greatest effectiveness of current educational technology is seen in the development of learning environments suitable for a constructivist approach to learning” (2003, p. 69).

Constructivism

It appears from the literature that a learning environment utilising constructivist pedagogy is positively connected to the level of success achieved with the implementation and management of educational technology, Schiller (1999) argues:

> The use of computers in schools for teaching and learning is best served by a constructivist approach to teaching and learning - in which student-active, teacher facilitated environments, developmentally appropriate acquisition of concepts and skills, and multi-age grouping in non-graded learning families are emphasised (p. 5).

Constructivism and educational technology, Tam (2000), points out, “have separately and often together, remade substantially the conception of the challenges of learning, and brought about new learning possibilities for almost all teaching and learning situations" (p. 11).

Constructivism provides ideas and principles about learning that have important implications for the construction of technology-supported learning environments. One of these implications is the need to embed learning into authentic and meaningful contexts (Brown, Collins, & Duguid, 1989; Cognition and Technology Group at Vanderbilt, 1992). The utilisation of authentic and meaningful contexts for learning, argues Tam (2000), becomes evident in the constructivist classroom where educational technologies are utilised to facilitate access to information through the integration of computers, multimedia software and the Internet into the curriculum. The learning environment created is not based on teacher control and knowledge, instead the teacher becomes more of a learning facilitator directing the learning (Lambert, *et al.*, 1995). Educational technology reinforces this role and enables the learner to access information in a variety of media formats and in an interactive fashion (Tam, (2000). This allows learners to make meaningful associations through their own explorations using these different technologies. The work of McKenzie (1999) and Becker (1999a, 1999b, 1998, 1994) have reinforced the positive impact of constructivist approaches on student learning within the classroom, while recognising the complementary relationship that exists between learning and constructivism.

While the potential benefits of the constructivist classroom have been recognised in literature, Klassen (2001) points out that constructivist classrooms have been difficult to create with past technological applications, but twenty-first century technological developments support the possibility for widespread school change based on constructivist teaching and learning theory. The potential of the constructivist classroom is highlighted by Brooks and Brooks (1993) in a comparison of constructivist and traditional classrooms.

Brooks and Brooks argue that the most effective classroom environment for the future will be focused on a style of learning, where learners have access to information on demand. To highlight this point, eight classroom characteristics were identified and described within the constructivist and traditional environment. The characteristics, outlined in Table 1, have particular significance for the development of the conceptual framework of this study because they emphasise the tension between the traditional and constructivist classroom and the role of educational technology within them.

Traditional Classrooms	**Constructivist Classrooms**
1. Curriculum is presented part to whole, with emphasis on basic skills.	Curriculum is presented whole to part with emphasis on big concepts.
2. Strict adherence to fixed curriculum is highly valued.	Pursuit of student questions is highly valued.
3. Curricular activities rely heavily on textbooks and workbooks.	Curricular activities rely heavily on primary sources of data and manipulative materials.
4. Students are viewed as "blank slates" onto which information is etched by the teacher.	Students are viewed as thinkers with emerging theories about the world.
5. Teachers generally behave in a didactic manner, disseminating information to students.	Teachers generally behave in an interactive manner, mediating the environment for students.
6. Teachers seek the correct answer to validate student learning. Students learn that school is about learning "what the teacher tells them."	Teachers seek the students' point of view in order to understand students' present conceptions for use in subsequent lessons.
7. Assessment of student learning is viewed as separate from teaching and occurs almost entirely through testing.	Assessment of student learning is interwoven with teaching, including observations and student exhibitions and portfolios.
8. Students primarily work alone.	Students primarily work in groups.

Table 1

Traditional classroom versus the constructivist classroom
(Brooks & Brooks, 1993, p. 14)

The creation of a constructivist learning environment within the primary school classroom that is focused on learning as opposed to knowledge acquisition is also significant to this study. It is strongly supported from the literature that this learning focused environment utilises educational technology more effectively (Davis, 1995; Howcutt *et al.*, 2000; McKenzie, 1999; Picciano, 1998). The presence of such a learning environment was found to be closely related to the successful implementation and management of an educational technology initiative (McKenzie, 1999). Researchers such as, Albright (1999) and Hooker (1997) argue that technology when fused with pedagogy leads to the enhancement of student learning. Given these findings it can be strongly argued that Constructivist classrooms are more amenable to the integration of technology than the traditional teacher directed classroom.

A strong case has also been put forward in the literature for the creation of environments in schools that recognise that students need to be given opportunities to work together, to learn from each other in active and constructive ways (Cognition and Technology Group at Vanderbilt, 1992; Howcutt *et al.*, 2000; Twigg, 1994; Tam, 2000). Considering that in an increasing number of cases students know more about technology than their teachers (Howcutt *et al.*, p. 39), real challenges exist for the traditional lock-step approach to teaching and learning where content and learning progress are controlled by the class teacher. This is particularly the case when the findings of the National Commission on Teaching and America's Future are considered:

> Students learn best when new ideas are connected to what they already know and have experienced; when they are actively engaged in applying and testing their knowledge using real-world problems; when their learning is organised around clear, high goals with lots of practice in reaching them; and when they can use their own interests and strengths as springboards for learning. (1996, p. 6)

Such a connected approach, argue Salomon and Perkins (1996), promotes a culture within the school that facilitates and promotes learning for all. When such learning has been augmented with educational technology, effective learning in relation to the achievement of outcomes and knowing how to learn can be more effectively realised (Dooling, 2000; McKenzie, 1999; Picciano, 1998). Researchers, such as Linn, Bell and Davis (1995) have even suggested that the use of modern educational technology is the best way to promote the kinds of learning deemed necessary for the twenty-first century, and that current structures and classrooms are ill-suited for these ends. It would appear, therefore, that for such effective and sustainable learning to occur, significant educational reform is required.

McKenzie (1999) argues that such reform needs to be focused on the process of teaching and learning employed by the classroom teacher. This point is further highlighted by Crowther (2002) who points out that the most influential factor in developing a successful classroom learning environment is the classroom teacher. It would appear, then, that what the teacher does and does not do will affect the level of success achieved in a school-based technology initiative. In short, the role of the classroom teacher is crucial to the integration of technology in the classroom, with the adoption of a constructivist pedagogy closely aligned with improvements in student learning outcomes.

The role of the teacher

The class teacher is intimately related to each of the implementation factors outlined at the commencement of this review, with the nature and quality of the learning environment in the classroom directly related to what the teacher does and does not do.

This is most evident, according to Lazear (2003), in the performance of students. The learning environment created in the classroom is at least partly influenced by what the teacher believes and values about teaching and learning. While the integration of technology into the classroom can provide the tool to promote and support the learning environment, the technology alone will not necessarily change the way teachers think about teaching and learning:

> Technology alone does little to support changes in the way teachers think about teaching and the way students think about learning. These types of changes represent a modification in a teacher's pedagogical belief system, not simply a change in the tools that are used to facilitate this process. (Hasselbring, Barron, & Risko, 2000, p. 28)

The capability of a classroom teacher, to create and sustain a learning environment that integrates educational technology is, according to Harris (1999), closely linked with the teacher's personal experience. It comes as no surprise, therefore, to find that teachers generally lack confidence and competence in using and utilising educational technology because most have little experience in the use of such technology. This point was highlighted in the findings of a recent study of teacher perceptions towards the integration and management of ICT in the Catholic Diocese of Newcastle, New South Wales with 93 percent of the research participants reporting that teacher confidence and competence with learning technology were crucial to the successful implementation and management of technology in the classroom (CSO, 2002).

A study conducted by The National Centre for Educational Statistics (1999) on teacher quality reported that only 20 percent of all teachers felt 'very well prepared' (i.e. had sufficient relevant experience) to integrate technology into their teaching. This perceived level of teacher efficacy in using and applying educational technology is one of the most profound obstacles to integrating educational technology into teaching (Wheatley, 2003). The need then for teachers to be knowledgeable and confident about using technology cannot be overestimated, with the literature indicating a strong connection between the relevant teacher experience in using technology and the level of technology integration in the classroom (Ely, 1992; Harvey, Kell, & Drexler, 1990; Stearns *et al.*, 1991).

There has been valuable research conducted on the role of the classroom teacher in the successful implementation and management of educational technology. One of the most important and influential studies exploring this relationship was the Apple Computer's Classrooms of Tomorrow (ACOT) study, conducted over a ten year period and focused on elementary, middle, and high school classes in average or low income districts in the

United States. These classes were provided with technology resources, with each student and teacher receiving a computer in school and another at home. Teachers received intensive support and training throughout the implementation stage. Over the course of the project, researchers looked at the changes in teachers' beliefs, attitudes, and behaviours and "observed profound changes in the nature of instruction, learning, assessment and the school culture itself" (Dwyer, 1994, p. 14).

Over time, Dwyer *et al.,* (1991) reported that technology use changed the way the ACOT teachers taught. As these teachers grew in confidence, their ability and inclination to utilise technology also increased. Teachers became more willing to experiment, with their teaching becoming more student-focused and collegial, leading to the development of more collaborative working relationships with other teachers on staff (Dwyer *et al.,* 1991). The ACOT findings are consistent with the research literature on the impact of computers on the learning process and dispel many myths about technology, with Dwyer (1994) concluding that:

> Teachers adapted to computers easily; children tended to be more involved with cooperative learning rather than learning in isolation; student interest in computer use did not decline over time; children, even the very young, did not find the keyboard a barrier to the use of the computer; and, software was not a limiting factor in the learning process (p. 15).

The results of the ACOT study, while over ten years old, strongly reinforces the importance of the teacher's role in the successful implementation and management of educational technology and are important for this study because the findings support the importance of the core factors of implementation developed in the conceptual framework of the study.

The ACOT findings (Dwyer, 1994) also highlighted the importance of strategic planning for the integration and management of educational technology. Such planning, it is argued, is essential for the ongoing success of a school-based technology initiative. This relationship between strategic planning and effective implementation of educational technology is now explored further.

Planning

Jones (2002) advises that strategic planning for the integration and management of educational technology "has to be part of our thinking about the whole school curriculum; its purposes, the needs of students and the community, theories of learning, school structure and organisation" (p. 10). Central to this planning will be thorough documentation about what is intended and what is happening, so that teachers (particularly new teachers) are kept informed about direction and progress. The importance of such documentation has been emphasised by Education Victoria (1998 – 2001):

> Essential to the implementation and management process is the development of a Learning Technologies Plan, and a series of implementation strategies linked to the schools vision, charter, curriculum plan, level of resourcing and range of teacher skills. (Learning Technologies In Victorian Schools 1998 – 2001, p. 17)

The Commonwealth Department of Education Training and Youth Affairs (1998) further highlighted this need, recommending that policy makers and educational leaders adopt a more integrated approach, linking informational technology resources to planning at a whole-school level. These recommendations have been strongly influenced by the implementation progress that had preceded DETYA's findings, with Fasano (1987) arguing that school-based technology planning had been ineffective because all segments of organisational life, namely leadership, pedagogy, instruction, administration and resources had not been adequately addressed.

The recognition by Fasano of the complicated and interrelated nature of technology planning for schools and more recently by DETYA (2000b) is reflected in the conceptual framework of this study and reinforced in literature (Picciano, 1998; Schiller, 1999; Roschelle *et.al*, 2000). This planning recognises the importance of educational technology to the core work of the school as well as the nature and quality of the learning environment. This integrative planning also provides a vehicle to formalise the shared beliefs about learning and pedagogy that exist within the school. Such an articulation provides direction and shape for teaching and learning, which in turn are critical to the successful implementation and management of educational technology (Picciano, 1998). The management of the school technology plan is a dynamic process that helps link key elements of successful implementation, namely learning environment, leadership, relational and resource factors. The interaction of these factors and the subsequent process of dynamic balance and redesign that continuously takes place in a changing context, it is argued, are congruous with the success achieved with the implementation and management of educational technology.

Just as the learning environment was viewed as a core factor of implementation the provision of resources, both physical and human, are identified in the literature as fundamental to the successful implementation, of educational technology in the primary school.

RESOURCE FACTORS

Resources refer to the physical resources of equipment and infrastructure associated with the management of educational technology, as well as the human resources which relate to the provision of professional development, release time and technical support utilised in the process of implementing and managing educational technology

Physical Resources

The most obvious and visible aspect of the resource factors are the physical resources of schools. The resourcing of schools with technology hardware and infrastructure has dramatically increased in recent years (Disseldorp & Chambers, 2003). This growth has been promoted by declines in the costs of computing power, improvements in the quality of productivity software, and the belief of increasing numbers of parents and members of the community that a capability to use technology constitutes another basic skill that schools should provide for their students (BECTA, 2003; Kiili, 2003). The escalating level of parental, community and government expectations is placing increasing pressure on schools to update and integrate technological resources into classrooms (Haddad & Draxler, 2002).

In Australia, the National Office for the Information Economy recommended to the federal government that “all schools and educational institutions should be connected to broadband to achieve enhanced educational outcomes through improved research, interactive learning and innovative curriculum content” (NOIE, 2003, p. 31). This is becoming more possible considering the growth of computer access in Australian schools as reported by The National Education Performance Monitoring Taskforce (2000) where 71% of schools in Australia had a student-computer ratio of 15-1 or less with the ratio reducing each year (Cuttance & Stokes, 2000).

These school-based technological advancements are being overshadowed in many countries by the rapid adoption of digital technology in the home environment. In the United Kingdom, surveys conducted by the Department for Education and Skills (2001), showed that 78 per-cent of households had a personal computer or laptop, with 64 per-cent of households having access to the Internet.

In Australia, similar developments are reported with the National Office for the Information Economy (April 21, 2002) indicating that 67 per-cent of Australian households own or lease a personal computer, while 80 per-cent of people aged 16-34 and 68 per-cent of people aged 35 years and over in Australia have Internet access. A learning technology survey conducted in the Maitland-Newcastle Catholic education Diocese (2004) in New South Wales, Australia involving three thousand students in forty one schools showed a steady increase in the level of access to technology from home with 96% of students having access to a personal computer and 86% of students having access to the Internet from home.

The growing level of student access to technology tools creates a challenging dilemma for schools as they try to catch up with the rapid technological developments in society. Once the leaders in utilising new educational technologies, schools are now faced with the situation that many students have ready access at home to more digital technology than is available at school (Haddad & Draxler, 2002). Such a resource change is resulting in schools not being able to maintain control over what technology is used and how it is used by students. This is creating new pedagogical and learning challenges for classroom teachers (STAR Report, 2001; Hayes *et al*. 2000). Compounding these challenges, students are increasingly expecting schools to provide ready access to the type of digital resources used at home.

Education is responding, although slowly, with the provisioning of equipment and infrastructure to enable twenty-first century technology networks to function. This has been noticeable with the establishment in New South Wales education of new standards of connectivity and hardware specifications (DSE, 2002; CAST-NET, 2003). While such developments are essential for the sustainability and future success of school-based technology initiatives, the provision of adequate support for teachers to utilise technology to plan and learn is essential.

Professional Development

Studies, including Becker (1994), Dooley (1999), Glennan and Melmed (1996), Hasselbring, *et al.*, (2000), McKenzie (1998), Mergendoller (2000), NCES (1999), Sheingold & Hadley (1990), U.S. Congress, Office of Technology Assessment (1995), indicate that resources, especially for release time and professional development and training, are needed for teachers and curriculum co-ordinators to do the detailed curriculum design work necessary for successful integration of the growing technology resources being provided for schools. Picciano (1998) highlights in particular the need for more teacher training and professional development to enable educational technology to be successfully integrated by classroom teachers. The need for continued and improved teacher training in respect to technology has been steadily reinforced by a range of writers including Boyd (1997), Bialo and Solomon (1997) and Zehr (1999, 1997).

The effectiveness of computer technology in the classroom is closely related to teachers becoming knowledgeable about both the technology itself and about how to use it to meet educational goals. This point was strongly reinforced in a recent MCEETYA report on ICT in Australian schools. They argued that effective and ongoing professional development was vital to a school technology initiative:

> Effective ongoing professional development for teachers was endorsed in *Learning in an online world* as one of the highest priorities for the school sector, to support the integration of ICT in teaching and learning. Students will only achieve the outcomes required if teachers are committed to a vision of the integration of new technologies into the curriculum and their daily work, and have the skills to exploit the new technologies to expand, extend and modify their practice (MCEETYA, 2002, p. 5)

Training teachers on the integration and use of technology appears to have a significant impact on whether they feel comfortable and knowledgeable in using technology (Ely, 1990; Harris, 1999; Harvey, Kell & Drexler; 1990; Stearns *et al.,* 1991). Training also increases the likelihood that teachers will use software and web sites for instruction (Berson, 1996; Diem 2000; Picciano, 1998). Teachers who receive more than eight hours of training tend to feel more prepared to integrate technology into their curriculum than those teachers who receive less (NCES, 1999, Milken Exchange, 1998a). Thus, as schools continue to purchase more and better technology, the benefit to students will increasingly depend on how well teachers are prepared to use these new tools. However, many teachers report that they are under prepared to integrate technology into the classroom. They also report a number of obstacles or barriers to their successful integration.

Barriers to Professional Development

Teachers' feelings of being under prepared to use these new technological tools appear to stem from several factors. When professional development is available, teachers typically receive only basic knowledge about the way they should operate the computers and software and little information on how to integrate the technology into instruction or on how to assess its benefits (Milken Exchange, 1998b; OTA, 1995). Since few teachers entering the profession prior to the mid-1980s received instruction that included technological applications, school systems appear to be concentrating their efforts on training teachers to use the hardware, rather than on how to integrate technology to make positive changes in the way students think and learn. This level of teacher exposure to educational technology reinforces the maintenance of the traditional knowledge acquisition environment as opposed to developing a constructivist learning environment for students of the twenty-first century (Picciano, 1998).

Hasselbring, *et al.*, (2000) argue to enhance constructivist learning will require a concerted effort by schools over a number of years involving long-term professional development and improved teacher training:

> Clearly, the task of re-educating the existing teaching force to understand and use technology effectively is huge and will require extensive professional development over many years. However, the problem will be exacerbated if those teachers entering the profession now and in the future have not been adequately prepared to use new and developing technologies (Hasselbring, *et al.*, 2000, p. 24).

To compound this problem Fatemi (1999) has pointed out that most educational technology inservicing experienced by classroom teachers is neither curriculum-based nor focused on effective implementation strategies. His research found that only nine per cent of teachers surveyed reported having more than five hours of technology training within the past year. Such lack of training, Fatemi concluded, was having a significant impact on recently graduated teachers:

> Interestingly, while the amount of training teachers receive has a big impact on their use of digital content (curriculum based software and the Internet), the number of years they have been teaching makes practically no difference. Teachers who have been in the classroom five years or fewer are no more likely to use (technology) than those who have been teaching for more than 20 years. … This finding may come as a disappointment to those who hope that younger teachers will make better use of technology than their older peers simply because they grew up with it (Fatemi, 1999, p. 5).

Such findings reinforce the importance of providing effective and appropriate educational technology-based professional development for all teachers, regardless of age or teaching experience. Although younger more recently graduated teachers have generally experienced greater levels of immersion with technology than older more experienced teachers, such exposure does not equate, according to Fatemi (1999), with competence in the integration of technology into the classroom.

It has also been argued, moreover, that such levels of competence may well be related to the technology program itself. The content of the technology training has been shown to influence how useful it is (Kennedy, 1999). Contextual technology training that is aligned with the curriculum and is relevant to what teachers do in the classroom is strongly promoted in literature (DEST, 2002; Hanby, 2000; McKenzie, 1998, 1999; NCREL, 1999; Neiderhauser & Stoddart, 1993; Picciano, 1998; QTP, 2003). Such training in the integration of technology into the curriculum, it is suggested, is nearly always more helpful than basic technology skills training alone. However, a combination of both integration and skills training is reported to be most effective (Trotter, 1999).

What has become obvious for administrators and educational leaders is the need for practical and appropriate technology professional development. Such professional development, argues Picciano (1998), needs to be closely linked to what is happening in the classroom. The connection of professional development within the context of classroom learning is strongly linked to the nature and quality of the learning environment. The relationship of professional development and teacher confidence and competence with educational technology will be further explored within this study, with particular emphasis placed on the types of relationships developed between teachers to enhance and or hinder this development.

How teachers learn whilst undertaking technology professional development is considered to be significant to this study. In particular, ‘just in time support’ for learners. McKenzie (1998) argued that this type of support is more valuable and important than technology classes and training. He goes further and argues that “they [teachers] need the technology to work reliably, and they want someone by their side when anything goes wrong” (McKenzie, 1999, p. 4). The availability of such support within the school environment was considered by Lamson and Barnett (1994) to be crucial to the development of confidence and competence by the classroom teacher, “Ongoing support is essential. If teachers are to become comfortable with technology use, they must have access to a teacher 'down the hall' for answers when things go wrong or for new ideas when they are ready for them” (p. 19).

This learning can also promote supportive relationships between teachers, which Jones (2002) argues will lead to more dialogue and learning within staff development programs. Proponents of teacher professional development programs have increasingly come to recognise the importance of the expertise of practising teachers and of teachers learning from, and with, one another (Acker 1995; Darling-Hammond, 1994; Renyi, 1996).

Lack of time is another barrier to the implementation and management of educational technology. According to Milken (1999), teachers are not given sufficient time to plan for the integration of the technology into their curriculum. The work of Treagust and Rennie (1993) confirm that time is a major factor relating to the success of a school-based technology initiative. In particular, they conclude that time was required to develop ownership of the program; time to plan and make modifications to the curricula and teaching strategies; time to work collaboratively with peers; time to implement changes; and time to reflect on student outcomes (Treagust & Rennie, 1993).

The importance of teachers being provided with the time and support to explore technology is viewed as essential (Strommen, 1999). The Boulder Valley Internet Project (Sherry *et al.,* 1997; Sherry, 1997) takes this point up further and argues that administrative support, in terms of time provision, significantly influenced the adoption and integration of educational technology in schools.

Another barrier is access to technical support by teachers. The absence of teacher technical support can quickly become a barrier to effective use of educational technology, with teachers frequently citing the need for on-site technology support (Strudler, 1995-1996). Evans-Andris (1995) revealed that in order for a technology co-ordinator to provide effective support to classroom teachers, it was imperative that the co-ordinator be in the school on a full-time basis and should work *with* teachers rather than working *for* teachers if they are to be effective in helping them use technology in meaningful ways. Glennan and Melmed (1996) highlighted further the importance of technical support for staff within schools with their research outlining the close relationship between success with school-based technology initiatives in technologically rich schools and the provision of technical support for classroom teachers.

The most common barrier to adequate training and professional development seems to be the expense involved. McKenzie (1999) argues that a concerted commitment to professional development for teachers is required with significant increases in funding being devoted to the design and delivery of professional development. The importance of such increases in funding was also highlighted by The Office of Technology Assessment’s (1995) recommendation that at least thirty percent of a school’s technology budget be allocated to professional development. As Boyd (1997) points out, “without training, however, other technology spending has a marginal effect” (p. 47).

These findings relating to the provision of physical and human resources are considered significant for this study because they emphasise the key role of resources for the implementation and management of educational technology. In particular, the findings highlight the significance of the teacher in the success of a school-based technology initiative. The findings suggest that the most effective use of resources in a technology initiative will occur when there is an alignment between and among the implementation factors and that, in reality, this will materialise when technology resources, both physical and human, are used in support of pedagogical and curriculum issues appropriate to a redefined concept of the learning environment for the twenty-first century school (McKenzie, 2001; 1999; Picciano, 1998). This requires the allocation of the vital resources of time and professional development and the utilisation of technology as a tool to enhance learning.

Underpinning the effectiveness of the provision and use of resources are the relationships that exist among learners and the development of positive work relationships among staff. (Acker, 1995; Darling-Hammond, 1994; Lieberman & Miller, 1992; Renyi, 1996; Schlager *et al.*, 1998; Talbert & McLaughlin, 1994). These relationships are vital to the successful implementation and management of educational technology as they can enhance the synergetic potential of a school staff working collaboratively and learning from each other. As a core theme of the conceptual framework of this study, the relational factors play a unique and pervasive role in the implementation and management of educational technology in the primary school exerting influencing on each of the other implementation factors. These relationships are central to this study and will now be explored fully.

RELATIONAL FACTORS

Barth (1990) argues that relational factors strongly shape key aspects of school life and attempts at school improvement, in particular, the relationships among staff within the school. These relationships, he points out, are the basis and precondition required to sustain school improvement, “The relationships among staff in schools are the basis, the precondition, the sine qua non that allow, energize, and sustain all other attempts at school improvement. Unless adults talk with one another, observe one another, and help one another, very little will change" (p. 32).

Relationships it is suggested are a precondition for the successful implementation of technology and will help ensure key elements in the implementation process function together.

Positive Staff Relationships

Positive staff relationships are usually based on commonalities of beliefs, interests and experiences that teachers see in themselves and others (Donaldson, 2001). These commonalities can most effectively be discovered when teachers spend time together in a supportive and trusting environment. Donaldson also notes that "at the root of many relationships is the need to share and enjoy time with others, the need to connect and befriend, and the need to seek professional assistance and camaraderie" (2001, p 62). Such suggestions actively breakdown the barriers traditionally faced as schools attempt to implement educational initiatives in the isolated classroom culture (Sizer, 1992).

The breaking down of the isolated classroom culture was evident in The Boulder Valley Internet Project (1997), with Sherry (1997) reporting that teachers in the project actively sought assistance from colleagues throughout the course of the project. This collegial support was highlighted by teachers choosing assistance and support from friends and colleagues in preference to available experts. Sherry (1997) argued that this happened because teachers felt that colleagues were able to empathise with and see things from the user's perspective. The relationships reported in the Boulder Valley Internet Project highlighted the significance of collegial support. In an environment where teachers feel supported by their colleagues, the Boulder Valley Internet Project (1997) found the ongoing success of a technology initiative more likely.

McLaughlin and Mei-Ling Yee (1998) argue that the support available to teachers in a collegial school environment enhanced both levels of opportunity and capacity for teachers, resulting in greater stimulation at work and higher levels of work motivation. This type of support is significant for this study because it highlights the importance of the classroom teacher and values the contribution teachers make towards the adoption of a school-based technology initiative.

A staff's commitment to valuing people as individuals and as groups which points out Nias (1989) was the foundation of their collaboration and the cornerstone of success with the management of new initiatives. In schools where this was the norm, Miller (1990) found that teachers were more willing to take risks and experiment with new initiatives. This willingness to work with new initiatives, contends McLaughlin (1993), is possible because of the relationship that exists between the norms of collegiality, the teachers' attitudes and the decisions made regarding teaching:

> Norms of collegiality and collaboration signal more than supportive social relationships among teachers; collegiality, our survey data shows, indicates a professional community with norms of innovation and learning in which teachers are enthusiastic about their work and the focus is on devising strategies that enable all students to prosper (McLaughlin, 1993, p. 87).

The work of Donaldson (2001); McLaughlin (1993); McLaughlin and Mei-Ling Yee (1998); Nias (1989); and Sherry (1997) highlights the importance of staff relationships based on collaboration and support. These relationships, McLaughlin (1993) maintains, are closely linked to the ongoing success of a school-based educational initiative. The embodiment of norms of collaboration and support within the culture of the school strongly influences the developing nature and quality of the learning environment and the provision of human resources and has significant implications for the leadership exercised in the school.

Literature highlights a close relationship between the level of success realised in the implementation and management of educational technology in the primary school and the balancing of a number of key implementation factors, namely relationships, resources, learning environment and leadership. These factors are fundamental to this study's conceptual framework and will be explored and tested within this study. The most pervasive of the factors of implementation were the relational factors. These factors are reflected in the core beliefs and vision of the school and embodied in the culture of the school through the relationships of stakeholders. With the adoption of a school-based technology initiative, the literature also emphasises the importance of the relationship between and among teachers. Furthermore, the relationship between teachers involved in a school-based technology initiative is closely linked to the leadership practiced. Leadership is a key focus of this study, especially in relation to its role in the implementation and management of educational technology.

LEADERSHIP

Leadership in a school influences the successful implementation and management of educational technology and is closely linked to the nature and quality of the learning environment, the provision or resources, and the quality of relationships. Research findings indicate that leadership exerts considerable influence on the ultimate level of success gained in the implementation and management of a technology initiative (DuFour, 1999; Glennan, & Melmed, 1996; Picciano, 1998).

A review of research studies pertaining to leadership and the implementation of technology initiatives revealed a number of interesting trends. Of particular note was the importance educational leaders placed on the implementation of educational technology (Bailey, 1997; Hill, 1996; Foster & Wright, 1996). The work of Carter (1996) and Ash (1994) also identified a strong link between leadership and the successful implementation and institutionalisation of educational technology. In particular, Ash's 1994 study of Michigan Adult Education Administrators found a strong relationship between technology implementation and leadership. The study concluded that successful adult education administrators needed to support, access, and use information and knowledge tools, be willing to train and retrain themselves and their staff, and find creative ways to solve hardware and software shortages. Further to Ash's findings, a number of research studies have also identified the leadership of the principal as influential in relation to the implementation and management of educational technology in schools (Fullan, 1996; Leithwood, Begley & Cousins, 1994; Mauer & Davidson, 1998; Means & Olson; 1995; Picciano, 1998).

Leadership of the Principal

The National Centre for Education Statistics (2000c) described 'principal leadership' as one of the most important factors influencing the effective use of technology in classrooms, while the works of Stearns (1991) and Pennell and Firestone and (1988) found the leadership role of the principal as key to the successful implementation of technology school-wide. Hasselbring, *et al.*, (2000) have argued that principals, "by virtue of their position were often seen as the gatekeepers who controlled classroom access to technology and who guided the culture of the school in ways that either supported an innovative use of learning technologies or stymied such an initiative" (p. 34).

American Research conducted by the Office of Technology Assessment (OTA, 1995) reported that support for a technology initiative was more likely to come from a principal who was knowledgeable about technology and technology issues. This support was evidenced, according to Sandholtz *et al*. (1997), by the administrative support made available by the principal. Such support was crucial in determining whether teachers integrated technology into the classroom. Sandholtz *et al.,* (1997) contend that by making technology use a priority, principals reduced problems such as insufficient time for continued learning, limited access to technology, and lack of technical support. They also observed that principals could offer teachers much needed emotional and moral support by showing interest in changes that teachers were instituting in their classrooms. Additionally, principals who exhibited leadership in a technology initiative were instrumental in modelling the use of technology in classrooms (Sandholtz *et al.,* 1997).

While there is a range of literature that recognises the significance of the school principal in the implementation and management of educational technology, Schiller (2003) points out that there is "little Australian research on the role of the principal in the implementation of ICT" (2003, p. 172). The case for such research is strengthened when it is considered that effective use of information and communication technology is now a major challenge facing school principals.

One of the important findings of research projects on the impact of the principal on technology was conducted by Schiller (1998) and found that success with technology implementation depends on the principal's active support for the technology implementation This support will be most effective argues Schiller, when adequate professional development and support for staff in the process of change is provided. This finding is significant for this study because it highlights the interrelatedness of leadership to the other core factors of implementation. This interdependent relationship will be further explored in this study with particular focus given to the leadership of the principal, and the relationship to the developing learning environment, the provision of resources and the relational factors of implementation.

While the role of the principal is key to the successful implementation of educational technology, an increasing number of writers have emphasised a strong correlation between the style of leadership adopted in a school and the success of a school-based initiative (Costello, 1997; Hoffman, 1996; Retallick, Coklin & Coombe, 1999). This style, maintains Marshall (1995), requires a commitment to leadership that transforms a traditional hierarchical leadership approach and adopts a shared, participatory and transformational approach.

Shared and Transformational Leadership

In a challenging educational climate of constant and turbulent change, no single person is likely to have the combined capacities necessary to engage in effective leadership of a technology initiative (Bass, 1985; Bass, Waldman, Avolio & Bebb, 1987; Bass, Avolio & Goodheim, 1987; Bennis & Nanus, 1985; Tichy & Devanna, 1986). The leadership of the initiative requires sharing primarily focus on interactions between leaders and those who have to implement the initiative.

Within a school-based technology initiative, it is acknowledged that schools require shared, collaborative and participative leadership. Livesay and Murray (1992) point out that this form of leadership will involve the co-ordination and ongoing development of the initiative, forming of partnerships, soliciting support of the community and educators, and the leverage of resources, all key areas of investigation of this study. These functions of leadership, they argue, are best served when they are shared. Picciano (1998) recommends the involvement of technology co-ordinators and a technology committee in the co-ordinating and management of a technology initiative. Such sharing of leadership, he contends, enables teachers to be more closely guided and supported in learning to use and utilise technology, both personally and professionally (Picciano, 1998). The findings of Crowther *et al.*, (2002) and the work of the IDEAS project (2001) reinforces the significance of leadership sharing with an educational initiative. Fullan and Stiegelbauer, (1991) argue that the level of support offered to teachers through the sharing of leadership is particularly effective in the early stages of implementation, because it is at this time that people most often have concerns and self-doubt. Unfortunately, there is little research that focuses on the effectiveness of or need for on-site technology support for classroom teachers (Prestidge, 2000).

What appears clear from the literature is that leadership has a direct relationship to the level of success realised in a school-based initiative, particularly with the implementation and management of educational technology in the primary school. Technology leadership, in such an environment of sharing professional collegiality, is more an attribute of schools rather than individuals (Neuman & Simmons, 2000).

CONCLUSIONS

Within the discussion of the core factors of the conceptual framework, namely, the learning environment, relationships, resources and leadership it has been argued that educational technology is a key component of the twenty-first century primary school learning environment and has a positive effect on the academic achievement and social development of students. The literature tends to suggest the learning environment of the twenty-first century classroom is closely connected to the educational technology utilised. The success of a school-based technology initiative has a direct connection with the interaction of the implementation factors identified in this chapter. Educational technology appears to be most successfully implemented and managed within primary schools when a constructivist pedagogy is adopted, leadership is shared, collegial support is present and appropriate resourcing provided. In this learning environment, it is argued, the class teacher has the strongest influence on the level of classroom integration of technology. Notwithstanding the importance of the classroom teacher, it is also argued that the ultimate success and sustainability of a school-based technology initiative will be directly related to the dynamic balance and redesign of the factors of implementation. This will be further investigated in a discussion of the conceptual framework for this study.

CONCEPTUAL FRAMEWORK

This research project is primarily concerned with the attempt to explore and analyse what happens in primary schools that have experienced success with the implementation and management of educational technology. The conceptual framework for this research is based on theoretical writings and research findings relating to the four key factors of implementation and management of educational technology, the learning environment, leadership, relationships and resources. As shown in the earlier reviews of the factors of implementation, this framework has emerged from the writings and research of many authors and researchers (eg. Brooks & Brooks, 1993; Picciano, 1998; McKenzie, 1999; Dwyer *et al.,* 1991; MCEETYA, 2002; Treagust & Rennie, 1993; Handy, 1995; Wheatley, 1992; The Boulder Valley Internet Project, 1997; Nias, 1999; and Schiller 2003, 1999, 1998).

The literature discussed in this section showed an implicit connection between twenty-first century learning environments and the positive effects of educational technology. Of special note are pedagogical approaches that embrace constructivism (Tam, 2000) and are grounded in learning (Brooks & Brooks, 1993). The literature shows that the developing learning environment is shaped by the provisioning of resources, both physical and human, the leadership practised and shared and the relationships promoted and practised. The ongoing development of the learning environment, as with the other key factors of implementation, appears to constitute a precondition for the other factors of implementation. The conceptual framework shows the interdependent relationships of the core factors of implementation: leadership, resources, learning environment and relational factors. These factors and their relationships are tested within the study.

The conceptual framework posits that the implementation and management of educational technology is a dynamic process of incremental and continual change and growth with each change being informed by the interactions and dynamic balance achieved between the learning environment, leadership, relationships and resources. This point of dynamic balance will be tested throughout the thesis and is central to the conceptual framework and, therefore, will be a major focus of this study.

In seeking to understand what happens in primary schools that have been judged successful with the implementation and management of educational technology, it is necessary to examine the factors that appear to promote success and the relationship between these factors. For example, the learning environment is primarily focused on practices and beliefs in respect to pedagogy and learning.

The thinking behind such a framework recognises the work of Wheatley (1992) who advocated the importance of utilising the science of our times, reinforcing a holistic approach where prime importance is placed within a network on the relationships that exist among seemingly discrete parts. The idea of a network of relationships is important to this study because it implies a continuous cycle of growth and redesign between and among the factors of implementation. The implementation factors acquire inputs from the external environment, the implementation factors respond to this input through interaction. The interaction between and among the implementation factors leads to dynamic redesign which allows for ongoing growth and development of the technology initiative.

This process is diagrammatically presented in figure 2. The external environment provides inputs that results in the need for educational technology to be implemented. This could be the result of the introduction of standardised computer testing in primary schools or the implementation of a learning software program. The inputs from the external environment effects and is processed through each of the four factors of implementation. The interdependent relationship between these factors is seen as creating a process of dynamic balance. This balancing results in modifications to the relationships of the key factors which in turn are converted into planning and action. For example, the introduction of a new learning software program affects the classroom learning environment, which in turn, has implications for the level of resourcing for classroom teachers, the leadership practised and the relationship between and among staff. The actions taken are informed and directed by the interaction of the implementation factors enabling the school to respond to educational technology change and in so doing promote organisational growth. Senge (1994) argues that such a process allows an organisation to “continually expand its capacity to create its future” (Senge, 1994, p. 87). This is possible because each of these factors, while being vitally important to the implementation and management of educational technology, is viewed as being dependent on the synergetic relationship between the other key factors.

The conceptual framework of this study is centred on four interdependent implementation factors, leadership, relationships, resources and the learning environment. The framework and its elements will be tested in this study and will be revised again, in terms of its usefulness, in chapter eight.

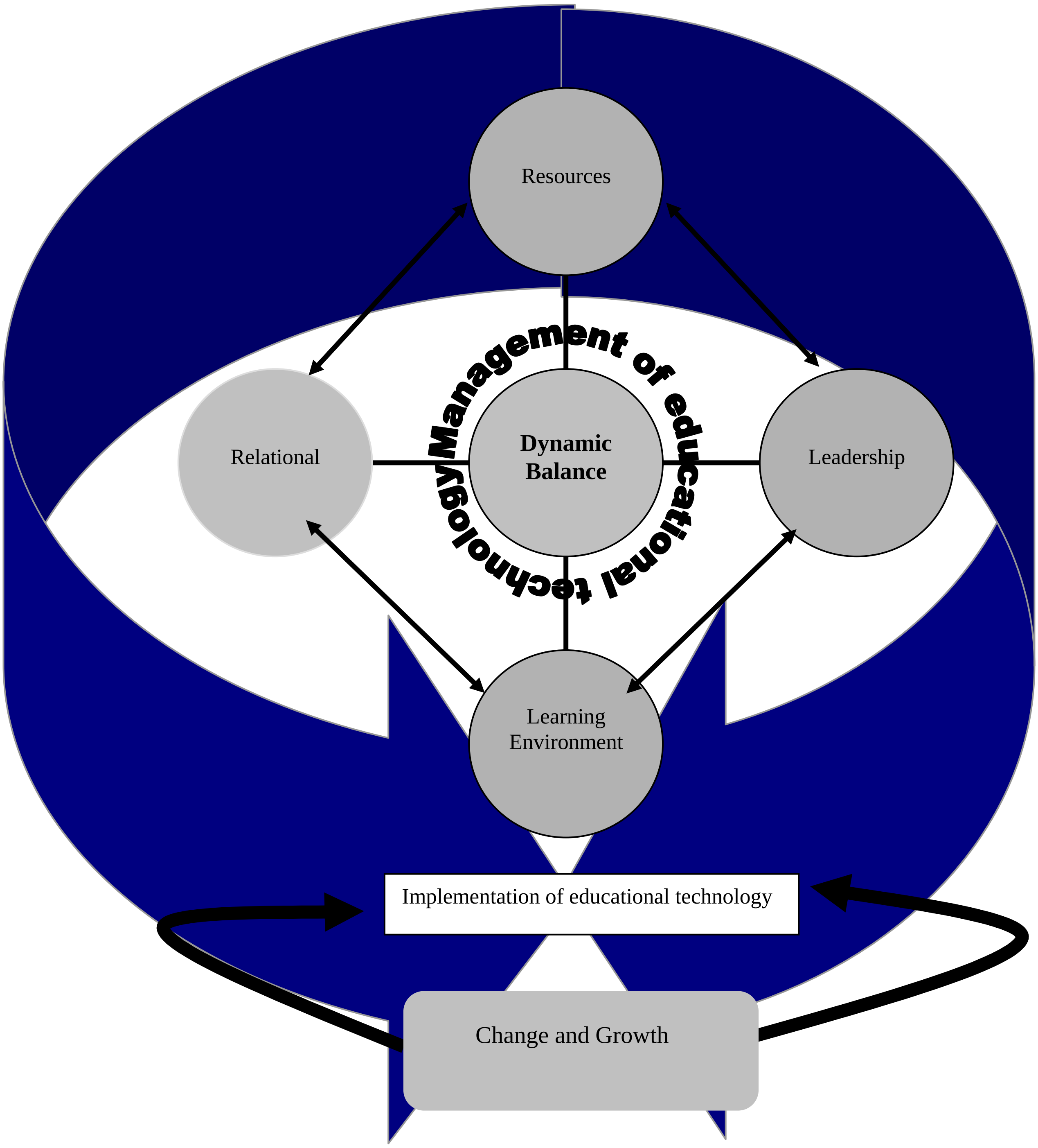


Figure 2

Conceptual Framework Model

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

This chapter outlines the research design and methodology that was used to explore the implementation and management of educational technology primary schools.

AIM OF THE STUDY

The fundamental aim of the study is to identify the factors that contributed to the successful implementation and management of educational technology in primary schools.

RESEARCH QUESTIONS

To facilitate this process, four research questions were asked, namely:

1. Why have these schools been successful in implementing and managing educational technology?

2. What factors have helped and/or hindered the successful implementation and management of educational technology within the selected schools?

3. What are the indicators of successful implementation of educational technology?

4. What were the particular contributions of leadership to the successful implementation and management of educational technology within the selected schools?

METHODOLOGY

This study utilises a qualitative methodology employing a multi-site case study approach to investigate the implementation and management of educational technology in three New South Wales primary schools. This methodology was chosen because it was considered to be the best approach to answer the research question, namely: What factors have contributed to the successful implementation and management of educational technology in three primary schools in New South Wales?

Qualitative research is a complex process with definitions that change over time (Robinson, 1995). In tracing the development of qualitative research through five historical moments, Denzin and Lincoln (1994) offer a ‘summary’ statement, which guides this study:

> Qualitative research is multimethod in focus, involving an interpretative, naturalistic approach to its subject matter. This means that qualitative researchers study things in their natural settings, attempting to make sense of, or interpret, phenomena in terms of the meanings people bring to them …[using a] variety of empirical materials – case study, personal experience, introspective, life story, interview, observational, historical, interactional and visual texts – that describe routine and problematic moments and meanings in individuals’ lives” (Denzin & Lincoln, 1994, p. 2).

The classic and pervasive purpose of qualitative research in education has been to adopt, create and use a variety of non-quantitative research methods to describe the rich interpersonal, social, and cultural contexts of education. In one sense, this is the major purpose of all qualitative research, “developing an understanding of educational institutions and processes through interpretation and narrative description” (Soltis, 1989 p. 249).

Qualitative research has five key features, according to Bogdan and Biklen (1992). Firstly, the natural setting is the data source and the researcher is the key-data collection instrument. Secondly, it attempts, primarily, to describe and only secondarily to analyse. Thirdly, the concern of the researcher is with process, that is, with what has occurred, as much as with product or outcome. Fourthly, its data are analysed inductively in that what is discovered, in turn, influences what is sought through data collection, data analysis and theory development proceeding simultaneously. Finally, it is essentially concerned with what things mean. It was said, (Wilson, 1977) to be based on the fundamental beliefs that must be studied in natural settings and that these events cannot be understood unless one understands how they are perceived and interpreted by the people who participated in them.

This study seeks to uncover shared practices and meaning of experiences in the implementation and management of educational technology, as described by the people who live the experience. To enable this to happen, Lofland and Lofland (1995) suggest, “the researcher seeks to witness how the studied others perceive, feel and act in order to grasp these seeings, feelings and actings fully and intimately because only through direct experience can one accurately know much about social life” (p. 3). These experiences occurred in this study through the use of naturally occurring, ordinary events in the natural setting of the primary school, in particular, formal and informal interaction among staff. Using the natural setting, argue Miles and Huberman (1984) provides for "richness and holism" revealing complexity and "providing thick descriptions that are vivid, nested in a real context" (p. 10). Such depth in descriptions can only be obtained by "getting close to the phenomenon under study" (Patton, 1980, p. 43).

To do this, according to Merriam (1988), requires a significant commitment to represent the research participants 'in their own terms.' Consequently every effort was made to represent the participants of the study 'in their own terms' through the gathering of data at school during school hours, in particular, conducting in-depth interviews during class time through the provision of teaching release provided by each school. As this study is concerned with "living peoples" (Agar as cited in Collins, 1997), it was vital that the researcher be part of their world by spending time in the school observing and interacting with research participants. This was essential in determining 'truth' as perceived by the research participant.

A major methodological consequence of studying people *in situ*, according to Lofland (as cited in Patton, 1980), is the process of discovery that is subsequently unearthed (pp. 36-37). This snapshot of experience in time provides the beginning place for understanding the world of appearances and intentions. It is this understanding of people that the researcher sought in the three schools studied. Such understanding, argue Bogdan and Taylor (1975), allows the researcher to "view what people say and do as products of how people interpret their world" (p. 13).

To this end, the setting was described and participants' own words cited to illustrate and support the items emerging from the data. Extracts from documents and observations of technology management strategies, processes and personal interactions add to the texture of the report and help provide an accurate representation of the data with possible significance for other primary schools.

The acquisition of quality data is closely linked to the skills of the researcher as the prime instrument of the research. Of particular importance is the need for the researcher to have sufficient knowledge and understanding of the issues of the research question, to enable him/her to identify with the participant during conversation (van Maanen, 1988).

The Role of the Researcher

The researcher, in this study, has considerable experience in the implementation and management of educational technology in the primary-school setting and brings an added knowledge, a “tacit knowledge,” (Lincoln & Guba, 1985) to the research process. This enabled the researcher to have an understanding of the issues of the research questions related to the implementation and management of educational technology. The development of this understanding, argues Patton (1990), allowed the researcher to empathise with research participants. This tacit knowledge can contribute depth and meaning to the exploration of the implementation and management of educational technology and enabled the researcher to identify with participants and describe their experiences with an “insider’s view” (Patton, 1990). As such, the background, experience, values and attitudes of the researcher were valid elements of the research process. This point was highlighted in the work of Cresswell (1994), who argued that a qualitative research study is open to the personal voice of the researcher as a means of providing detail and depth of insight. This insight has been developed in this study through a range of techniques and experiences.

In particular, the researcher’s background in primary school education extending over a twenty-two year period, including fifteen in leadership positions, seven of which were as a primary school principal. These experiences have provided him with a depth of understanding of primary school education. Experiences with the implementation and management of educational technology as assistant principal, principal and, more recently, as head of learning technologies for a diocesan school system, have provided the researcher a broad range of experiences and skills within this field.

The researcher’s experience with, and commitment to, the integration of technology into primary schools has, on the whole, been beneficial to the research project. It has equipped the researcher to be part of the situation in a non-participative way, yet able to observe critically and objectively what was happening (Paton, 1990; Sherman & Webb, 1995). As a result of his professional and personal experiences, the researcher was better able to identify, empathise and appreciate each participant’s perspective. This was achieved within this study by utilising detailed or thick descriptions of research participants’ stories

Thick Descriptions

The researcher sought data that would enable the writing of deep and detailed descriptions of the perceptions of people under study, as suggested by Anderson (1990), Bodgan and Biklen (1992), Hammersley and Atkinson (1994), and Patton (1990). In effect, responding to the research questions resulted in a “thick description” (See -

Geertz, 1973 and Fetterman & Pitman, 1986) being developed of the experiences of teachers implementing and managing educational technology in three New South Wales primary schools. This kind of qualitative research was significant to this study because it dealt closely with the perceptions and understanding of participants. This point is highlighted in the work of Wolcott, (1990) who argued that thick descriptions provide an opportunity for deeper insight into the reality of the participant because he/she is "less concerned with knowledge and more concerned with understanding" (p. 127). The accessing of 'thick descriptions' from research participants was also contextual in that it took into consideration the special characteristics and contexts of the three schools involved in the study.

Sampling Procedures

Three New South Wales Primary schools were classified as successful through the recommendation of educators experienced with the implementation and management of educational technology. In choosing these sites, the researcher used "purposive sampling" (Patton, 1990), that is, the selection of sites based on the researcher's judgment of their potential for providing worthwhile and comprehensive data. This approach was adopted on the basis of reputational-case selection. In a reputational-case selection, instances are chosen on the recommendation of recognised experts in an area (Goetz & LeCompte, 1982; Merriam, 1988). The use of a reputational-case selection, according to Merriam (1988), presumes the sample will provide valuable information for the researcher that, in turn, will help answer the research question.

The researcher selected purposive sampling and in particular reputational-case selection, because a judgement was made that this sampling approach would provide valuable data relating to the research question, namely: What factors have contributed to the successful implementation and management of educational technology in three primary schools in New South Wales? To this end, Merriam (1988) advises the "need to select a sample from which one can learn the most." (p. 48)

Selection Guide

In determining the sample, the researcher developed a selection guide (Manhiem, 1977; Patton, 1980) containing a list of desirable attributes considered to be consistent with the successful implementation and management of educational technology in a primary school setting. (See Appendix 1.) The Department of Education (Victoria) Teacher's Capability Kit (1998) and Learning Technologies in Victorian Schools (1998 – 2001) were used in the construction of the selection guide. Regional educational consultants and learning technologies consultants throughout New South Wales were given the selection guide and were invited to recommend schools they considered suitable for the research project.

Eight recommendations based on these attributes (see Appendix 2 – 9) were received. Each school was visited and rated according to (1) the attributes listed in the selection guide and (2) outcomes achieved in the implementation and management of educational technology. In determining the rating, school documentation, in particular the strategic plan, school technology plan, school policy documentation and school newsletters were studied. School observations were conducted focusing particularly on the central technology areas of each school, such as the library, computer centre, staff room and classrooms, with interviews conducted with the school principal and the 'key technology driver'. Using this data, each school was rated and the results are presented graphically in Appendices 2-9. Following the rating of each school, three schools emerged as most suitable, because they "shed light on what could be" (Schofield, as cited in Eisner & Peshkin, 1990, p. 217). Schofield (1995) suggests, that when it is known or expected to be ideal or exceptional on some a *priori basis* then studying a specific sample to see what is actually going on can also shed light on what is possible. This is particularly significant for this study, given the dynamic and evolving nature of educational technology. The schools studied provided opportunities for insight into the possibilities and potential of educational technology in the primary school.

Site selection was based on information about the outcomes achieved in respect to the integration and management of educational technology and the conditions existing at each site. Three schools were selected for inclusion in this study. These schools were offered, and accepted a place in the research project. These schools were then re-visited and each staff were addressed at a meeting. Following the visit, each staff member was given a written invitation to participate in the project. (See Appendix 10)
The pseudonyms of High Tops primary, Western View primary and Garden Vista primary were used throughout the study to describe the research schools.

DATA COLLECTION

It has been argued earlier that a qualitative methodology was selected because it was the most effective way to answer the research question. Data were gathered in a fieldwork context, in the natural setting of the participants, as advised by authorities such as, (Bogdan & Bilken, 1992; Lincoln & Guba, 1985; Lofland & Lofland, 1995; Patton, 1990). Data were collected through the use of interviews, observation and a study of documentation.

Following selection and contact with staff two weeks were spent in separate weekly intervals in each of the three schools. A further two weeks were spent completing follow up visits and data collection. In total, forty-six interviews were conducted at the three participating schools. All teaching staff who indicated that they would like to be involved in the research project were interviewed, with sixteen interviews conducted at Garden Vista, eleven at High Tops and nineteen at Western View primary schools.

While there is no prescribed number of interviews in a qualitative study, Lee and Fielding (1996) suggest the "median sample size in qualitative research is about forty" (p. 23). Whereas Kvale (1996) argues that, "current interview studies tend to be around 15 $\pm$ 10" (p. 102). A decision to conduct forty-six interviews was based, primarily, on the response of teachers in the three schools.

Given the broad nature of the research focus and emergence of new themes during data gathering process, the interviews were utilised to confirm a saturation point with collected data. Kvale (1996) suggests that "new interviews might be conducted until a point of saturation, where further interviews yield little new knowledge" (p. 102). This point is elaborated further by Morse (1993) who advises that, "in qualitative research, the investigator samples until repetition from multiple sources is obtained. This provides concurring and confirming data, and ensures saturation" (p. 230). Within this study it was felt that such a saturation point had been achieved with data repetition from multiple sources occurring in all the key factors of implementation and management.

The data gathering took place in two separate time frames. The rationale for the two time frames was based on logistics and practicality, with Western View, Garden Vista and High Tops indicating they preferred weekly visitation blocks three to four weeks apart. It was reported in the three schools that a number of extra-curricula and sporting events scheduled could impinge on the availability of staff if the research was gathered in a single block. In light of this fact, negotiations were conducted with each school relating to the most convenient visiting times.

Having time between interview periods allowed the researcher time to reflect on the preliminary analysis of interviews and to pursue new threads of meaning during the second round of interviews, document study and observation. This proved to be an extremely valuable and effective strategy and permitted targeted follow-up on specific issues. The break also gave participants, who had been interviewed, time to reflect on discussions and opportunities to follow up issues. This was reinforced at Garden Vista on the second visit, where a teacher wanted to share her thoughts on integrating multi-media authoring programs into HSIE:

> I was wondering if you had a moment after school to listen to an idea I have for using multi-media authoring in HSIE (Human Society and its Environment)? Since your last visit I have been thinking about the project approach and I have got a copy of Hyperstudio on approval and I think I have found a way of using it my room. (GVobs Wk2day1)

This conversation stemmed from a lunchtime discussion among staff on a project approach in HSIE that appeared to be stimulated in the interviews in the first round of data gathering:

> Pam – “Have your kids been using the computers much for research in HSIE?”
>
> Bernadette – “Well, to be honest, last term I was pretty slack, but this term each child has had to do an Internet project on the environment unit. Jenny has been a great help getting me organised.”
>
> Pam –“So what did they do? I mean, did they all do the same thing, or did they have a choice?”
>
> Bernadette – “It’s pretty hard for each child to do a different project. I used a common project with ten questions they had to research. The last couple of questions were fairly involved and they had to write a story, design a poster and make a travel brochure. They all really loved it. Next year I would like to use PowerPoint and get the kids to make a presentation to show their parents.”
>
> Pam –“Have you ever heard of Hyperstudio?”
>
> Bernadette – “No”
>
> Pam – “It sounds a bit like PowerPoint but it’s for kids. Jenny was telling me about it. I asked Jenny if we could get a copy on appro to check it out. I know a couple of my boys would absolutely love a program like that. You know who I mean. They hate doing anything neat and tidy but love experimenting on the computer. When it comes I'll have to get you to give me a hand. In fact I read in the New Horizons software magazine that you can buy support material ideal for me, Hyperstudio for dummies.”
>
> “Bernadette – Sounds good. I don't know where I'll find the time. But I would love to give it a go” (GVobs Wk1day4).

As outlined above, data were gathered using interviews, non-participant observations and the study of documentation. While all the data collection methods used were valuable to the study, interviews provided the majority of data for the study.

Interviews

Semi-structured interviews were conducted with the principal, assistant principal, curriculum co-ordinator, technology co-ordinator, class teachers and librarian. Researching lived experience, and in the case of this study experiences of the implementation and management of educational technology, meant going to the source of that experience, the staff involved in the implementation and management of educational technology.

The phenomenon explored in this study was the world of the teacher in the three schools under study, in an attempt to answer the research questions. Exploring that world, to a large part entailed asking questions that gave meaning to the everyday, routine aspects of the implementation of technology. The interview process, according to van Maanen, (1990), allows the gathering of lived experience, (anecdotes, stories or recollections of experience) and reflections in dialogue with the interviewee.

The approach used in this study required, as Brenner and Wrubel (1989) describe, "looking at the whole of the experience within the social, experiential, and cultural contexts" (p 21). This was vitally important in this study as the foundation of the conceptual framework under investigation is the synergetic interaction and dynamic balance of the learning environment, leadership, resource and relational factors of implementation. It was posited that data from the whole experience is the best way to uncover new insights, meanings and understandings, which in turn confirm or reject the premise of the conceptual framework. To do this required researching the lived experiences of principals, executive teams, librarians and class teachers in their schools. Exploring lived experience, according to van Maanen (1990), is "to question the way we experience the world" and to Zaner (as cited in Crotty, 1998) it attempts to "bring out or make explicit those structures that remain merely implicit and taken for granted, in order to make possible a critical understanding of them and permit their assessment" (p. 142). The explication of the implicit by the interviewees in this study offered a deep insight into the foundation of the success realised with the implementation and management of educational technology in each school. This was particularly the case with the development of each of the factors of implementation and the exploration of the interdependent relationship developed between these factors.

One of the most effective ways to elicit the meaning of certain elements of cultural experience is to talk to people and to listen carefully as they share their thoughts, impressions and stories. As Patton (1990) suggests, “the purpose of interviewing is to allow us to enter into the other person’s perspective” (p. 278). Stories are all around us and provide a rich source for research. The significance of the human story is emphasised by Connelly and Clandinin (1996) who suggest that, “Humans are storytelling organisms who, individually and socially, lead storied lives” (p. 2). Within this study, narratives were created quite naturally as research participants recounted past and current experiences with the implementation and management of educational technology. As one Western View teacher explained, during a lunchtime discussion, “The opportunity to reflect on what has happened over the past years and tell my story seemed to put things into perspective in a way I hadn’t thought of before” (GVobs Wk2Day4). Teachers were encouraged to tell their stories on their experiences of the implementation and management of educational technology.

Inviting participants to reflect on and discuss their experiences with the integration and management of educational technology and to share the significance of these experiences provided data that was rich in meaning. Such ‘rich data’ or thick description argues Bodgan and Biklen (1992), helps create a ‘story’ that brings the data to life and gives readers a feeling of ‘being there.’ To facilitate the gathering of this data, an open-ended flexible approach to interviewing was used, rather than a totally prescriptive standardised interview format. This flexibility is strongly recommended by Bogdan and Biliken, (1992), Hammersley and Atkinson, (1995), Lofland and Lofland, (1995), and Patton, (1990). In such an approach Hammersley and Atkinson (1995) advise researchers as follows, “decide beforehand the exact questions to ask, and do not ask each interviewee exactly the same questions… then adopt a more flexible approach, allowing the discussion to flow in a way that seems natural” (p. 152).

In addition to semi-structured interviewing, “casual interviewing” (Lofland & Lofland, 1995) also provided useful data. In other words, data were collected from informal conversations, in particular, ‘chats’ with participants before and after formal interview times. Such conversations were written down at the first opportunity, while the details were still fresh.

Interview Guide

An interview guide was used with class teachers, teacher librarians, executive teachers and principals, Collins (1997) reports that in her study "the purpose of the interview guide was to allow the researcher to be systematic yet flexible while indicating topics to be covered during the course of the interview" (p. 80). Further to this point, Stake suggests that "trying out questions in a pilot form should be routine" (1995 p. 65) in the development of an interview guide. To facilitate the development of the interview guide in this study, a pilot study was conducted at a regional New South Wales primary school. The pilot school was invited to participate in the pilot study on the recommendation of a regional technology consultant. The findings of the pilot study strongly influenced the interview guide with new items being included and existing items being reinforced and enhanced.

Of particular importance in the pilot study's findings was the relationship of informal support to the integration and management of educational technology. The pilot study showed a strong link between informal collegial support and technology adoption by class teachers. It was reported in the pilot study by classroom teachers that success with the integration of technology into the classroom was closely linked to the way staff related to each other. The more supportive the staff relationships, the more likely staff were to seek help and guidance from colleagues. Teachers at the pilot school consistently reported that fellow colleagues were the most effective teachers and providers of professional development for their school technology initiative. This highlighted the significance of the supportive work environment in the school and suggested changes to the interview guide.

A flexible design was used when constructing the interview guide, as "it was not the researcher's intention to ask all questions at every interview, but rather to cover the subject matter of the questions during the course of the interview" (Collins, 1997, p. 80). This flexibility proved to be very useful for the researcher and enabled emerging issues to be explored. This approach was strongly endorsed by a teacher at Western View primary during the second week of interviewing, who suggested that, "the interview wasn't too bad at all. I thought all the questions would be set and very specific. I felt as though we just had a chat for an hour or so" (WVobs Wk2Day1).

The resultant interview guide (see Appendix 13) was broken up into six categories that relate directly to the conceptual framework outlined in the previous chapter and the ensuing issues that developed. The results of the pilot study generated a number of significant changes to the interview guide.

Interview Guide

Questions

1. **Background**

(a) How long have you been teaching?

(b) In what schools have you taught?

(c) How long have you worked at this school?

(d) Do you have access to a computer outside of school hours?

(e) Do you have Internet access outside of school hours?

(f) Do you use email outside of school hours?

2. Relational Factors

(a) Describe the working relationships that exist here?

(b) What happens here that lets the school technology initiative be successful?

(c) How are professional relationships developed here?

(d) How do the staff support one another at this school?

(e) How can a supportive work environment be created in a school?

(f) Can you give an example of a situation that you have experienced that reflects the working relationship that exists here?

Questions 2 (e) and 2 (f) were not listed in the pilot study but emerged from the findings of the pilot study. A developing theme identified in the pilot study linked to the successful implementation and management of educational technology was the supportive work environment in existence within the school. The findings of the pilot study identified a connection between the development and maintenance of a supportive work environment and the success of the school based technology initiative. To explore this theme further, questions 2 (e) and 2 (f) were included in the interview guide.

3. Leadership

(a) Is success in technology at this school dependent on a key person?

(b) What role does the principal play in the implementation and management of educational technology at this school?

(c) What effect does the principal's level of confidence and competence in utilising technology have on the school's technology initiative?

(d) As a classroom teacher, how are you supported in the school's technology initiative?

(e) Is leadership shared at this school?
(If so, how?)

(g) How are important decisions made at this school?

(h) Can you give an example of a situation that you have experienced that reflects the type of leadership practised at this school?

Questions 3 (c) was not listed in the pilot study but emerged from its findings. The pilot study identified a connection between the confidence and competence of the principal in utilising technology and the level of support provided for a technology initiative. To explore this theme further, question 3 (c) was included in the interview guide.

4. Resource

(a) What resources do schools need to integrate technology into the classroom?

(b) What are the most significant resource issues confronting classroom teachers as they attempt to implement and manage educational technology?

(c) How do you learn, in respect to educational technology, at this school?

(d) What type of technology training do you find most effective?

(e) Can you give an example of a situation that you have experienced that reflects the way you learn most effectively with technology?

(f) What needs to happen at this school to enable classroom teachers to be better prepared for the future challenges of the information age?

Questions 4 (b) (c) and (e) were not listed in the pilot study but emerged from its findings. These questions picked up the developing theme of interdependence within the resource theme. Findings from the pilot study showed that a range of physical and human resources was required in the school to support a school technology initiative. These resources appeared to be most effectively utilised in the pilot school when they were linked to meaningful and contextual learning experiences for staff. To explore this theme further, questions 3 (b) (c) and (e) were included in the interview guide.

5. Learning Environment

(a) How can technology be integrated into the classroom?

(b) Can technology be integrated across the curriculum?

(c) Can technology enhance learning and thinking? If so, how?
(What implication does this have for classroom teachers?)

(d) Much is written about classrooms of tomorrow and the role technology will play.
What are your thoughts on the classrooms of the 21st century?

(e) Can technology effect the achievement of learning outcomes for students?

(f) Does the school have a technology plan?

(g) How was it developed?

Questions 5 (d) and (e) were not listed in the pilot study but emerged from its findings. The pilot study presented a range of perceptions on the effect of educational technology on the achievement of student learning outcomes. These effects looked at both academic and affective domains, with a number of participants highlighting the difficulty in measuring the effect of educational technology on the achievement of student outcomes. While difficulties measuring the effect of educational technology were outlined in the pilot study, unanimous recognition was shown for the significance of educational technology to have a positive effect on student learning in the classroom of the future. To explore these findings further questions 3 (d) and (e) were included in the interview guide.

6. Success/Challenges/the Future

(a) What challenges do you face personally in relation to the integration of technology into the classroom?

(b) With the value of hindsight, what changes would you recommend to the school's technology committee in relation to the school's technology initiative?

(c) What advice would you offer a school embarking on a school based technology initiative?

Interviews with a broad range of people in a relaxed comfortable environment were arranged at the three schools, which significantly added to the potential of gaining an understanding of the phenomenon being studied. Interviews ranged from forty-five to ninety minutes in length, with questions designed to be deliberately open ended to encourage the interviewee to participate in a conversation (Maykut & Morehouse, 1997).

The responses to the interview process were very positive, with one Garden Vista teacher reinforcing the benefits of being able to stop and talk about school life: “I think these interviews will be wonderful for our school community. Just having the opportunity to get an outsider with expertise to come into our school and talk with staff is great” (GVobs Wk1Day1.) At Western View a teacher revealed that the interview process offered a valuable opportunity to stop, reflect and consider what was important: “This process is very helpful for me because it has really made me stop and think about things that I normally take for granted but I can now see are really important” (WVint12). Discussions with the principal at High Tops revealed an expectation of communal benefit for those involved in the interview process, with the principal suggesting: “I think all the staff involved will benefit and enjoy sharing their story with you” (HTobs Wk1day1).

While every effort was made to create a relaxed and non-threatening environment, there were a number of instances where interviewees questioned their own value to make worthwhile contributions prior to being interviewed. (WVobs Wk2Day3, GVobs Wk2Day4, WVint12) One teacher suggested that, “after all the interviewing you have done and information you have gathered, I think you are wasting your time on me. I don’t know if I’ll have anything worthwhile for you” (GVobs Wk2Day4). This response was treated as a personal confidence issue as all the above-mentioned participants ended up contributing actively to the interview process.

Recording Interviews

Prior to commencing each interview, permission to tape record the interview was sought from the interviewee. Permission was granted, with all formal interviews being tape-recorded. Ownership of tapes and transcripts was established prior to the interview. Participants were informed that transcripts and tapes would be destroyed once transcripts had been analysed. Initially the researcher had intended to take notes during the interview, however, this technique was abandoned during the pilot study when the researcher found the process inhibiting and somewhat off-putting for the interviewee.

As soon as possible after the interviews, the tape recording of the interviews was transcribed. This task required consistent and dedicated effort. Field notes were kept throughout the whole research process. These included descriptions of settings, activities, objects and a range of demographic information. They also contained observations of social interactions. Field notes took two forms. At the end of each day in the field, prior to going home, brief notes and word prompts were written serving as a memory aid for later preparation of more detailed field notes. As soon as possible after the observation, or interview, using the brief note as a memory prompt, a more comprehensive field note was written.

When typing the material the data were organised for entry into the Qualitative Data Analysis - Non-numeric, Unstructured, Data, Index Searching and Theorising (QSR NUD*IST) program. Working with textual documents, QSR NUD*IST facilitates the indexing of components of these documents. The speed with which the program is able to search for words and phrases and the support it offers to the analysis phase through the retrieval of indexed text segments, related memos, text and index searches proved to be valuable. The value of QSR NUD*IST has been strongly promoted and published in the work of Qualitative Solutions and Research, (1994), Richards and Richards, (1994), Richards, (1995), Weitzman and Miles, (1995).

QSR NUD*IST was chosen for several reasons. It was readily available and could be learned quickly. Also, other researchers Collins (1997), Bazeley and Richards (2000) and Qualitative Solutions and Research (1994), had recommended it for research such as this. QSR NUD*IST also had an impressive array of functions that it was believed would be useful, aside from its basic ability to index and later retrieve categorical interview segments. Another contributing factor that was relevant to the selection of QSR NUD*IST was the focus of the research. As this research has a clear focus on technology it seemed very appropriate and logical that the researcher use a technologically-driven program to assist with data reduction, organisation and analysis.

Completed interviews and observation notes were transcribed, initially using Dragon Naturally Speaking Preferred Version 3 Continuous Speech Recognition Program. Transcripts were read carefully and then transferred to Microsoft Word 2000 for editing and conversion to text files for importation into QSR NUD*IST. All transcripts were completed using the speech recognition program as the program was trained to recognise the researcher’s voice. While this was a very arduous and time- consuming process, it was believed this procedure promoted consistency and accuracy in transcribing the tape recorded interviews.

All qualitative data collected in the form of interviews and observations were labelled and coded when introduced to the QSR NUD*IST program. These labels appear throughout this study and serve to identify the data accurately. For example, with the label GVint01, the abbreviation GV representing the school Garden Vista; int represents an abbreviation for interview; and the number the order of introduction into QSR NUD*IST. Observation data are coded similarly; GVobs Wk1Day1 represents, observational data, the capital refers to the school and the week and day on which the observation occurred. (See data analysis section for more details).

Study of Documentation

The study of relevant documentation involved studying school policies, in particular Key Learning Area policies, school technology plans, school handbooks and/or prospectus documents, school newsletters and school development plans. Rich data were obtained from the systematic study of each school’s official and unofficial documentation. This was particularly true when the documentation was for public use, such as a prospectus, school advertisements, and submissions for excellence awards. A range of documentation was requested from each school. It included: school handbook, parent handbook, school newsletter, annual report, special submissions for awards and the school technology plan. The contents of the documentation were analysed in relation to the themes emerging from the interviews. For example, the theme of relationships was explored in all documentation with formal references to relationships analysed. Explicit references to relationships were subsequently utilised in highlighting aspects of the relationship theme. A similar process of exploring emerging themes took place with non-participant school observation.

School Observation

Non-participant observation was a valuable technique and involved the extended immersion in the life of teachers at each site, in order to discern their habits and thoughts, as well as to decipher the social structure that bound them together (Van Maanen, 1979). Observations were conducted in a variety of settings within each school.

These included classrooms, library, technology laboratories, staff room, office, school administration centre, and the general environment of the site and its location. When interviewing was not being conducted, data were collected from a range of planned and unplanned events, such as, meetings, staff training sessions, classroom and library lessons, independent research and problem-solving activities, and unplanned events such as, incidental interaction, informal staff-room contact and discussions in the office and administrative area of the school. An example of this type of contact took place at High Tops primary during lunch time in the staffroom, where a number of staff became involved in a discussion on interactive web sites. One staff member who was experienced in using an interactive web site related to space travel explained to his colleagues how he had used the site as part of a class independent project.

Throughout the process of data gathering, special consideration was given to confidentiality concerns and issues especially to confidentiality and the impact of the researcher's presence

Ethics of the Research Process

The researcher had to gain permission from the ethics committee of the Australian Catholic University and the Strategic Information and Reporting Directorate of the New South Wales Department of Education and Training to undertake this doctoral study. This involved a rigorous process of review. During this process two issues of concern were highlighted: 1. Confidentiality and 2. Researcher access and presence.

Confidentiality

The need to maintain confidentiality in order to protect participants' rights was a matter of continual concern for the study. Literature supports the need for this concern with Collins (1997) arguing that "preserving confidentiality is a crucial issue and an ethical concern" (p. 91). There were a few occasions when the interviewee expressed concern or apprehension about the process being used, and some respondents were concerned with issues of confidentiality. Prior to the first interview at Garden Vista, a teacher asked, "Will I be recognised in the writing up of your report? I don't know where the interview will go but I have a number of strong views and I would not want to be disadvantaged or ostracised for expressing my thoughts" (GVobs Wk1Day1). Another teacher, who wanted further clarification in regard to confidentiality issues, asked, "Do you use our real names when you write the report? I read your explanation letter, but I was unsure how you could maintain anonymity? (GVobs Wk1Day2). At Western View, a teacher expressed concern about the possibility of being identified by a superior, commenting, “While it is good to be able to talk to someone about my experiences here, I feel a little apprehensive that my thoughts will be communicated to my superiors” (WVint13).

Issues of confidentiality and the protection of participants’ rights presented an ongoing ethical dilemma for the research. In order to maintain validity and credibility, it was important that reliable data was used, yet it became clear that this might inadvertently reveal the identity of the schools and their members. The challenge of maintaining validity and credibility was particularly critical when strong personal criticism was expressed by an interviewee. To counter these difficulties, accepted confidentiality practices were used, namely: school and personal pseudonyms, aggregated data (where possible), and a coding process based on numbers. During the second research block and a post-research visit, participants were offered opportunities to discuss issues relating to the process itself as well as to confidentiality.

Researcher’s Access and Presence

To assist in the data-gathering process and to develop a sense of familiarity at each of the schools, visits were conducted on two separate occasions prior to the commencement of individual weekly-data collection blocks. The researcher had been introduced to each staff at formal staff gatherings. At Garden Vista introductions during the Monday staff meeting were as follows:

> You will remember Doug from his earlier visits. Today Doug will be commencing two weeks of data collection. Doug will be using the Deputy's office and the interview timetable is on the display board. On behalf of the school community I would like to welcome Doug to our school. I hope your association with Garden Vista is a rewarding and enjoyable one (GVobs Wk1day1)

Western View announced the researcher’s presence through the weekly memo, staff white board and a formal welcome at morning tea. The staff memo stated:

> <u>Doug Ashleigh</u>
> Today Doug Ashleigh will be commencing research as part of his doctoral studies. Doug’s thesis is focusing on three schools in New South Wales that have successfully implemented technology, and we have been fortunate enough to be asked to participate. As discussed at last week’s staff meeting, release time will be arranged for the staff being interviewed. The interview timetable is on the whiteboard. Thank you for supporting this research (WVobs Wk1Day1).

The principal at High Tops primary school personally introduced the researcher to each staff member at morning tea and, following morning tea, the researcher was introduced to the teachers on playground duty. Their weekly diary had listed the time of visits. At all three schools the researcher was made to feel very welcome. The fact that the researcher was not a ‘new face’ appeared to create a certain level of familiarity and acceptance by the staff. As one Western View teacher remarked, “Seeing you around the school regularly, I suppose I started to view you as another staff member” (WVint1). As this level of familiarity towards the researcher grew it was possible to seek feedback and verification from the participants through responses to the research progress report issued to all participants during the second block of data gathering. Further verification was also sought at the end of the data gathering period when school research reports were given to all participants. This report outlined the emerging themes in each school, highlighting the focus areas for data analysis.

ANALYSIS OF DATA

In qualitative field studies, Lofland and Lofland, (1995) argue that, “analysis is conceived as an emergent product of a process of gradual induction. Analysis is the fieldworker’s derivative ordering of the data” (p. 181). In this study an integrated approach to analysis was sourced. In keeping with the advice of Corbin and Strauss (1990), data collection, data analysis and theory development proceeded simultaneously. What was discovered, in turn, influenced what was sought, for example, early findings that emerged from the relationship data revealed the presence of a core belief among staff. This core belief had strong links to learning, which in turn provided a focus during learning environment and leadership discussions. In practice, this allowed for a deeper and more purposeful concentration on emerging themes and key areas.

Data analysis became an interactive and cyclical process, with the coding of data leading to new ideas (Miles & Huberman, 1994). As this process continued conclusions were drawn, leading to new themes emerging or the pursuit of new ideas, as displayed in the model presented by Miles and Huberman (1994, p. 12)

Through this model, Miles and Huberman (1994) see data analysis “consisting of three concurrent flows of activity: data reduction, data display, and conclusion drawing/verification” (p. 10). They describe it as a “continuous, iterative enterprise” (p 12). This gradual narrowing of research focus is referred to by Hammersley and Atkinson (1995) as the “characteristic ‘funnel’ structure” (p. 206). This approach was used in this study to reduce the broad range of themes created during the initial coding a dominant themes. For example, the support theme within relationships was eventually formed through the merging of enthusiasm, sharing, care and concern and general support.

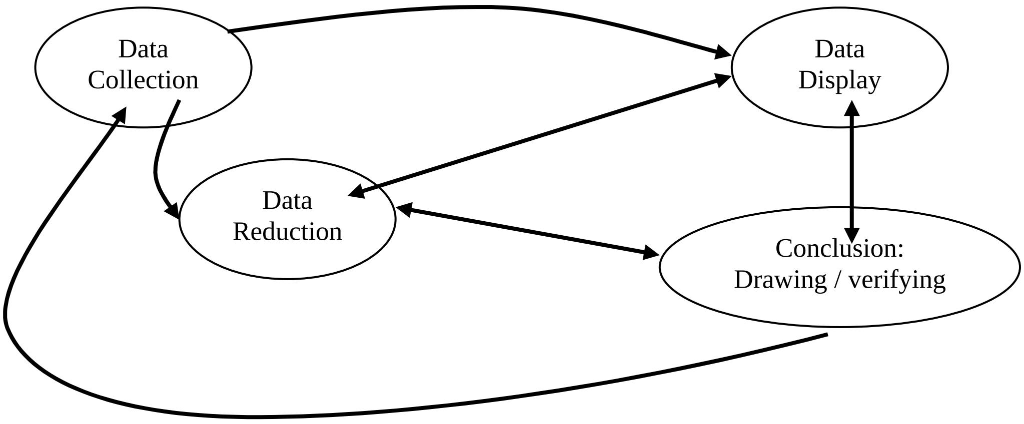


Figure 3

Components of Data Analysis: Interactive Model

Analysing data in a qualitative, multi-site study, according to Merriam (1988), is similar to analysing data in a single site study. The difference is in the management of the data. The data management system in this study was developed in ways which were demonstrably cognisant of the research goals and methodology. The primary goal was to develop an index system (see appendix 14) which not only reduced the data but provided access to it, so that all relevant data could focus on a point, a form of sign-posting (Kelle, 1997). The result was a multi-faceted index, providing many ways to access and view the text, and was made possible by the power of the QSR NUD*IST software system.

QSR NUD*IST software met the study's objectives in diverse ways. The researcher was a first-time user of QSR NUD*IST so the fact that it was an Australian-developed software tool for qualitative research with excellent local support and training was a big advantage. The user support manual was very valuable, in particular the advice on project design and planning for flexibility (QSR NUD*IST Guide 1996). The QSR NUD*IST company also provided an excellent, free tutorial, downloadable from their web site (http://www.qsr.com.au/). Good advice was also available via the QSR NUD*IST user group associated with this site.

Having worked through the tutorial and spent time working with an expert, it became clear to the researcher that QSR NUD*IST had the capacity to handle large amounts of unstructured text data in diverse ways, while allowing the researcher to stay close to the original text documents at all times. For example, while it was possible to view a list of all text units categorised by, ‘support’, often a text unit out of context was not meaningful. By highlighting the segment and pressing J, QSR NUD*IST enabled *jumping* to the original document allowing the user to read the context around the text unit. As van Maanen advises, “grasping and formulating a thematic understanding is not a rule-bound process but a free act of ‘seeing meaning” (van Maanen 1990, p. 79). QSR NUD*IST gave such freedom to stay close to the original text. The tool gave confidence that the meaning and vernacular of the respondent’s voices were not lost in data during the deconstruction-reconstruction processes.

A key challenge in designing a data management system based on text data was that not all the questions that needed to be answered were fully known, as many questions arose from the data themselves. The interpretative methodology led to an index system of an organic nature, which was shaped and re-shaped many times during the thematic stage. This made the task of ensuring an outcome of a functional index system a very complex and involved process

With the content analysis and interpretation required of data analysis in this study, there subsequently emerged characteristics, issues and variables that required categorisation and coding. As this process continued, the need to retrieve and collate data for summation and interpretation became vitally important. Although this process needed to be conceptualised and defined through the study, there were numerous mechanical tasks or phases with which a computer program was found to be most helpful. The QSR NUD*IST program was vital to the reduction and display of the data in this study. The essence of this thematic process is best summed up in van Maanen’s reflection on meaning, “The meaning or essence of a phenomenon is never simple or one-dimensional. Meaning is multi-dimensional and multi-layered. Reflecting in lived experience becomes reflectively analysing the structural or thematic aspects of that lived experience” (1990, p. 78).

The first stage in the data analysis involved the construction of key words that could be used in the initial research focus areas that formed a branching conceptual tree structure. With the subsequent gathering, coding and analysing of data, the research tree evolved and matured eventually forming the research tree shown in Appendix 12. In creating trees and managing them, Bazeley and Richards (2000) advise that the researcher “clarifies ideas about what goes with what. Thus they will be informed by, and in turn will inform the analytical and theory building processes of the researcher” (p. 114).

These words were drawn from the researcher's knowledge of the literature and supported from the subsequent development of the conceptual framework, the reading of the data and the researcher's personal experience. This analysis commenced by drawing up a preliminary conceptual map of the data (Miles & Huberman (1994). The preliminary tree was linked to the conceptual framework and based on a range of ideas and theories that the researcher regarded as a useful starting list from which to consider the interviews, observations and documentation. It was understood, though, that the conceptual tree structure would not be used to constrain the ways in which the respondents' dialogue was considered. It was expected and it transpired that new and more developed ideas would emerge from the interview transcripts, memos, observation and document study.

The indexing process began at a very early stage, before the first document was introduced to QSR NUD*IST. Bazeley and Richards (2000) advise that almost all qualitative researchers use coding to identify topics, themes or issues, and bring together data segments where they occur. Within this project, headings from the interview schedule which were directly related to the conceptual framework were used as the major themes or nodal titles. With the first version of the conceptual tree structure in place, the first interview transcript was introduced to QSR NUD*IST and coded. Such coding, advises Bazeley and Richards (2000), "has an organisational and an analytical role" (p 23), and "it is one way to manage data and store knowledge gained from the documents, or interpretations made" (p 23). This took place as soon as a transcript became available. All transcripts were read through in their entirety, with each section of the text displaying relevance to the research question deposited in the appropriate node(s). New coding categories were created as new ideas and ways of looking at the issues became apparent from examining the stories of the teaching staff. For example, 'partnership' was separated from 'team work' and a new coding category established within the relationships node when specific data emerged revealing the significance of partnership and the subtle differences between partnership and teamwork. It was found that the preliminary tree structure expanded rapidly as the analytical process proceeded. The analytical process adopted attempted to be as exhaustive as possible through a concerted effort to code (See Appendix 10-11) all relevant data in some way.

Inevitably, some text units were indexed under many different nodal headings, whereas others were not indexed at all (except as base data). One sentence uttered by a respondent could contain information relevant to understanding in five or six concepts and headings, whereas a long monologue could be completely irrelevant to answering the research question. Some of the nodes contained well over four hundred text units with data coming from the vast majority of documents, while other nodes contained significantly less, coming predominantly from a small number of documents.

In the case of heavily utilised nodes, sub-categories were often created as new ways in which to divide the data became apparent. This made retrievals more manageable. For example, so much data was stored in the "Learning Environment/success' node that retrievals of this category were taking an impractical amount of time to read. Thus, sub-categories were created, namely, ‘staff success’, ‘curriculum success’, and ‘perceived success’.

As data were analysed, the memo facility available in QSR *NUDIST was utilised to provide conceptual points of connection. Bazeley and Richards (2000) advise, “memos give clues to the process being studied, or spins thinking off in a new direction” (p. 51). The significance of the memo function is further reinforced by Miles and Huberman (1994) who suggested that, “they don’t just report data; they tie together different pieces of data into a recognisable cluster, often to show that those data are instances of a general concept” (p. 134). Taking note of ideas as they occur throughout the analytical process has been seen as an integral part of much qualitative research and, according to Glasser (1978), assists the researcher with the “theorizing write-up of ideas about codes and their relationships as they strike the analyst while coding” (p. 83). While using QSR NUD*IST the memos function was used at various points attaching to nodes and documents. For example, a memo attached to the document GVint01 referred to the emergence of the theme of co-dependence in respect to the Key Driver. “High levels of competence with technology and ownership for technology by the Key Driver can lead to co-dependence between staff and Key Driver” (Memo GVint01). Memos such as this proved vitally important to the analysis process and are, as Miles and Huberman describe, one of the most useful and powerful sense-making tools at hand.

In essence, the tree structure (see appendix 12) was, primarily, a repository for ideas and textual segments, with memos a forum for recording any ideas about linkages and relationships. Richards (1995) talks of 'parking' nodes in the index system and warns of spending too much time making sure they 'belong' in a tidy system, pointing out that “QSR NUD*IST does not mind if they are never linked to other categories, though at any point nodes can be shifted, explored or deleted as the analyst sees appropriate.

Eventually, after careful reading and reflection, category saturation was reached, involving a detailed knowledge and rigorous exploration of the data. Some categories became more of a central focus with a number of them developing into core themes. This point is strongly reinforced by Bazeley and Richards (2000) who emphasise the role of the researcher in, “creating bigger ideas from the little first categories and hunches, locating the categories that matter, abstracting from them, exploring their relations and crafting an account of the data that offers not just a description of what was found, but an analysis” (p. 91).

It is doubtful if time could have been found to use manual methods, to create such a comprehensive and systematic indexing system. In addition, QSR NUD*IST allowed the data to be explored in numerous ways. Print-outs were always available quickly for the researcher to record thoughts on and facilitate the development of theory in a highly organised and systematic way.

While the ability of QSR NUD*IST to reduce and display data in thematic links was of great value to the research process, the analytical thinking belonged to the researcher. The organisational skills and facilities for automation offered by QSR NUD*IST made mundane tasks easier, but as Kelle reminds us: “the role of the computer remains restricted to an intelligent archiving ['code-and-retrieve'] system, the analysis itself is always done by a human interpreter” (p. 157).

Quality standards for the research: Validity, Reliability

In setting standards for the quality of this work, the advice of Miles and Huberman (1994) that getting it all right was an unworkable aim was acknowledged. Guidance was gained from Wolcott (1990) who advises “not to try and get it all wrong” (p. 277) and, in particular, to be cognisant of the issues and expectations of reliability and validity. Reliability of findings in qualitative research, such as this, is more problematic than validity. The question centres on whether other researchers, given similar settings and subjects, could generate similar conclusions or identify comparable relationships among constructs. Precise reconstruction of any study is virtually impossible, but the replication of a study which is conducted in a natural setting is particularly subject to the ever-changing nature of the society, organisation, or culture under investigation. Unique situations cannot be repeated nor can the same subjects recreate the scenes which were previously observed or recounted and subsequently recorded. This difficulty of replicating a qualitative study was highlighted in the work of LeCompte and Goetz (1982), who argued that “there are constraints preventing the replication of a research project which employs ethnographic techniques” (p. 35).

Further arguments offered by Katz (1997) outline research which employs ethnographic techniques that is interpretative in nature, preclude the answering of questions about “reliability, representativeness, reactivity and replicability in ways that have become standard in traditions of quantitative research based on fixed research designs” (pp. 410-411). This limitation of the reliability of qualitative research is also supported in the work of LeCompte and Goetz, (1992) and Lincoln and Guba, (1986).

As is the case in ethnographic research, the researcher was the primary instrument in the data collection and analysis process. In order to enhance reliability and hence trustworthiness of the study (Lincoln & Guba, 1986), the data collection and analysis process have been made as transparent as possible. The QSR NUD*IST program provided the framework for the replication of the analytical phase of this study. Future researchers studying the QSR NUD*IST tree (see Appendix 12) and the indexing system complete with definitions (see Appendix 14) should have sufficient materials to assist them in the event that they wish to replicate this research project.

Reliability is “dependent upon stability, consistency and predictability” (Lincoln & Guba, 1985 p. 296). Dependability in interpretative research is often accomplished using a range of strategies, such as, “multiple methods of data collection, member checks and the maintenance of an audit trail” (Lincoln & Guba, 1985, p. 382) The audit trail used in this study included raw data, data reduction and analysis procedures, data reconstruction and synthesis and processing notes. In particular, a log containing personal notes, which allowed reflection upon what was happening in relationship to personal values and perceptions and the memo function in QSR NUD*IST was utilised.

Through the process of triangulation of data sources, that is, data gathered from a range of different participants, events and activities within each site and by the use of different methods of data collection, a broad range of data were gathered. The triangulation of data, according to Pitman and Maxwell (1992), is “an essential validation technique for conclusions and recommendations” (p. 743). With this in mind, the use of multiple data collection methods and multiple perspectives served as a verification check.

For the purpose of checking data accuracy, informal feedback and checking of data were sought from participants as an ongoing part of the research. In this way, participants were given an opportunity for involvement in the verification process, thereby, enhancing the consistency of the project. By using multiple methods of data collection and the constant comparative method of data analysis, an audit trail was created. This documentation, according to Maykut and Morehouse (1997), allows researchers to walk people through their work, from beginning to end, enabling an understanding of the path taken and the trustworthiness of the outcomes reached.

A commitment to formal ‘member checking’ was maintained in the study (Lincoln & Guba, 1985). In practical terms, this took the form of regular feedback to each staff at staff meetings, the provision of a summary report to each research participant following the initial interview stage, and the provision of case study reports for each school. Sufficient time was given to allow all research participants an opportunity to read and critique what had been written.

Feedback was invited in an attempt to identify any factual inaccuracies, ambiguities or any other matter of concern. No research participant returned any written feedback. In addition, each research participant was provided a meeting time for further clarification and follow-up during the post interview visit. During this visit the staff were addressed at a staff meeting and given the opportunity to discuss the report further. While no staff accepted the invitation to meet to discuss the report, a number of anecdotal comments were made relating to the report and the research process, with a Garden Vista teacher remarking, “I thought the report was very fair” (GVint09). At Western View a teacher commented that, “the report was spot on” (HTint06).

While qualitative research, and case studies in particular, may be generalised to conceptual propositions but not to populations or universes (Yin, 1989), it is proposed that the findings of this study have the potential to be generalised to other primary schools. As this is a study of three primary schools identified as having achieved success with the implementation and management of educational technology, involving forty-six interviews, it presents a glimpse of what may be going on or what could happen in other primary schools. It is likely, however, that this research illuminates the researcher’s and others' understandings of the factors that influence the successful implementation and management of educational technology in other sites, and, as such, provides valuable knowledge and insight. Whilst all schools have individual characteristics, they do have common elements and it is hoped that this study will contribute to the literature relating to the implementation and management of educational technology in primary schools.

CONCLUSION

In this chapter, the methodological approach of this study has been discussed. In attempting to answer the research question, data collection techniques were employed with the explicit purpose of attempting to capture what Geertz (1973) describes as, “thick description.” By listening to the story of the participants, that is, the teachers involved with the implementation and management of educational technology, a ‘richer description’ was gained about what happens to enable successful implementation and management of educational technology to occur.

In the ensuing chapters, discussions of the data focusing on the key themes identified in the conceptual framework and reinforced in the data analysis will be examined. These themes in order of their discussion are: (I) Relationships, (II) Leadership, (III) Learning Environment Factors, and (IV) Resources.

CHAPTER FOUR

RELATIONAL THEME

As outlined in the previous chapter, data were gathered from a variety of sources, namely, interview, observation and documentation, in an attempt to determine why the selected schools were successful in their attempts to implement and manage educational technology. Initially, it had been planned to respond individually to the research questions, but it became clear during the analysis phase that the data could be organised around the key functions of learning environment, relational, leadership and resource factors identified in literature and presented in the conceptual framework. It was, decided therefore, to present, analyse and discuss the data for each of these themes and then relate findings to the stated research questions separately in chapter eight.

KEY RESEARCH THEMES

Data retrieved from searches conducted in QSR NUD*IST, shown in Figure 4 and 5 outline the number of text units and percentage of documents referenced to each of the implementation factors, and demonstrates the significance of each of these factors. The data generated in QSR NUD*IST showed a consistent spread of text units across all the key themes.

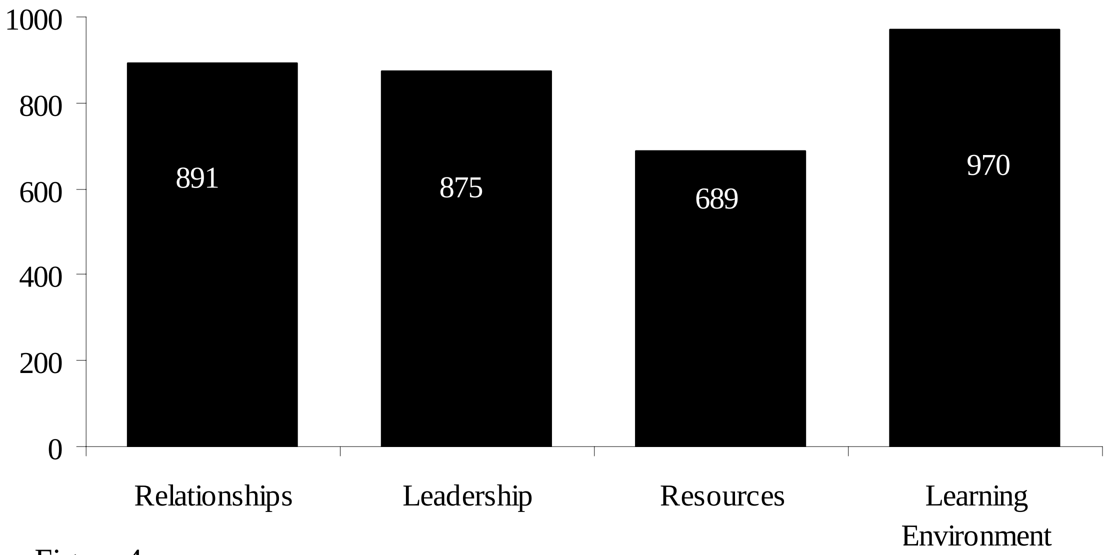


Figure 4

Number of text units referenced to implementation factors themes

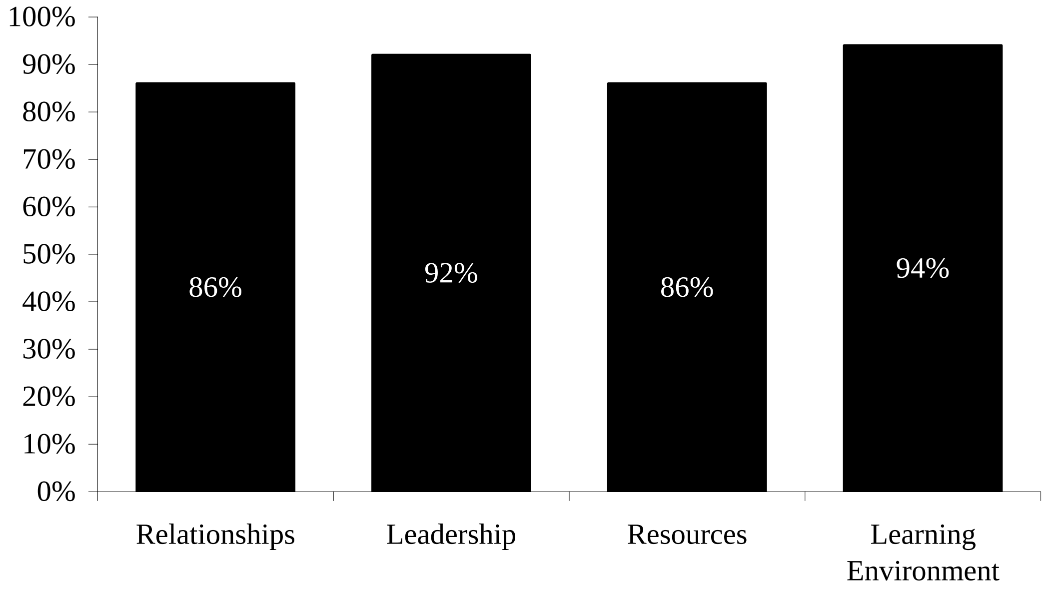


Figure 5

Percentage of text units referenced to key themes

Key Themes and Their Implications

The data provide a strong connection between the key factors of the conceptual framework and success in the implementation and management of educational technology. From a very early stage in the project, success was considered to be multi-faceted, characterised by a number of interacting and influential factors. Similarly, the conceptual framework was formulated along comparable lines with the interdependence of key themes being fundamental to its development. Such a view was reflected in an early discussion of success, with a Western View teacher describing success in the following terms:

> At this school we have been able to achieve our success through a strong commitment to the education of our students, strong and shared leadership, and a supportive and motivated staff. I know that might sound a bit like waffle, but it is true. We are a nationally recognised, successful school in one of the more difficult areas in Australia. This success hasn't just been luck; it has required careful planning, a clear vision and the development of an infectious learning community (WVint16).

While each of the key factors outlined in the conceptual framework has strong support in the data, and is considered extremely important to the successful implementation and management of educational technology in the primary school setting, relationships were recognised as a prerequisite to such success. This point was summarised succinctly by a Garden Vista teacher who suggested that "without relationships working well in this school innovations are impossible" (GVint11). In effect, the working relationships in practice at each of the schools appeared to act as a catalyst for successful implementation and management of educational technology. This point supports the work of Barth (1990):

> The relationships among adults in schools are the basis, the precondition, the sine qua non that allow, energize, and sustain all other attempts at school improvement. Unless adults talk with one another, observe one another, and help one another, very little will change. (p. 32)

It quickly became evident that an understanding of the relationships that existed in the research settings would enable a fuller understanding of how successful implementation and management of educational technology had been achieved.

RELATIONSHIPS AS A KEY THEME

Relationships were central to the work culture of each school. Such relationships, reports Nias (1998), are closely aligned with the social and emotional dimensions of the collaborative cultures formed within the school. These relationships are usually based on commonalities that teachers see in themselves and others (Donaldson, 2001). Such commonalities Donaldson argues can only be discovered when teachers spend time together, informally, in a supportive and trusting environment. Central to this relationship “is the need to share and enjoy time with others, the need to connect and befriend, and the need to seek professional assistance and camaraderie” (p 62).

The data analysis strongly reinforced the importance of such relationships, with a High Tops teacher suggesting that, “at the end of the day it is the relationships we have with each other that count, not the number of computers” (HTint08). The results of searches using QSR NUD*IST confirms the importance of this theme with 86 percent of documents and 891 text units coded to the relationship theme out of a total 3,425 text units. The data clearly showed that relationships between staff were most crucial to the successful implementation and management of educational technology in the primary school.

The quality of relationships among staff, argues Fullan (1999), is central to school success. He sees the importance for organisational members to develop trust and compassion for each other. Ultimately, the state of this relationship becomes very important as a foundation for genuine, teacher-initiated collaboration in primary schools (Hargraves, 1994). In this study such collaboration was seen in practical terms in the level of support offered to a school initiative, with a High Tops teacher predicting that, "any new initiative will be doomed to a slow torturous death if the staff can't work together harmoniously" (HTobs Wk2Day3). This point was further reinforced at Western View with a teacher concluding that "the most important thing is to develop good relationships with the staff. When the staff get on it makes it much easier to get on with teaching" The staff has to 'get on' if the staff is not happy they can't work effectively as a team" (WVint11). This point was further highlighted in the work of Duignan (1997) who suggests that "without quality relationships, it is difficult to imagine how an organisation or its leadership can function effectively" (p.17).

Given the importance attributed to relationships in the literature, it comes as no surprise to find relationships emerging as a very powerful and recurring theme emanating from the data throughout this study and closely linked to the successful implementation and management of educational technology. In a pre-interview discussion, a teacher at Garden Vista likened relationships within the school to mortar that held a building together:

> Relationships are really important to the way life is around here. It is like the mortar or cement holding all parts together. I suppose just like a building when the joins become weak it can affect the whole structure. We are really lucky here because we all seem to get on well and there is a lot of professional respect. But saying that, it is not easy, we have to work at maintaining our relationships. You can't take them for granted; building relationships requires time and effort (GVobs Wk1Day4).

This comparison between relationships and structure was further explored at High Tops, with a teacher stressing the importance of establishing a strong foundation, suggesting that, "the foundation must be right because any initiative that is going to work in a school is built on people and the foundation or building blocks for people are relationships" (HTint09). The fundamental importance of this human mortar was further emphasised at Garden Vista, where a teacher suggested that, "promoting and maintaining positive relationships was central to this school and its success" (GVint05), while, at High Tops, a teacher proposed that, "the successes achieved came most importantly from the relationships that exist within staff" (HTint01). The emergence of such meanings highlighted a number of relational themes that were further explored.

Relationship Themes

These themes are represented graphically in Figure 6 and Figure 7.

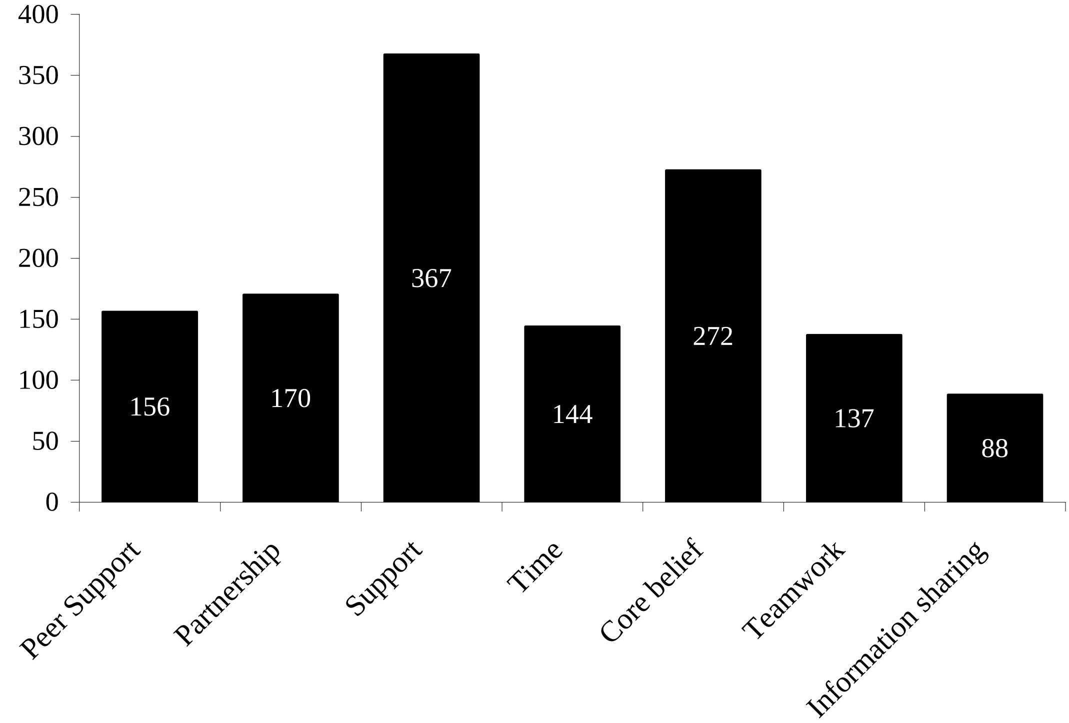


Figure 6

Number of text units referenced to relationship sub-themes

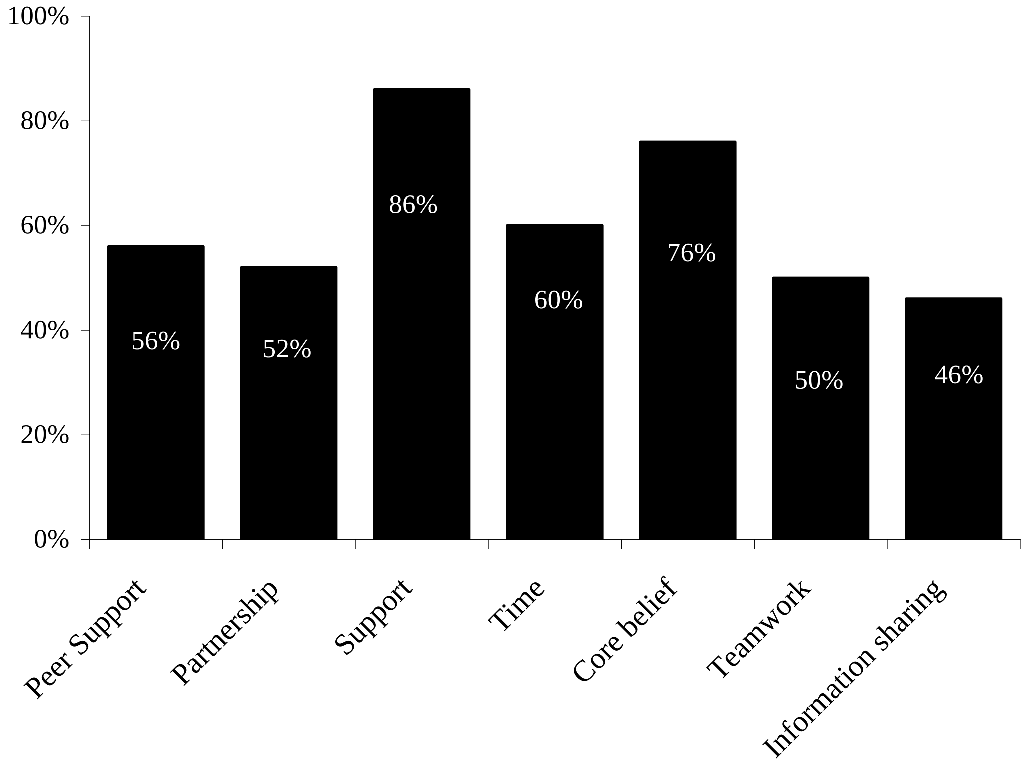


Figure 7

Percentage of documents referenced to relationship sub-themes

Figures 6 and 7 clearly show a range of significant and emerging relationship themes with support emerging as the most strongly coded theme with 367 text units and 86 per cent of documents being referenced.

Support

Support was intimately linked to the development of relationships. Support, in this study, refers to the general perception and experiences of the receipt of assistance and/or time that has been freely given by colleagues. The work of Fenlason and Beehr (1994) categorises two kinds of social support offered in the workplace: instrumental support and emotional support. The former is characterised by rendering tangible assistance such as physical aid, advice or knowledge to complete tasks. The latter is characterised by caring behaviour and sympathetic listening. These two kinds of support were closely linked with the successful implementation and management of educational technology at Garden Vista, High Tops and Western View primary schools.

Support was perceived as a multi-faceted entity, as a Garden Vista teacher explained, “Support is hard to describe. It comes in so many ways, sometimes planned, but quite often spontaneous” (GVint09). Support seemed to be a natural gift that was freely offered and received. This was highlighted at Garden Vista where one teacher reinforced the support offered through teamwork; “Everyone has been supportive of each other, to get where we have, it can’t happen with one person, it has to be a team-effort” (GVint11). While another Garden Vista teacher referred to support in terms of the staff’s willingness to share: “support is demonstrated here through sharing, it’s a way of life, and people just share. From giving time to help, to sharing new ideas” (GVint14).

It became apparent within the research schools that support was offered in a variety of practical and meaningful ways, such as acquiring assistance out of school hours. As a Garden Vista teacher explained, “I can even ring up staff at night to get help when I get stuck with a problem, my colleagues are only too willing to help” (GVint05). Further examples of support were observed in the willingness of staff to give free time during school to help out a colleague. This was particularly evident during observations at Garden Vista as two staff members arrived at school. The following conversation was conducted on the run, which seemed to put into practice in a simple, meaningful and concrete way much of the dialogue regarding support:

> Teacher 1: “How did you go with those cricket teams?
> [Before an answer can be given]

> Do you need a hand at lunchtime?
> I have a free" (GVobs Wk2Day3).

Within this brief interlude, no request for assistance was sought, the offer was a natural intuitive response to a possible perceived need. Support was given with little expectation of direct repayment. There seemed to be an unwritten principle of providing support for the common good of the school. This point was further highlighted at Western View, as a teacher stated:

> I know that I can ask for help and not feel that I have to pay someone back. They know that I will naturally help them or someone else. If something is needed I will do it for them. It develops among the staff a really good sense of trust and respect for one another. No one really takes advantage of that, everyone does their [sic] little bit (WVint11).

In a discussion with a staff member at High Tops, this support was compared with a "merry-go-round' in that, what goes around eventually comes around" (HTobs Wk1Day3). This flexibility and the informal nature of such support was viewed as a strength of each school, with the principal at Garden Vista concluding that "the most effective support at this school appears to happen incidentally over a 'cuppa' in the staff room or a chat in the hallway before school" (GVint01).

Informal Support

Unplanned support that regularly occurred spontaneously is described as informal support in this study. This informal, almost casual, philosophy for support appeared to be strongly present in all schools. A High Tops teacher stated that "the greatest support comes through informal channels within the school. All the staff seem to use these informal support channels when needed. There is no such thing as 'my work', or 'my knowledge'. We actively learn from each other" (HTint03).

The natural and intuitive way that support was given was viewed by many staff members as a key strength, and an endearing and enduring quality of the school. This concept of informal support was clearly illustrated by a Western View teacher, who described the phenomenon of informal support as an experience of solidarity:

> The other day, for example, one of the teachers had a particularly difficult time working with a group of year 5 students, and the teacher was pretty shaken, so a number of staff got together and sat around and spent their lunch time chatting, sharing, and laughing about their own school horror stories. By the end of lunch they where all having a bit of a giggle and sharing their own stories and I really think that teacher felt so much better to know that what happened to her had happened to other teachers. In their own non-pushy way, they had given this teacher a lot of really good strategies and ideas for dealing with the

> reoccurrence of the situation. Those sorts of things happen all the time. I call it situation or experience solidarity; I think that is a real example of what makes this school a good school, is that people care about each other. People put effort and time into relationships with one another. I suppose, above all, people are here for a common reason (WVint11).

Such social experiences create a shared memory for a group and develop a sense of community that builds relationships based on appreciation of peers as individuals (Ashforth & Humphrey, 1995; Wenger,). This situational solidarity happens, according to a Garden Vista teacher, because “people naturally talk about their experiences and feel able to talk about and share their experiences; there is a real willingness to share and support each other” (GVint12).

Central to the development of this support was the creation of an environment where the staff felt safe and secure to take risks and try new ideas and practices. This point was highlighted in an earlier study by Miller (1990) who looked at the impact of the workplace on school improvement efforts where experimentation and risk taking were viewed as essential to improvement efforts. Miller argued that in schools where these conditions were the norms, teachers were more willing to take risks. According to a High Tops teacher, this is a core feature of support, and is demonstrated in the saving of time: “The non-threatening and accepting culture at school can save, and has saved me hours and hours of frustration” (HTint05). Put into practical terms, one staff member at Garden Vista explained that “nothing was too much trouble, even the most stupid unimportant things. Everyone was made to feel valued and important. I don't think anyone felt stupid or threatened” (GVint13).

Through the establishment and maintenance of such a supportive school environment teachers expressed a willingness to be involved in professional dialogue with their peers. A Garden Vista teacher suggested that, “feeling as valued in this school as I do, makes it much easier to become actively involved in professional discussions.” (GVint09). This finding supports the work of Jaggar (1989) who argued that, “teachers can help one another to grow, learn, and change through honest, professional dialogue, during which they talk, listen, and challenge one another's ideas in an atmosphere of respect and support” (p. 77).

Such a supportive school environment was particularly effective and influential in promoting collegial learning where peer support strategies were consistently used in formal and informal learning. In essence, the natural use of peer support strategies had developed and evolved in the three schools to a point where support from peers was a dominant and observable feature of the learning culture in each school.

Peer Support

Peer support was acknowledged as the formal and informal learning support provided by school colleagues. Research participants regularly interchanged the term with ‘peer tutoring’. They saw peer support and peer tutoring as being closely related. The fostering of positive work relationships within the three schools appeared to be influenced by the adoption of such peer support and the use of peer tutoring.

Peer Support was directly referenced to fifty-six percent of documents with 156 text units being retrieved in a QSR NUD*IST search. Practically, peer support was demonstrated through the adoption of peer tutoring strategies whereby staff at Garden Vista, High Tops and Western View primary schools freely gave of their time and expertise to assist others in the school. Peer tutoring, in this sense, appeared to be a natural occurrence for a significant number of teachers, with one Garden Vista teacher explaining, “At this school there is almost an expectation that staff members help others. The philosophy adopted here is one of what goes around comes around. I will offer the technology tutors help down the track with sport or take a duty for them so they can do something” (GVint07). To many of the teachers, peer tutoring was a term used for something that just happened in the school and appeared to be succinctly captured in the words of a Garden Vista teacher:

> If I wasn't sure of something, or I needed help I would have no hesitation in speaking with any staff member and seeking help. That is the sort of system we have operating here. People with skills are buddied up with people with less skill. I suppose in reality that is a form of peer tutoring (GVint09).

Given the potential challenges many staff face in learning, let alone becoming competent in using educational technology, a natural peer tutoring strategy has a number of benefits, in particular, the utilisation of established networks of trust and respect and the reinforcement of a non-threatening learning environment. This occurs, according to a Garden Vista teacher, because “teachers seem to prefer the non-threatening small group learning situation. If they do something wrong, or they don't know how to do something, generally speaking, they feel comfortable enough to ask for help” (GVint02). Such support, freely given in a non-threatening and accepting learning environment became increasingly recognised as an intrinsic characteristic of each school and intimately related to the core beliefs of each school.

Core Belief

Core beliefs emerged as a significant theme, with 272 text units and 76 percent of documents being directly referenced through a QSR NUD*IST search. Exploring the data provided valuable insight into these beliefs in schools under study. At Western View, the School Vision statement set the scene and articulated succinctly the core beliefs that have resonated throughout the data:

> This school will be a stimulating, positive and caring learning environment, which enables all members of our school community to experience success, pursue excellence, think creatively and adapt to change. We will be a community of learners who confidently and enthusiastically direct our learning, co-operate, solve problems and communicate ideas. Our learning community will be built upon mutual respect and trust where every individual is nurtured and encouraged." (Western View Vision Statement, 2000).

The Western View Vision Statement reveals an underlying expectation of involvement. In particular, the statement promotes the importance of the school community being proactive and open to new ideas, challenges and change. This was also a factor at Garden Vista with a teacher stating, "If you do not 'have a go' you won't learn anything. As soon as you 'have a go' you are opened to learning new ideas" (GVint08). Such an expectation of involvement and openness to new ideas, challenges and change was influential, according to a High Tops teacher, in creating a "sense of co-responsibility to participate" (HTint08). This view was taken one step further by another Western View teacher who made reference to an unwritten expectation of involvement and commitment: "There is an expectation of involvement and commitment. The way things are done around here requires teachers to get up and get moving and to be involved" (WVint15). At High Tops, this expectation of involvement was explained in terms of being part of the school's initiative. Where such involvement in the initiative "seemed to be a pre-requisite and part of the culture that had evolved" (HTint08).

This school culture, while difficult to describe accurately, was more easily experienced as a High Tops teacher explained:

> The culture of our school is more of a lived thing than a planned organisational outcome. The culture is constantly evolving and is influenced by the values and experiences people bring and the way people interact (HTint08).

Such an understanding of culture recognises that developing school culture is influenced by a range of variables. As Beare *et al.,* (1991) point out, “school culture is determined by the individual values and experiences which each person brings and the way in which people act and interact, and the footprints they leave behind” (p. 174). Within the three research sites, the core belief of the school appeared to be constantly reinforced in the lived experience of the teachers studied. This experience created and fashioned the evolving school culture through the everyday interactions and actions of members of the school community. The actions and interactions within a school that are most influential are found, according to Fullan and Hargraves (1996), in the life of the school:

> in the gestures, jokes and glances that signal sympathy and understanding; in the hard work and personal interest shown in corridors or outside classrooms doors; in birthdays, treat days and other little ceremonial celebrations, in the acceptance and intermixture of personal lives with professional ones; in overt praise, recognition and gratitude; and in sharing and discussion of ideas and resources (p. 136)

In effect, gaining an understanding of how these schools had experienced success with the implementation and management of educational technology required a synchronous understanding of the culture of each school. The implementation and management of educational technology was intimately linked to core beliefs and, as outlined earlier, the core beliefs of each school in this study helped fashion the evolving school culture. This relationship between core values and the evolving school culture was a consistent finding across all schools and appeared to promote involvement and participation by the school staff in the school based-technology initiative. As staff in each school became increasingly involved in their respective technology initiatives, a growing sense of belonging seemed to emerge. As a Garden Vista teacher explained:

> As I have become involved with the technology developments here I have felt like I have been making a significant contribution. I really feel part of what’s happening. This has been really important for me because it has made me feel wanted and motivated me to stay involved and has even given me the confidence to experiment with technology in ways that I would not have imagined eighteen months ago (GVint15).

This sense of belonging for a number of teachers was synonymous with the culture of the school. This was particularly the case for a first year teacher at High Tops:

> As this is close to the end of my first year here, I can say from personal experience that one of the finest qualities of this school is seen in the way students, teachers and parents are accepted and made to feel special. For me as a new teacher, I was very quickly made to feel that I belonged here. Teachers, in particular, went out of their way to make me feel worthwhile and important. This wasn’t done on my account, it

> was the culture, and the way things happen here (HTint10).

This point was further highlighted at Western View by an experienced class teacher who explained that, "this sense of belonging is one of the school's greatest strengths and achievements" (WVint04). This sense of belonging was also evident in the unashamed pride that was regularly demonstrated in the following extracts from teachers at Garden Vista, Western View and High Tops Primary schools:

> I don't know whether any school could do what we have done. I think a lot would depend on the staff. It is hard for me as this is my first school, but I think we have a great school, a fantastic school. There are no negative people or teachers that don't want to be here (HTint10).

> I believe this is a great school. I know I don't have a great deal of experience to make that judgment but some of the things that happen here I think would make any organisation work well (WVint11).

> I can honestly say that this is the best our school has been during my time. Through the commitment and guidance of our principal we have a great school and I am proud to be a teacher here (GVint06).

This pride was invariably related to the belief that the respective school was a good school (GVint13, HTint04, HTint11, WVint08, WVint16,). As such, the expression of being a 'good school' was strongly linked to the quality of the relationships existing in the school. As a Western View teacher explained, "this school is a good school because people care about each other. People put effort and time into relationships with one another, I suppose, above all, people are here for a common reason, the students" (WVint11). Given the importance of relationships to the culture of each school, it comes as no surprise to find the development and maintenance of positive work relationships intimately related to the success realised, in particular success with the with the implementation and management of educational technology.

Success

While teachers consistently recognised and celebrated the success of their respective school, defining this success was a difficult and complicated task:

> I think our success has something to do with our culture here. I find that this school is accepting, once an idea is accepted, people work together and co-operate. People listen to each other and make collaborative decisions. Once this happens people start accepting and start moving in the direction of the change. Gradually everybody comes on board and the enthusiasm picks up (GVint10).

This reference to culture is strongly supported in the views of most participants, with one Garden Vista teacher believing the school's culture is most strongly reinforced in the way the staff works together:

> The way the staff works together says it all. If the school has a supportive culture it should be first and foremost evident in the way staff work together. I've definitely seen growth in the way the staff here works together. Supporting each other in the workplace does seem to be a part of our culture now (GVint12).

This point was taken up further by A Western View teacher who linked success to the establishment of a stable foundation, "I believe we have been able to create a successful school because we started with the foundations. We had a vision and we put time into developing a community of learners that we've based on support, trust and respect" (WVint19).

A Western View teacher argued that success in the implementation of technology was directly linked to the shared vision statement of the school; "We are a very successful school because we have a vision, a vision that we own. It is not just a statement for visitors to read. It is an action statement that we are working really hard to achieve" (WVint06). Such a shared vision, argues Semrow *et al.*, (1999), aids in creating positive change and learning experiences, which in turn enhance the possibilities for success as each value becomes directly tied to another, creating a framework for organisational success.

This success can be seen in the growth in confidence and competence of teachers in using technology. As classroom teachers became more confident in using technology a natural flow-on to the utilisation of this technology in the classroom resulted. "I think we are very successful in making teachers feel comfortable with technology first of all. So I think, giving teachers confidence and skills in using technology in the classroom in a non-threatening environment has been a real success of our school" (GVint02). This finding reinforces the earlier works of Ely (1990), Harvey, Kell, and Drexler (1990), and Stearns *et al.*, (1991) who emphasised the importance of teachers being knowledgeable and confident about using technology before it can be adopted and implemented into the classroom.

This understanding of success for implementation was developed further by a Garden Vista teacher who stated that "success is actually seeing teachers use technology independently in their classrooms" (GVint04). Such success with the integration and management of educational technology in some respects was “caught rather than taught,” (HTint03) as the following observation at Garden Vista illustrates:

> [Primary student] Excuse me Mrs. P, Mr. O wanted to know if the network is fixed because he wants to use Internet for HSIE?
> Yes, its fine, Tell Mr. O to put on his boardies before he goes surfing.
> [Speaking with interviewer] That is a perfect example of the learning culture here. Mr O was initially one of the school’s strongest critics of the move into technology, he felt we were wasting money and the money could be much better spent in other areas. Seeing the progress we made resulted in him having a turn around. A couple of staff believes it was a miracle. He purchased a computer and is now one of our school’s strongest technology advocates. If nothing else, we have been successful with him, I think the critical mass and the culture of support that exists here have had a lot to do with this success (GVobs Wk2Day2).

While the schools involved in the study were considered successful in the implementation and management of technology, success in each school was definitely not exclusively related to technology. A number of interviewees went to great lengths to stress this point, in particular, two Western View teachers:

> Technology is an integral part of the culture of our school. Be that as it may, it is only part of the school, it is not the school. While some people view the school as a technology school, we are more than that. There are lots of great things happening here: the student welfare program, the improvements in reading achievements are all examples of success, and the school should feel proud (WVint09).
>
> We have to be very careful not to take success out of context. Our success should relate to the achievement of learning outcomes. Just because a school has a truckload of computers, a whiz-bang network and top-notch software it doesn't logically mean they are using these resources effectively, or that they are integrating them into the classroom. I think as a school we are successful because we put the needs of our students, staff and community first (WVint11).

A strong and clear message coming from the data, was that success is holistic and related to many areas of school life, such as, “assessment and reporting” (WVint02); “positive learning environment” (WVint18); “responding to the learning needs of students” (GVint08); “free flow of information within the school” (WVint01); “reputation for excellence.” (HTint07); reading and numeracy (WVint05); and “dedicated teaching staff” (WVint05, GVint02). This broad view of success facilitated a strong belief by teachers that reinforced the perception that what happened in each school was ‘good’, as one High Tops teacher explained: “I think we’ve got it right at this school. We know what we want; we have a clear picture of where we are going. What we are doing must be good because everyone wants to follow” (HTobs Wk2Day2).

For these schools to remain credible and to be seen as educational leaders there was an expectation by staff that their respective school had to be, “out there walking the talk” (HTobs Wk2Day2). Doing this, according to a Garden Vista teacher, meant being “at the forefront of education, providing the best for the children by being open and ready to embrace change” (GVint09). Central to this, and, in particular, rationalising any educational change, was the worth or value-added effect for students. One High Tops teacher argued “educational change at this school, first and foremost, is foreground in the effect the change will have on learning outcomes for students” (HTint07). The pre-condition of any change centred on providing benefits for students, as one Garden Vista teacher explained: “It comes down to people saying it's not necessarily what I need, but what my children need to do to achieve outcomes, and that's what it comes down to, putting children first” (GVint10).

With this in mind, the implementation and management of educational technology according to a High Tops teacher, was not dissimilar to any other school initiative, in that “they [the teachers] will embrace the technology initiative because they can see it enhances student outcomes” (HTint01). In essence, the motivational force to implement and manage educational technology was focused on providing learning opportunities that, in particular, were believed to, “give kids a better opportunity to achieve” (GVint08), and therein, provide benefits for students. As one Western View teacher concluded: “we all get behind the technology initiative because we really feel it will make a difference to our students” (WVint 04).

Enacting this belief meant in reality, a commitment to teamwork and the promotion of partnership. A teacher from High Tops explained; “To make our belief in the potential of technology become a reality required teamwork and the development of learning partnerships among colleagues” (HTint04). The effects of such teamwork and learning partnerships can be seen, according to at Western View in “a rekindling of the love for learning and a belief in the power of teamwork” (WVint18).

Teamwork and Partnership

The utilisation of teamwork and the development of a sense of team and partnership have emerged as important factors in the promotion and maintenance of positive relationships and the ongoing success of the implementation and management of educational technology in the three schools.

Figures 8 and 9 show the number of text units and the percentage of documents referenced to the themes partnership and teamwork.

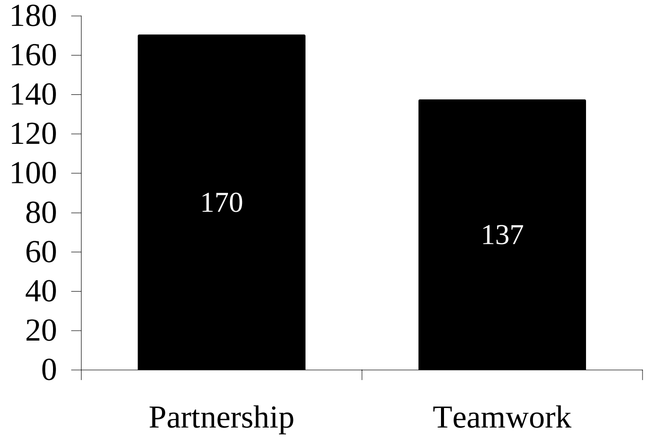


Figure 8

Number of text units referenced to partnership and teamwork

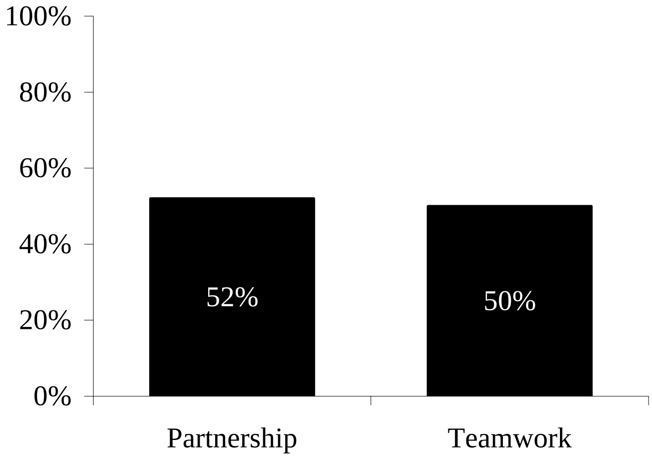


Figure 9

Percentage of documents referenced to partnership and teamwork

While teamwork was continually viewed as an important factor in the ongoing success of each school's technology implementation, partnership was regularly used as a pre-requisite to such teamwork. At Garden Vista, a teacher succinctly described this relationship: "In our school team we are all partners" (GVint04). At High Tops a teacher reinforced the interrelated nature of teamwork and partnership explaining that, "the partnership between staff and parents survives and grows because we work as a team" (HTint08). Such partnership brought with it openness to different points of view, operating styles and the overall diversity that exists in the school. Discussions with a staff member at Western View revealed the importance and complexity of these partnerships:

> School life here, and I suppose in all schools is really about developing, maintaining and enriching partnerships, whether they be with the department, our local member, the P and C, the parents of students in my class, other schools, the staff and most of all the kids. Each partnership is different, but I really think they all have a couple of common elements, namely, respect and honesty. With such a diversity of partnerships, if schools try and wear different hats for each, or put on a special show to impress, they are doomed to failure. It won't take kids, staff and parents long to see right through the act. The way a school behaves in its partnerships should reflect its vision and core beliefs (WVobs Wk1Day4).

These sentiments were supported in many school publications. At High Tops, an application for the Director General's School Achievement Award was titled 'New Learning for a New Millennium – A Partnership between Parents, Students and Teachers'. While at Western View, the number one goal in the application for the 'Australian Quality Awards for Business Excellence' was, "to provide the highest quality educational opportunities through forging strong partnerships with parents." (p. 3)

Partnership in the three schools studied had strong connections to the strategic direction of the school, as outlined during an interview at Western View: "I see that we [the staff] are in a partnership, working towards the realisation of our school vision" (WVint13). The most effective strategy to emerge from the data for promoting and enriching partnership was teamwork. The principal at Garden Vista put this relationship into a school context:

> As you would be aware, Garden Vista is trying to encourage and promote the concept of partnership within a teamwork environment. Partnership and teamwork are inextricably connected here. One depends on the other. Put in practical terms, partnership provides us with direction, while teamwork provides us with a way to get there. One of our grand aims is to develop a strong partnership between school and home to promote life-long learning. That is our direction. How we hope to strive towards that goal is to work collaboratively in representative teams (GVobs Wk1Day3).

The benefits derived from working collaboratively in teams were strongly reinforced by the data. The realisation of the potential of group work became apparent in the interviews, with one High Tops teacher making connections to the work of Stephen Covey and the development of group synergy:

> I think it was Steven Covey who talks about synergy, where the power of the group is greater than the sum of its parts. That is very, very true

> here; the achievement of our school as a group is much greater than each individual person and that is a real success" (HTint09).

The impact and personal benefits of working on an effective team were strong motivational factors for the continued promotion of a team approach. For those that had a successful experience with school teams there did not appear to be any other way to work. Such an experience appeared to convince a number of teachers of the intrinsic power of the team approach, with one Garden Vista teacher explaining that:

> It had to be a team thing, so I suppose you try to avoid technology being a one-person show. Coming directly from above telling teachers what they are going to do does not work well. It definitely must be a collaborative approach to make success with the integration of technology sustainable (GVint13).

Consequently, teamwork was referred to as being 'collaborative' (HTint04, HTint11 and HTint07, WVint04, WVint08, GVint13,) which is consistent with the findings of Nias (1989) and Little and McLaughlin (1993). Such findings were also strongly linked to the creation of a sense of belonging, which, in a subtle but effective way, reinforced the core belief of the school and promoted the supportive culture of the school. As a Garden Vista teacher explained:

> Feeling part of a team creates a sense of belonging which helps motivate team members to become involved. It is infectious, once you become part of this collaborative community there is a natural flow on of support for other members of the team. This process has happened here and is one of our greatest strengths and achievements (GVint04).

In such a culture, Donaldson (2001) argues, teachers are happiest and most contented. This was particularly the case at High Tops for those involved in the school technology project. One teacher related the positive experience of working on this team with the desire to participate in another project,

> There is something special about working together as a whole staff team on a collaborative project. The support and learning that took place was quite phenomenal resulting in the creation of a quality outcome that we felt very proud of. It makes me want to be involved in the process again (HTint04).

The level of personal satisfaction gained in the completion of the collaborative project was described by other teachers at High Tops as "the highpoint in my teaching career" (HTint09) and a "unique learning opportunity that I felt privileged and proud to have been part of" (HTint02). In effect, the teamwork practised developed ownership. When such ownership was focused on the strategic goals and vision of the school, Schwahn and Spady (1998), advise that organisational learning and change is more likely, resulting in possible changes, particularly in respect to the way work is completed. These findings are supported in the data from the three schools. This point was reinforced by a Western view teacher who explained the effect the team process had on the way he worked, forcing him to “work much more closely with colleagues” and to “get in and learn from colleagues” (WVint07). The end product for this teacher was “a renewed enthusiasm and confidence to utilise technology in the classroom” (WVint07).

A further result of such organisational learning and change took place in these schools with the sharing of responsibility and ownership within the implementation and management of educational technology. Such a ‘flattening of leadership structures’, based on a team approach was also strongly supported in the work of Banner and Gagné (1995). In a fashion, adopting of a team approach proactively countered the potential for teachers to develop co-dependence on one person having all the knowledge or possessing all the skills. More recent work of Crowther *et al.,* (2002) and the IDEAS project (2001) have shown that it is possible to see leaders at different levels of the school hierarchy and teachers without formal leadership roles working to a common purpose and supporting one another.

The data revealed that the team process enforced a sharing of responsibility by flattening the leadership structure within the school, thereby reducing the possibility of one person gaining too much power and ownership. This team process also countered the dependency on one person for successful implementation. As a teacher from Western View explained:

> The team concept works really well, it is very fair and equitable. What it really does, is stop ownership of an area by a single person and empowers the team to take responsibility. This is particularly the case with a technology initiative. When people are moving from different teams, you don't stay connected to the one committee forever. I think that is great and makes for ongoing information and skill sharing” (WVint11).

The result of such a team approach is a natural sharing of knowledge, as a Western View teacher explained:

> There is no such thing here as one person hanging onto all the knowledge. The team structure we operate doesn't allow it. Teams can only function as a democratic team, no one owns the team. The best thing, from my perspective, is that teams regularly change. If one person stayed on the one team ‘forever and a day’ real ownership problems can happen. It becomes hard for people to accept others’ ideas and work if they differ from their own (WVint12).

This idea of letting go of power and handing on information and knowledge was very important in the development of professional respect between staff. This was noted by a Garden Vista teacher:

> knowing that my colleagues have faith in me, and respect me enough professionally to hand on their work, is very empowering, and is one of the key reasons why teachers are so willing to take on extra responsibilities” (GVint07).

Discussions with the principal at High Tops echoed these sentiments and revealed that the greater the ability of the staff to develop professional respect among colleagues within the culture of the school, the greater the chance for teamwork strategies to be effective (HTobs Wk1Day3). When teamwork strategies worked effectively, the principal reported that transformations were evident within the school:

> When people work with each other, as opposed to without each other and against each other, the results can be remarkable. The entire tone and climate of a school can change. In fact, schools can rapidly transform from places where the main work was teaching to places where the key function is learning (HTobs Wk1Day3).

For a number of teachers, teamwork had the ability to transform the workplace and in so doing “create a level playing field” (HTint08), where “barriers are broken down” (GVint16), leading to the achievement of “great things” (WVint03). With such potential it was not surprising to find overwhelming support for the continued growth of teamwork within each of the schools. This growth was seen by some teachers as the basis for the development of collegiality and reinforced the findings of Barth who argued that “teamwork is being heralded as the way to develop collegiality” (1990, p. 54). This point was strongly emphasised by one Garden Vista teacher who saw teamwork within a primary setting as the best way to respond to the unpredictability and non-rational demands placed on the primary school teacher:

> The reality today for primary school teachers is that they can’t plan for every possibility. There are too many unpredictable and unexpected outcomes confronting primary school teachers. The best way to respond to such situations is through the support of a team. The natural collegiality that develops in teams flows on to other aspects of school life. Having experienced the effects of being in such a team has empowered me to work more collegially with other teachers. In so doing, I have become more open to learning from and with my fellow teachers. Given what I have experienced I see the future growth of schools being closely related to the level of collegiality that exists, which in turn is nourished by the teamwork that takes place in the school (GVint03).

The practice of teamwork, in the experience of one Western View teacher, can have a profound impact on teachers, leading to a situation where,

> There is no such thing as ‘them and us,’ it is simply ours. It is as if people leave their egos in the car park and enter the school with an open, inquisitive mind. Teams regularly change and the only constant that appears to remain is the professional respect and support each team member gets (WVint15).

The utilisation of teamwork appeared to strengthen the significance of positive staff relationships. This point was highlighted by a Western View teacher who saw a close and correspondent connection between the maintenance of positive relationships between staff and the practice of teamwork:

> The relationships here are really positive and this is largely due to the fact that we have learnt to work, support and learn with each other in a range of different professional teams. These teams have become more effective as our relationships have become stronger and more collegial. In a fashion one augments the other (WVint11).

While teamwork was considered important in the promotion and development of positive staff relationships, such relationships were consistently recognised as contributing to the success achieved with the implementation and management of educational technology across the three research sites. Developing and maintaining such relationships within the hectic and often chaotic life of a primary school was a challenge regularly acknowledged during the interviews as requiring time and considerable effort. As one Garden Vista teacher described: “developing good relationships with my colleagues takes time and effort” (GVint03). At Western View a teacher reinforced the importance of working at relationships: “good working relationships don’t just happen; there is a lot of give and take, a lot of trust and hopefully a lot of fun” (WVint06). Given that the analysis of interviews and observational data continually reinforced the importance of positive work relationships in each of the schools, the recurring theme of ‘time’ emerged as crucial to the sustainability of positive working relationships.

Time

Time was linked to the development and maintenance of healthy relationships in two main ways: firstly, through ‘making the time’ and secondly, through the use of ‘social time’. Teachers interviewed regularly referred to the need to ‘make time’ for relationships. Making time was categorised in three main ways: time for providing assistance; time for stopping and listening; and time for talking.

The ability and willingness of teachers taking time to be available to listen and support each other was important in managing some of the stress that teachers face. A Western View teacher explained this as, “having a colleague readily available, willing to listen and not judge was a godsend during stressful times" (WVint02). This point is supported in current writings on teacher burnout with strong backing for the notion that social support from colleagues can reduce teacher stress and burnout (Maslach & Leiter, 1999; Nias, 1999; Schwarzer & Greenglass, 1999). This point is supported by Nias, who argues that collegial relations:

> Strengthen the moral perspectives and values of teachers, and thus have the ability to reduce burnout. One reason for this is the development of a collegial culture characterised by mutual support and care, in which individuals feel able to express their emotions, negative and positive, to admit to failure and weakness, to voice resentment and frustration, to demonstrate affection (1999, p 235).

Given the complexity of school life, such support was recognised and appreciated by teachers, with a Western View teacher explaining, "we are all busy here, some days its crazy, but those are the really important times to make time for others. If someone is willing to put my needs before a deadline or a photocopy machine, I feel valued and important" (WVInt09). Similarly, the importance and value of time was reinforced by a teacher from Garden Vista, who stated that:

> Time is such a precious commodity in schools, there is never enough and we are always chasing and behind time. It is easy to give lip service to time; it is another thing to actually give time. I am so fortunate here to have colleagues that unreservedly give of their time (GVint02).

Observations made at each school during the main daily gathering times, before school, recess and lunchtime, demonstrated an interactive light-hearted atmosphere, where teachers were flexible in respect to seating and appeared to give time to each other. Observation made at Garden Vista School showed an informal welcoming environment in the staff room, where time for listening, sharing and talking were evident:

> Lunchtime the staff is in a jovial mood discussing a television program screened the previous night. It is interesting to note that staff seating arrangements are quite fluid. I have not been able to detect any cliques or small groups. As a staff member approaches the table after completing duty a staff member relates the story and loud laughter once again erupts (GVobs W2Day3).

The giving of personal time appeared to be freely shared and non discriminatory, in that, there was no evidence of anyone being excluded. The sharing of this time reflected an informal and natural staff process. A Western View teacher explained, "no-one ever told me that I had to make time for my colleagues at recess, lunch or after school, it just happens. It is a natural behaviour here" (WVInt13). While the collegial support provided through the free provision of time was fundamental to the development of a positive work environment, the revitalisation of relationships required the giving of social time.

Social Time

Social time, more specifically referred to in this study as time used for social interaction, emerged as a significant theme. A Western View teacher explained: “social time is all about having a bit of fun. We have to be very serious and business like most of the time; a bit of fun is great for the soul. It can energise the fading batteries” (WVInt05). The importance of social time was further emphasised by a number of teachers during interviews with a natural flow on to other areas of school life evident. Such findings were also consistent with Fine (1988) and Ashforth and Humphrey (1995) who found that social sharing led to improved cooperation, communication and emotional commitment.

Within the three schools under study, social time took many forms, including: “celebrating birthdays” (, GVint04, HTint01, HTint07, WVint03, WVInt13); “having a drink after work” (HTint07, WVint03); and “going out for tea” (GVint04, WVInt03). Such events, argue Donaldson (2001), are vital for the ongoing growth of relationships as “the root of many relationships is the need to share and enjoy time with others; the need to connect and befriend” (p. 62). The research findings revealed an important ingredient for each of the three staffs when enjoying social time, was having fun and, in particular, laughter (GVint01, WVInt06). This was also highlighted in a significant finding in the work of Nias (1998) and Pollard (1987) who found that humour was found to reduce tension, induce relaxation, promote and maintain a sense of social cohesion and staff morale. Further, research by Burford (1987) reported that a relationship exists between humour and the school work setting. This relationship he argues is reflected in “Group support, socialisation, group cohesiveness and coping capacity for stress, conflict, ambiguity and uncertainty (p. 31).

The importance of staff social time was further rationalised by a Western View teacher who pointed out that:

> At school we work hard at creating a positive work environment for all staff. Given the challenging and often confronting situations that staffs face in respect to students and parents, it is vitally important that the staff get on well and support each other. We actively try and encourage social activities, like, birthdays, staff gatherings and just fun” (WVint03).

The connection with having fun emerged strongly in a number of interviews, with a newly graduated teacher at Western View referring to this as the "fun factor" of a school. This factor related to the level of fun perceived in a school. This teacher went on to point out that, "the greater the presence of this factor [fun], the happier the school" (WVint15). It was recognised by a number of teachers that the presence of 'fun' within the staff could be perceived by the students, and had a very positive flow- on effect. A Western View teacher explaining:

> I think it is really important to be able to have a bit of fun, play a few practical jokes and socialise as a staff. Life is pretty serious and full on most of the time, it is really nice to be able to have a joke, or play a game from time to time. The kids here pick it up really quickly. They love seeing teachers being human and having fun. I think it helps break down barriers and encourages more open communication with the older students (WVint13).

While the supportive working environment evident in each of the schools studied was not solely reliant on congenial relationships between staff, there did appear to be a strong connection with congeniality. In effect, most staff viewed a happy, fun-filled work environment as the most desirable working environment. As a High Tops teacher argued:

> Being able to have a good laugh and have some fun with the staff cannot be underestimated. One of the best experiences for me at High Tops has been the fun I've had with my colleagues. The birthdays and special events I have celebrated with the staff help make this school a special place-a place that I love teaching in, where I am proud to say I teach (HTint09).

Declarations such as above were a testament to the sense of pride evident among staff in the three schools. Central to this pride was the development and maintenance of a positive work environment that was built on collegial and congenial relationships. The importance of such relationships at the three schools appeared to influence the developing school culture significantly. While each school created a unique culture that was reflective of the people in that school, many of the values and beliefs that were evident were similar. A staff member at High concluded:

> As a visitor looking in, you may not be able to see all the things that make this school a special place. To the outsider our school would probably be judged on external things like: the buildings and grounds, integration of children with special needs, the technology project or our academic achievements. While these things are important to me, they are secondary. It is the little things, the unseen things that make a difference. The willingness of staff to stop and help out on a busy day, give up free time to help someone, with-out conditions or expectations, to share their knowledge and skills and to have a laugh and be a friend. It is hard to understand these things without actually experiencing them. For me, these are the things that make a difference, that make

> coming to work an enjoyable experience. We have something special here, it is a pity we can't bottle it and share it with other schools" (HTInt07).

The analysis of data identified four key implementation factors related to the implementation and management of educational technology within the primary school: learning environment, relationships, leadership, and resources. Of all these factors relationships emerged as a most pervasive and influential factor implicitly and explicitly linked to the successful implementation and management of educational technology.

CONCLUSION

Within this chapter, findings of the relational factor of implementation were presented. The analysis of data revealed a number of emerging themes, in particular, support, core-belief, time, partnership and teamwork. Theses themes were discussed in detail revealing a strong connection between the successful implementation and management of educational technology and the type and quality of relationships in the school. The supportive environment identified in the data was closely linked to the informal support networks and the utilisation of teamwork strategies. These teamwork strategies were a recognisable feature of each school's culture.

Success at the three schools under study was closely linked, but not confined to the implementation and management of technology. Success was viewed as holistic, and related to many areas of school life, such as, "assessment and reporting" (WVint02); "positive learning environment" (WVint18); "responding to the learning needs of students" (GVint08); "Free flow of information within the school" (WVint01); "Reputation for excellence" (HTint07); Reading and numeracy (WVint05), and to a "dedicated teaching staff" (WVint05, GVint02). Closely linked to success for the implementation and management of educational technology were the promotion and maintenance of a positive and supportive work environment characterised by collegial relationships. These relationships appeared to be most effective when supported congenially.

In the following chapter the leadership theme will be presented, with key themes identified and discussed.

CHAPTER FIVE

LEADERSHIP

Leadership has been identified as a key factor in the successful implementation and management of educational technology and is inextricably linked to relational, resource and learning environment factors within this study. It has been suggested by Bennis and Nanus (1985) that, “leadership is the pivotal force behind successful organisations” (p. 2). A number of other authors (Bresnen, 1995; Greenleaf, 1997; Marshall, 1995; Ogawa & Bossert, 1995; Roberts, 1985; Stogdill, 1974; Sergiovanni & Corbally, 1986) strongly support this point of view.

THE LEADERSHIP THEMES

The data and subsequent analysis in this study identified and validated the important role that leadership played in the three schools. Leadership was directly referenced to ninety two per cent of documents with eight hundred and seventy five text units retrieved in a QSR NUD*IST report. The data revealed a number of important themes within the broad leadership theme.

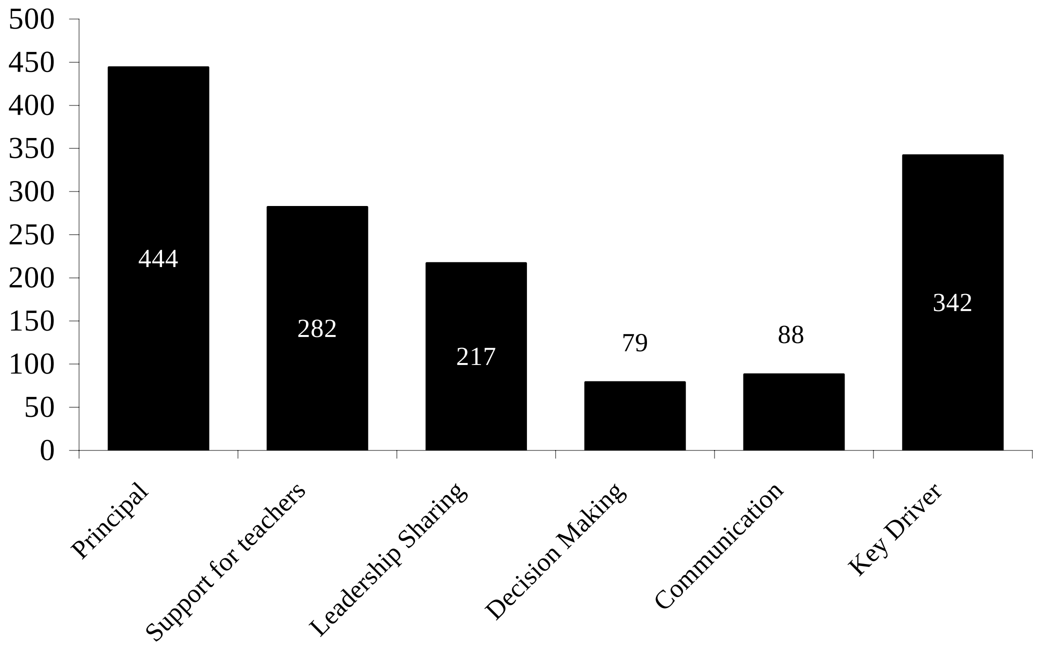


Figure 10

Number of text units referenced to Leadership Sub-themes

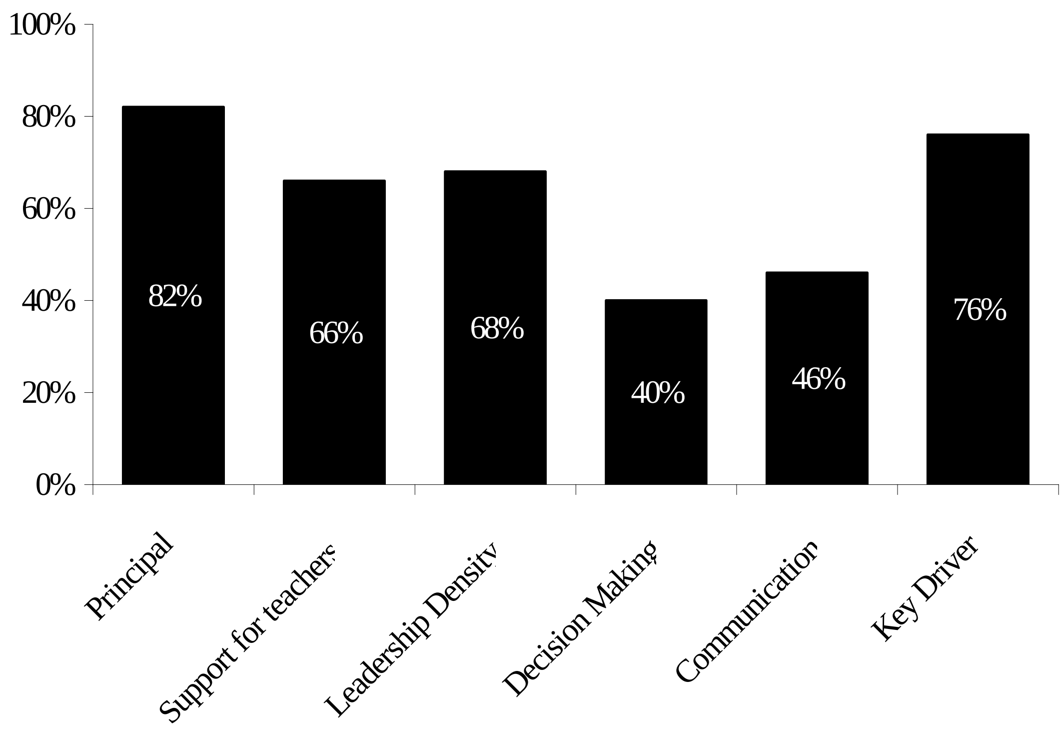


Figure 11

Percentage of documents referenced to Leadership Sub-themes

These themes were categorised under the headings, ‘the role of the principal,’ ‘key-driver,’ ‘support for teachers,’ ‘leadership density,’ ‘decision-making,’ and ‘communication.’ (See figures 10 & 11)

Each of these themes will be explored in this chapter, commencing with the theme that emerged most strongly, ‘the role of the principal’. Considering that the “school principal is often the gatekeeper who controls classroom access to technology and who guides the culture of the school in ways that can either support the innovative use of learning technologies or stymie it” (Hasselbring, *et al.*, 2000 p. 34), it seems an appropriate point to commence any discussions on leadership and the implementation and management of educational technology. The role of the principal, it is argued, is fundamental to the implementation and management of educational technology.

The Role of the Principal

The principal was consistently recognised as having a prime influence on leadership in respect to the implementation and management of educational technology, with 444 text units and eighty two per cent of documents referenced to the principal in a QSR

NUD*IST search. This fundamental importance of the relationship of the principal to school initiatives is supported by Hall, Hord and Griffin (1980) who concluded that "a most important factor to explain the quality and quantity of change in schools is the concerns of the principal and what the principals did and did not do" (p. 26). Principal leadership has also been described as one of the most important factors affecting the effective use of technology in classrooms (National Centre for Education Statistics, 2000a). This point of view was reinforced by a Garden Vista teacher who explained what she believed to be the obvious:

> I think most if not all teachers would agree that the principal holds the keys to success. We may have to grab the keys and open the doors, but the fact is, if the principal really wants an initiative to work and lends their [sic] support there's a much greater chance of success, than an initiative starting without the principal's support. I know this sounds pretty basic and common sense but it is so true. The active support of the principal, particularly with technology is essential (GVint08).

This point of view is supported by Means and Olson (1995) who suggested that projects having the active support of the principal are most likely to be successful, because the principal is better situated to understand individual and collective concerns. One High Tops teacher illustrated this thinking by describing the principal as being, "intuitively in touch with concerns" (HTint05). At Western View, a teacher expressed great admiration for the principal's ability and willingness to take the time to listen and try to understand concerns: "I am really amazed, because it doesn't matter how busy my principal is, she always gives her time, and listens to my concerns. By taking the time to learn about what makes me tick, she has developed a bond of admiration and loyalty on my part" (WVint19). Given the nature of the principal's position, he/she is best placed to harness the organisational forces necessary for successful implementation. As the principal from Garden Vista explained, "the principal is really the only one who can see the whole picture" (GVint01).

The school principal, then, is a vital force in the management and implementation of change. The importance of this role is supported through three related fields of literature, namely, literature which explores the role of the principal in implementing educational change (Fullan, 1996, Leithwood, Begley and Cousins, 1994); literature which highlights the principal as a key factor in successful school improvement (Fullan, 1993); and literature which identifies the principal as a key facilitator in bringing about successful school change (Hall & George, 1999, Hall & Hord, 1987). A significant conclusion from this literature finds the major responsibility for school improvement and change resting with the school principal. While a substantial body of research exists relating to the role of the principal in the above fields, Schiller (2003) points out that there is a distinct gap in the research relating to the role of the principal and the implementation of Information Communication Technology (ICT). A number of authors, however, have tried to provide guidelines for principals in integrating ICT into schools (Mauer & Davidson, 1998; Picciano, 1998). While examples of 'best practice' of ICT in schools identify a key role for the principal (Michael, 1998), there is still need for further research into the role of the principal in this area. Schiller argues that there exists "little Australian research on the role of the principal in the implementation of ICT" (2003, p. 172).

The findings of this study showed a link between the principal and the successful implementation and management of educational technology. This finding was corroborated by a Garden Vista teacher who stated that:

> One of the great things about this school is the level of leadership sharing that happens. The staff feels important and valued decision makers. It is a proven way to operate here. Our principal encourages and reinforces the sharing of leadership, meeting with us each term to discuss things we think should happen, we talk about our strengths our weaknesses and he listens. It is fabulous. I guess everyone feels they have an input. Maybe that is why this technology business is working (GVint09).

When the implementation and management of technology were considered to be working successfully, a number of Western View teachers believed it created a flow- on effect and a catalyst for much needed cultural change. Technology gave the school, according to Western View teachers, "something to hang our hats on" (WVint09) and a "focus and direction" (WVint01). At Western View, the principal's impact on the school was, for a number of teachers, clearly evident:

> I can honestly say that this is the best our school has been during my time. Through the commitment and guidance of our principal we have a great school and I am proud to be a teacher here. That wasn't always the case. In my first few years we had lots of troubles, a really unsettled staff and poor leadership. Our students were out of control. Casual teachers used to dread visits. The self-esteem of our school and community was at rock bottom. The kids were starting to believe they were worthless and stupid and began acting accordingly. Our movement into technology gave us a sense of purpose, it let our staff, kids and community experience much needed success (WVint19).

Another Western View teacher lauded the impact the principal had on the development of the school:

> Since our current boss took over things have really turned around. We

> immediately re-evaluated what we were doing, where our most needy areas were. The boss really listened to the staff, got involved in the discussions and put the time in with planning teams. She quickly gained the respect of the staff (WVint16).

The data in this study indicated that principals have to be acutely aware of what is happening in their schools. A High Tops teacher expressed this idea forcefully: “The boss needs to have his [sic] finger on the pulse” (HTint10). During discussions with an executive teacher at Western View, the importance of the principal knowing what was happening in his or her school was looked on as being essential to the fulfilment of strategic plans. A teacher suggested that, “the principal has the big picture, or vision in mind, and is the most important person to keep abreast of what is happening in the school. The principal is really the only one that possesses the strategic knowledge to be able to support or discourage an initiative” (WVobs Week2Day3). Without the principal’s support, the chances of a change becoming successful are greatly diminished. It was even suggested by a Garden Vista teacher that, “if the principal was not behind it [school technology initiative], in the first place, it wouldn’t get off the ground” (GVint08). This point was signalled in the earlier works of Means and Olson (1995) and Berman and McLaughlin (1978).

The principal, therefore, can be viewed as a fundamental change agent in the school, a view supported by Caldwell (1997), Hill (1999) and Sergiovanni (1996). This is particularly the case with the integration and management of technology. As a Western View teacher concluded, “everyone knows technology won’t get a look in without the principal’s seal of approval” (WVint09). The intricate and interdependent nature of educational technology, however, creates high demands and expectations for the principal.

Expectations of the Principal

As the principal of Garden Vista explained, “the professional expectations being placed on the principal are creating an untenable role that is discouraging rather than encouraging new people to join the principalship” (GVint01). Summaries generated from the data, using QSR NUD*IST, indicated that 261 text units and 45 per cent of documents were referenced to the theme, principal expectations. (See Figures 12 and 13)

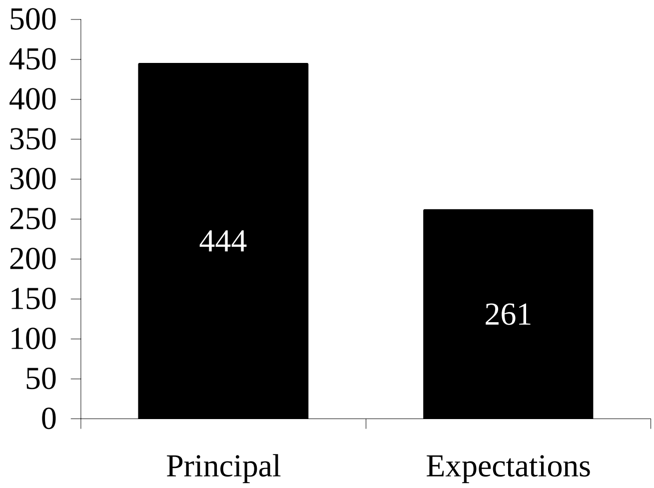


Figure 12

Number of text units referenced to principal expectations

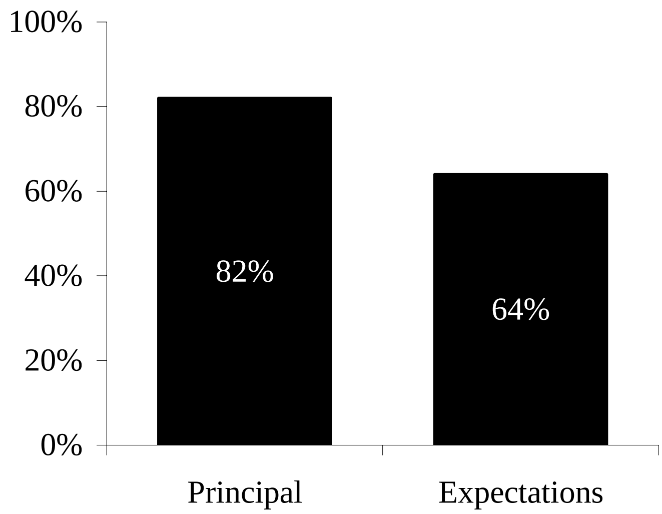


Figure 13

Percentage of documents referenced to principal expectations

The data revealed a range of expectations of the principal, with one High Tops teacher suggesting that the "principal needed to be almost a superhero" (HTint03). These high expectations were not solely confined to the domain of technology. As Marsh (1990) asserts, "evidence tends to emphasise the importance of the school principal in all school improvement activities" (p. 180). This point was also emphasised by a Western View teacher who stated:

> I really believe the principal has been the driving force, and responsible for our success. Not just with the use of technology, but with everything. If the principal hadn't been here for the past five years the

> innovations that we have undertaken would not have happened (WVint03).

A number of respondents suggested that the level of expectation of principals was increasing at an alarming rate. This fact was having an impact on the longevity of current leaders, and on the willingness of prospective leaders to pursue promotional positions. Discussions at Garden Vista also revealed that the personal demands on the principal were so great that "you would have to be mad to take on the job of principal today" (GVobs Week1Day3). While such comments are subjective, there is a growing body of evidence indicating that fewer people are applying for the position of principal and that the growing demands of the position negatively influence prospective applicants for the principalship (d'Arbon *et al.*, 2003). This was also borne out in the findings of Caldwell (2000) who suggested that, "reports from nation after nation refer to the shrinking pool of applicants for the principalship." The Leadership Succession research in Catholic Schools in New South Wales (d'Arbon *et.al*. 2001) found that the impact of the principalship on personal and family life was one of the main reasons offered for not applying for a principalship. This was strongly supported by a Western View teacher who argued that:

> Being a principal in today's schools is not an easy job, the stress and burnout rates are enormous with more and more demands being placed on the principal daily. Our boss is answerable to everyone, and everyone wants their [sic] pound of flesh. When I see what our boss goes through, it puts me off wanting to be a principal (WVint08).

Added to the growing demands facing the school principal is the expectation that technology will be integrated into the life of the classroom. To do this, D'Orsa and Boonen (1996) suggest that the principal needs to be knowledgeable about a wide range of technology issues. Such knowledge should transfer, according to Lee (2001) and Gurr (2001), into the principal understanding what is available and where to get advice and assistance with educational technology, particularly in relation to developing technical infrastructure. To acquire knowledge about a broad range of technology issues and developments, agrees a Garden Vista teacher, places new and demanding expectations on the principal:

> The growing expectation that the school principal will have a sound knowledge of technology developments in the school is creating a new pressure that didn't exist a decade ago (GVint 03)

Teachers in the research schools expressed a broad range of expectations of their principal and the role he or she should play in the implementation and management of educational technology. In particular, they expected the principal to, "empower others"

(GVint07, HTint04, HTint07, WVint03, WVint09); “support the key-driver” (GVint08, GVint09, HTint03, HTint08); “be responsible for exploring creative options to access professional development for the staff” (HTint03); and “actively promoting shared leadership” (GVint02, HTint03, WVint04, WVint16, WVint18). While the principals fulfilled such expectations, they were concomitantly expected to “keep the big picture in focus and keep the ship on course” (GVint10); “be committed to accessing the funds and support required for the continuation of the program” (GVint11); “have a sound grasp of the learning principles guiding classroom integration” (HTint03, HTint05); and “be technically competent” (HTint02, HTint05, WVint04).

The area of technical competence emerged as an important theme and implied a number of future pre-requisites and desirable qualities of the primary school principal. Such competence was considered by research participants to be more involved than demonstrating proficiency in using a computer. Technical competence was seen to embrace an understanding of, and an aptitude for using technology to achieve learning outcomes. Without such competence, Brunner (1992) argues, principals will not understand the extensive restructuring that must accompany the integration of technology into the curriculum and, ultimately, will not support the implementation of technology.

Technical Competence

The emergence of technical competence as a recognised expectation placed a number of interesting demands on the principal. While the desired level of technical competence required varied in the data, the importance of principals, particularly principals of the future, possessing a high level of technical competence was strongly supported. A Western View teacher provided a typical response:

> I really believe that future leaders of schools will need to have a high level of understanding and demonstrate competence in the use of technology. I think the principal needs to use best practice in his or her daily work. I think parents expect the head person in the school to be competent, to be able to lead in all areas, and technology is a particularly important area in the eyes of the parents. This is especially important for credibility, if the principal is asking for financial support from the parent body. I don't think it would look good if the boss was computer phobic and was asking for support for a technology initiative. Actions speak louder than words and that is particularly the case with technology (WVint04).

The importance of the school principal in modelling the use of technology and understanding how technology can be used as an instructional tool is strongly supported in the work of Bailey and Lumley (1997). This point was reinforced at High Tops, with a teacher suggesting that future developments in education would require the principal to be technically competent. “A pre-requisite of the principalship for the future being, competency in using and applying information and communication technology. I would even go so far as to say that a principal in the 21st century will be an expert in the integration of technology into the life of the school’ (HTint02).

Such technical competence was considered to be a key skill of the principal with a close relationship developing between technology competence and future employment recruitment:

> Technology competency will be a standard pre-requisite for future principals. The bottom line in the future will be competence in using technology. The preferred applicant may well be the one with expert skill levels. You only have to look in advertisements in the Sydney Morning Herald. A desirable quality for a principal in many cases is technical competency and experience in using technology (HTint05).

The link between technical competence and credibility was also strongly reinforced in the data. Being competent or, more importantly, being willing to use technology in the daily role of the principal, was seen as a key to professional credibility. As Harvey *et al.*, (1988) concluded “principals need to be experienced computer users in order to offer assistance to teachers” (p. 34). This point was reinforced at Garden Vista with a teacher explaining that “it's important that he [principal] demonstrates a positive use of technology. It is hard to be credible with technology if you’re not using it” (GVint12). The importance of leaders using technology in the school was also emphasised by Ritchie (1996) who concluded that unless the top administrators in a school use the technology themselves, other staff will be less likely to utilise the technology. Similarly, at High Tops, a teacher felt that, “ideally the principal should demonstrate technical competence and be a user of technology in their [sic] daily work. I think a principal is more credible if they [sic] are doing what they are saying or promoting” (HTint02). One High Tops teacher went so far as to suggest that every principal should have a computer on his/her desk to enable technology to become an integrated part of his/her professional life. “I think all principals should have a computer on their desk, not just for looks. The staff needs to see their principal using technology in their [sic] work” (HTint05). The issue of credibility was succinctly summed up in the words of a High Tops teacher who suggested that consistency of expectations needed to be pursued:

> I think the principal needs to be competent in the use of technology. If there is an expectation that teachers integrate technology into their

> classroom, it only seems fair that the same applies to the principal (HTint05).

While it was strongly acknowledged in the interviews that not all current principals should possess highly developed technical skills with the implementation and management of educational technology, an openness to, and a positive attitude toward the use of educational technology were considered essential building blocks for the successful implementation and management of educational technology. This point was taken up by a teacher from Garden Vista who suggested that the "key thing for principals is, to have the right attitude to technology" (GVint09). A Garden Vista teacher explained that having a positive attitude to technology enabled "the principal to lead by example, being prepared to learn" (GVint08).

Such learning is vital for the principal of the future, given that future schooling will more strongly integrate technology into its daily life than it does today (Dede, 1998, Hawkins & Collins, 1999, Means, 1994; Picciano, 1998). This is rapidly creating a situation where the principal cannot, according to a High Tops teacher, "ignore technology. It is not something that can be done in isolation of the school leader" (HTint04). If principals do not have the required skill level, a Western View teacher firmly believed that "they must upgrade and re-skill themselves" (WVint03). Accordingly, being technically competent was seen to take on a new dimension and, according to a Garden Vista teacher, should not be centred on, "being the technical whiz kid in the school" (GVint01). Accordingly, technical competence was seen to embrace "empowering others" (GVint07); "utilising current technology to be more efficient" (WVint05); "multi-tasking software applications" (WVint11); and "being able to learn from others and with others" (GVint02, HTint05, HTint10, WVint13). Given the close relationship that exists between the role of the principal and the successful implementation and management of an educational technology initiative, it is recommended that a broad view of technical competence is needed. The result of adopting a narrow view, will, according to a High Tops teacher, "restrict the potential and the possibilities of technology in the school" (HTint09).

These potentials and possibilities of educational technology will only be successfully implemented in schools if the principal actively supports them, learns as well, provides adequate professional development for and supports his/her staff in the process of change (Schiller, 1998). A Western View teacher went so far as to suggest that, in the future, schools reluctant to embrace and integrate technology would place students at a distinct disadvantage:

> It is hard to imagine a school not embracing technology in the future, so I really think the principal of the future is going to have to be a promoter of technology in schools. I really don't think that new principals can be as successful or effective or realise their school's potential if they are not wholeheartedly supporting technology. I suppose more importantly than being skilled in using technology the leader needs to be able to encourage others to become leaders in technology, encouraging and valuing contributions from other staff with the implementation and management of technology in school. I think technology can only work well when it operates as a team effort (WVint03).

As the principal's technical competence grew in the three schools being studied there appeared to be a parallel development of positive and supportive relationships between the principal and staff. This was highlighted by a Western View teacher who pointed out that "the more confident and competent the principal gets with technology, the more the principal needs to develop and empower people" (WVInt14). Again, at Western View, this relationship was picked up and explored by a teacher characterising technical competence as a function of both technical skills and interpersonal relationships:

> What makes our boss technically competent is the fact that she is not only technically skilful, she is extremely competent in utilising the group processes that the learning foundation of our school is built on. She actively learns from others and shares her knowledge, at our school. This makes her technically competent (WVint09).

Given the huge demands being placed on the school principal, the changing learning environment faced and the expectations confronted, it comes as no surprise to find the role of the principal in a state of flux. This is particularly the case when the implementation and management of educational technology are taken into account.

Developing Role of the Principal

Earlier discussions indicated that the implementation and management of educational technology was closely related to the role of the principal with this role crucial to the successful introduction and use of educational technology (See Hall *et al.*, 1980; National Centre for Education Statistics, 2000; Picciano, 1998). While the implementation and management of educational technology is unquestionably a key focus for the twenty-first century school principal, Leithwood *et al.*, (1998) argue that the future role of the principal will focus more on relational factors including the "building of a productive organisational culture within school" and, "providing assistance in the construction of school processes, in order to further the participation of the staff in decision-making" (p. 69).

Such factors will, according to a Garden Vista teacher, become the core aspects of the future principal's role:

> The principal's role is really involved and it seems to be getting more complicated and demanding every year. The interesting thing I have noticed over the years is the importance of the relational stuff. While being an instructional leader or being able to manage money and resources are very important they will be more effective when relationships are developed. The heart of what a principal does is relational. The most effective principals in the twenty-first century will be the ones that develop strong and supportive relationships with the staff (GVint03).

Principals within this study were quick to point out the importance of the relational factors of leadership. As the principal of Garden Vista explained, the ability of a school principal to fulfil his/her role should, "first and foremost be judged by the working relationships that exist in the school" (GVint01). This principal went further and qualified this role in respect of the implementation and management of educational technology by suggesting that "the principal has to develop and nourish relationships while accessing the resources and finance required to make a technology initiative happen" (GVint01). In doing this, principals reported having their endeavours restricted by budget constraints and the system bureaucracy. This concern created a need for principals to be creative and extremely flexible. The principal from High Tops explained: "To get things done in schools requires more and more creative thinking, where novel options are explored" (Htint01). This point was substantiated by a Western View teacher who saw the school principal being faced more regularly with situations that required thinking outside the conforming boundaries of the traditional school; "Our boss, to her credit, had to tackle our problems creatively, a bit like the Freedom Furniture add, 'think outside the square' " (WVint11).

At High Tops, creative and innovative thinking took place through the development of an educative relationship with the wider educational and business community. Such relationships produced positive results. As one teacher emphasised, "by putting your school face in the right mirrors you would be surprised who sees you, who wants to learn about you and who wants to be part of your work" (HTint04). The principal of High Tops explained that such assertiveness has a genuine flow-on effect for the school, in particular raising the profile and educational expectations of the school community.

> I am very proud of our achievements. Unfortunately, most of the great work schools produce is kept under lock and key. The local school community becomes aware, but in this age of global communication schools have access to wonderful vehicles for promotion and don't use them. Here we take a slightly different approach. We pursue avenues to promote our school and, in so doing, we create a professional presence. This definitely has a flow on benefit to our school. We are becoming known as a school of best practice. Our collaborative project has generated a lot of interest and our school will definitely benefit from this. There is a growing expectation in our school community for high educational standards. (HTobs Wk1Day2).

The concept of self-promotion, while appearing to be a natural consequence of the school's technology initiative, generated among a number of High Tops staff a belief that peer schools were not supportive of what had been achieved at High Tops. It was outlined by teachers (HTint04, HTint09, HTint12) that High Tops was seen as a school bent on self-promotion. As mentioned by staff, other schools saw them as "go getters" (HTint01), "full of self importance" (HTint03), and "opportunists" (HTint07). According to the principal of High Tops, such responses were said to be indicative of the, "tall poppy syndrome that existed in Australia" (HTint01).

Tall Poppy Syndrome

The principal also believed that many schools were feeling threatened by the innovative and public approach that had been adopted at High Tops. From the principal's perspective, to do this required an "erudite belief in what you are doing, why you are doing it and where you are heading" (HTint01). The importance of the principal being able to articulate an educational vision in word and action was seen to be important, and was strongly emphasised in the three research sites. A Western View teacher suggested that the clear direction that comes from having a sound educational vision can have an extremely positive influence on younger, less experienced staff:

> I think because the Principal had a vision and she could see where the school was heading, she was able to articulate that to the staff. It is very important for younger teachers to have a credible leader that can provide clear direction. The principal, by her positive modelling of professionalism can have a huge impact on teachers, particularly inexperienced teachers (WVint06).

Again, at Garden Vista, a staff member reinforced this point of view by suggesting that the "principal needs to have the big picture in mind; he or she needs to be ever mindful of why the school is embracing technology and what the school's needs are. In a fashion, they keep the ship on course and balance the needs of technology against other needs in the school" (GVint07).

In the course of leading the school in the technology initiative, the principal at High Tops expressed concern, when meeting or socialising with local peers, in particular, of the difficulty faced in keeping focused, in order to avoid conforming to the educationally mediocrity that was subtly espoused by principal colleagues. This required an ongoing commitment and belief that what was happening at High Tops was right, and was providing an educational benefit for the students. This was further acknowledged by a High Tops teacher who expressed admiration for the school principal for having the courage to follow through on his educational convictions:

> I really must commend our principal for his vision in sticking to his guns and continually supporting and promoting the technology initiative at this school. I hear from colleagues at other schools that our school cops a fair bit of criticism about the way we try and promote ourselves and the resources we spend on technology. Obviously these people have never worked at this school or experienced the learning culture that exists here. I really think they are a little jealous or envious of what we have done (HTint02).

The challenge for the principal in managing an educational technology initiative involves maintaining a dynamic balance between all the competing demands of the principalship. Working towards such a balance, created both concern and admiration from teachers, with one Western View Teacher, declaring: "The principal is amazing in the way she can balance all the commitments of her job. I don't know how long she can work at the rate she has to [to fulfil her role]. I'm frightened she will burn out (WVint19).

While each of the principals in the study was unique in the specific way they led their school communities and worked towards creating a balance, they were also similar in the way they were perceived to provide support for the implementation and management of technology. The provision of principal support was in many ways synonymous with the maintenance of dynamic balance. This was particularly the case when the vast array of behaviours and functions associated with principal support were considered. These functions and behaviours included; "being interested and promoting technology" (GVint02, HTint08, WVint15, WVint18,); "acquiring funds and acknowledging effort" (GVint04, Gvint09, WVint07); "providing information" (GVint03, Htint03, Htint10); "listening to frustrations and concerns" (GVint11, GVint15, HTint07, Htint05, WVint11, WVint13, WVint15); "establishing and maintaining support systems" (HTint03, WVint08); and "participating in training" (GVint03). These functions and behaviours led a Western View teacher to conclude that, "no principal is superman, no principal can achieve the vast range of expectations placed on them [sic] by the educational community (WVint09). The difference between principals according to a High Tops teacher comes down to committed action:

> The bottom line for me on whether a principal is good or not, comes down to their willingness to become involved. Not just talking about being supportive, but getting in and 'having a go' so to speak" (Htint07).

The practical application of this support for the implementation and management of educational technology by the principal in the workplace was, subsequently, demonstrated through the provision of "release time" (GVint08, HTint07, WVint09, WVint19) and "school-based training" (HTint09, HTint02, WVint11); the purchase of resources, such as a digital camera, data projector, scanner, digital video camera, specialised software and computer hardware (HTint03, WVint07, WVint11); and the promotion of professional development, in particular, Teaching and Learning in Technology (TILT) training (GVint03, HTint06). The practical application of this support was consistently emphasised and strongly linked to the principal's belief in the potential benefits of educational technology, as a Garden Vista teacher explained:

> Let's face it, the Principal has a very important role to make sure that things are organised in such a way that technology can be imparted to others. The Principal has to demonstrate leadership to make sure that it does happen. The Principal cannot sit back and hope that it will happen. The principal has to orchestrate support for the teachers in the school if technology is going to have any chance of being integrated into the classroom (GVint06).

The data in this study supports the view that the level of success realised in a school-based technology initiative has a direct relationship to the support provided for teachers.

Support for Teachers and Teachers Supporting Each Other

Support, like the relationship data presented in the previous chapter, is a significant feature of the findings on leadership. One of the key factors identified in the data was the level of support teachers received from school administrators in the integration of technology into their classrooms. This finding is also supported in the work of Sandholtz *et al.,* (1997). Exploring this point further, an analysis of the data revealed the emergence of a close relationship between leadership and support, with QSR NUD*IST searches revealing 282 text units and 66% of documents being referenced to the theme, 'support for teachers.'

Support for teachers was viewed as a prerequisite component of leadership within the schools. The support experienced, in practice, mirrored the style of leadership in operation at the school. As a Garden Vista teacher explained,

> We worked out a while ago that a supportive school environment works best here; everything we do is based on the belief in that. When people feel valued and respected, when people feel part of the big picture and have ownership in where we are going. When people are happy and feel cared for, everything else seems to fall into place. Yeah, a lot depends on the leader, but you'd have to be blind and stupid not to pick up the way to do things here" (GVint08).

First and foremost, implementing a major technology program required staff support and commitment to the initiative. Staff members from Garden Vista pointed out: "It is essential that the staff want to do it, believe in it and have a hand in the organisation and delivery of the initiative" (GVint14). It is significant that Fullan (1994), Owens (1991) and Sergiovanni (1988, 1996) related the implementation of an initiative with the development of a shared vision. The staff at the three schools believed strongly that the technology initiative was going to make a difference. As a teacher from High Tops explained, "there has to be a meaningful and realistic reason for change. The most important rationale for any change here has to be the kids and whether the change will help the kids" (HTint04).

The importance of ownership of the technology initiative was strongly upheld on all three sites. A High Tops teacher identified the potential of technology "to improve learning outcomes, which will provide the greatest help for students" (HTint15). For the potential of technology to become a reality, a Western View teacher acknowledged that, "it must be owned" (WVint18). A Garden Vista teacher advocated the need for shared ownership of an initiative thus:

> I believe that for anything new the decision to do it has to have been reached by everybody. By that I mean that everyone feels they have had an opportunity to be part of it. There has to be a sense of shared ownership. When this happens everyone can see the need and benefit in doing it. If it is one person only pushing the barrow people will automatically get their backs up. They will not participate and be as co-operative as if they owned the decision. When the whole staff is included in organising there is a greater chance of success (GVint08).

The teachers interviewed were consistent in their belief that support was also the first sign of success. Without the initial support for an initiative and, in particular, a technology initiative, the chances of successful implementation taking place were significantly reduced, as a teacher at High Tops explained:

> Introducing a technology program, like we have done here, I suppose it is the same as any new initiative, it is dependent on the staff. By that I mean, the staff hold the key to success and failure. If the staff is not convinced the initiative will be worthwhile, or if the staff haven't been involved in the planning, they are not going to be committed, and from my experience they will not be willing to do the hard yards. Conversely, if the staff is convinced it will be worthwhile and make a difference to their students and if they have been actively involved in the planning process they will give more of themselves, and they will develop ownership of the program. Once staff takes on ownership anything is possible, look at what we have done here" (HTobs Wk1Day3).

Once ownership was established everything seemed to fall into place. Teachers spoke of colleagues naturally helping each other. As a Garden Vista teacher explained, "once we can see value in a change, it just seems natural, the path [support process] is well worn, and there are plenty of sign-posts [direction]. You can't help but follow the good example that has been set by other teachers" (GVint15). The data confirms the view that gaining support for, and developing ownership in a school-wide technology initiative, is inextricably connected to the promotion and nurturing of a supportive school environment. While each school's support environment was unique, there was consistent recognition of the fundamental importance of collegial support. To quote a Garden Vista teacher: "the greatest support I get is from all my colleagues (GVint03).

While collegial support was not mandated in any school publication, there did appear to be a very strong cultural connection to the concept of teachers supporting each other. A Garden Vista teacher described it, "there is almost an expectation that staff members will help one another. It seems to be part of the culture here. It doesn't take long to pick it up, you just watch others. Everyone does it" (GVint07). At High Tops, the benefits and flow-on effect of teachers freely helping colleagues were also strongly reinforced with the positive benefits highlighted:

> Teachers' helping each other is a really positive way to embrace a major change. I think we have developed a bit of a risk taking learning environment, where we all learn from each other and from our mistakes. That can only happen because we feel supported. This support leads to a growth in staff confidence, where our staff seems keen, not only to try new ideas but also to adapt them to suit their needs (HTint06).

Much of this support can be classified as 'informal support' in-as-much as teachers do it voluntarily and outside any formal requirements.

Informal Support

According to a Western Valley teacher, the greatest support came through “informal channels within the school” (WVint09). There is strong support in the data for the use of informal support channels. A staff member from High Tops commented, “knowledge and work is shared here. We actively learn from each other. I suppose we have developed over the past couple of years, an environment where we try and recognise each others’ strengths and successes, and celebrate these” (HTint03). At the core of informal support, is a willingness to take time, in particular taking time to listen. A Western View teacher explained,

> We are very supportive of each other; everyone seems willing to share their time and expertise. Nothing is a hassle, the staff is always willing to help out, give up their own time, or sit down and have a chat. The one special thing that seems to happen here, even at the most hectic and chaotic times, is the willingness of staff to stop and listen to others (WVint04).

Unfortunately, according to Fullan (1991), conditions in education, generally, are not conducive to the successful diffusion of an initiative, such as the implementation and management of educational technology, because teachers do not having adequate opportunities to learn from colleagues, “There is simply not enough encouragement for teachers to work together, learn from each other and improve expertise as a community” (Fullan & Hargraves, 1991, p1).

The findings of this study show that the promotion of a supportive school environment can provide informal and unplanned opportunities for staff to work and learn together. A High Tops teacher stated,

> The supportive environment that exists here is synonymous with our success. I don’t think I would have been willing to try the things I have with technology if I didn’t have the support of my colleagues (HTint07).

Parallels can be drawn from Riel’s (1990) work, where he suggested that "new tools alone do not create educational change. The power is not in the tool but in the community that can be brought together and the collective vision that they share for redefining classroom learning” (p. 35).

In this study, the supportive work environment was tantamount to the active devolution of power and, in particular, the proactive sharing of leadership. The principal from Garden Vista admitted,

> I can provide all the resources, release time and training, but if I don't delegate and empower others to lead in this area, the results will be very disappointing. It is only when teachers are encouraged to take an active role in the leadership of their school by sharing their expertise, time and experience with others that real and meaningful change can occur (GVInt01).

An exploration of this emerging theme, leadership sharing, revealed strong support for the adoption of practices that encouraged and nourished power-sharing.

Leadership Sharing

Leadership-sharing emerged as a significant theme with searches using QSR NUD*IST showing 217 text units and 68% of documents referenced to the theme. The active demonstration of leadership sharing was seen to be consistent with the development and provision of support. To quote a High Tops teacher:

> While the principal is the main planner and organiser of physical support, it is not practical or realistic for him to deliver the support. It requires empowerment and the sharing of leadership roles. I would go so far as to say that the more we share leadership at High Tops, the more support is provided for staff (Htint11).

Gaining this support required the leader or the leadership team to present adequate information and be willing to share leadership. This concept of leadership-sharing is highlighted in the work of (Cooper & Boyd, 1996; Crowther *et al.*, 2002; Picciano, 1998; Sergiovanni, 1984, 1986, 1987, 1996; Telford, 1997).

The sharing of leadership was widely practised in the three schools and appeared to have had an important influence on the success of each school's technology initiative. A Garden Vista teacher said:

> One of the great things about this school is the level of leadership sharing that happens. The staff feels important and valued decision makers. It is a proven way to operate here. Our Principal meets with us each term to discuss things we think should happen, we talk about our strengths our weaknesses and he listens. It is fabulous. I guess everyone feels they have an input. Maybe that is why this technology business is working (GVint07).

At High Tops, a teacher claimed that leadership sharing was an identifiable characteristic of the school:

> Everyone, including newly appointed graduates, has an important and valued role to play in the school decisions. I've never been used to this sort of leadership sharing. It certainly creates a sense of loyalty, ownership and pride. Pretty smart really, when you think about it (HTint02).

Leadership sharing was actively practised through the development of "small committees, reference groups, policy teams and technology mentors" (HTint01). The formation of these groups, according to a High Tops teacher, must involve selection based on merit and ability; "the sharing of the leadership roles must be centred on the most capable person and that does not necessarily mean the most senior" (HTint09). At Western View, the leader of the team did not possess any great power. Team leadership was viewed as a function of the most able person. A teacher explained,

> I suppose leadership is determined by merit, competence and skill. In reality, who leads a team is no big deal. No one seems to get caught up with position. It really is a level playing field. This can only happen because relationships are developed and time is put into relationships (WVint15).

A commitment to leadership sharing can have an enormous impact on the development of the school culture, as a newly graduated teacher from Western View identified,

> I believe Western View is a great school. I know I don't have a great deal of experience to make that judgment but some of the things that happen here, I think, would make any organisation work well. The school is made up of lots of different teams and people are on a number of these teams. When I arrived I'd been here no more than two or three weeks and I was asked to go on to a committee and soon after that I was placed on another committee and before the end of term two I was put in charge of a committee. Now that for me, a new graduate, was a very empowering and powerful experience. I really felt as though I was valued for my professional contributions. I was valued for my ability to contribute and I was valued for my commitment to education. The team concept works really well. What it really does is stops ownership of an area by a single person. People are moving to and from different teams, and you don't stay connected to the one committee forever. I think that is great and makes for ongoing information and skill sharing (WVint11).

The adoption of leadership sharing practices, according to the principal of Garden Vista, sends a very clear message to teachers, namely, that "teachers are valued professionally and teamwork can produce great things" (GVint01). When teachers are valued and work in democratic teams, the principal goes on to point out, they "tend to feel good about their contributions and in a growing number of cases these teachers feel more benevolent towards their colleagues" (GVint01). The result of this can be seen in the supportive work environment created. In reality, leadership sharing and a supportive work environment can be catalysts for each other. This was strongly suggested by a Western Valley teacher who related her experience as the leader of a key learning area committee, "It was such a rewarding and empowering experience to have fellow teachers, members of my team, going out of their way to support me when I was leading the group. It created, in me, the desire to let someone else experience that level of support" (WVint09). It became apparent to the researcher, that the maintenance of this level of support was closely linked to the adoption of teamwork strategies in the workplace.

Teamwork in the Workplace

Within the research sites, the data indicated that a team approach to leadership was practised, with decision-making shared and small teams operating. In particular, this was evident in the formation of a technology committee. A teacher at Garden Vista commented:

> At the school we just don't have one person we have a team committed to technology. Admittedly, one person is the *Key Driver* but she is strongly supported by the team. We are all pushing in very subtle ways. I think we're lucky we have the structure we have, because, I mean, you have each other there as well and you're not out there on your own. (GVint02).

The promotion and establishment of a formal technology committee with representation by key stakeholders can be very effective (Anderson & Dexter, 2000). This was particularly the case at High Tops when a teacher and member of the technology committee spoke of the decisions the school technology committee were able to reach through adopting a fair and democratic decision-making process, "as a school technology committee, we worked as a close knit team, and while we had a chairperson, everyone was on an equal footing. Our decisions were reached through consensus and discernment" (GVint02).

The significance of the decision-making process in operation was further reinforced at Garden Vista, where decision making was seen as a vital component of the team approach:

> This school is very good and democratic in its decision making process. Wherever possible, decisions are made collaboratively. I have been to schools where it goes to an executive and then it is a *fait accompli*. Here, there are committees that make recommendations that are presented to staff meetings, where we all get an opportunity for input (GVint07).

Warning against decision making that is not consultative and democratic when initiating technological change, Picciano (1998) suggests that, "top down implementation of technology without consultation and involvement will likely increase resistance among staff and may possibly doom entire undertakings. Involvement is critical" (p12). At Western View, teamwork, in particular the committee structure reinforced collaborative decision making and rendered a top-down implementation model ineffective. One Western View teacher suggested,

> Within the school we have a committee structure and all teachers are involved on committees. I'm currently on three committees. Within the committee structure decisions are made, and recommendations prepared and presented to the whole staff. Generally speaking, committee recommendations are taken on board by the staff. I think this system works very well and everyone has an opportunity to express their opinion, and I really think all staff has a say in the process (WVint04).

At High Tops, a newly graduated teacher reported that, “within one week of commencing I was involved in a committee and very soon I felt very much part of the decision-making team at the school” (Htint04). The sense of identity and belonging that was experienced by the High Tops teacher was very much indicative of experiences of other teachers at the three research sites, for example, (GVInt03, Gvint05, GVInt07, GVint10, GVint11, GVInt14, Gvint15, HTInt02, HTInt04, HTInt07, HTInt10, HTInt11, WVInt03, WVInt04, WVInt07, WVInt10, WVInt12, WVInt13, WVInt15, WVInt8, WVInt19).

The formation process used to establish teams and committees was very important in the development of ownership and identity. The Assistant Principal at Garden Vista suggested that the construction of teams, according to experience, skill and interest, not seniority, helped break down supervisory barriers:

> The fact that I, as Assistant Principal, can get help and feel very comfortable about getting help from anyone on staff has a lot to do with the way the staff are. There is no ownership of knowledge by individual staff; information and knowledge are freely exchanged. Our teams and committees are full of people that want to be there, that choose to be there. We have a great working staff (GVint09).

Discussions at Western View revealed teamwork to be most successful when staff were authentic and honest. One teacher stated, “we should be a walking example of what we preach. If the school promotes shared leadership, then leadership should be seen to be shared. If the principal promotes support, then the principal must take time to listen and understand” (WVint16). To create a school environment where staff feel supported requires effort and commitment. To be authentic in their role, staff members believed they had to “make a difference” (GVint04); “make the school a better place” (WVint06); “improve learning outcomes” (GVint08); and “pursue life-long learning” (HTint02).

As outlined earlier, leadership, and in particular the promotion and practice of shared leadership, were significant in the three research sites. Strong links emerged between the leadership in operation in the school and the role of the *Key Driver* in a school-based technology initiative. These relationships will be explored in the ensuing discussion.

Key Driver

A *Key Driver*, which this research refers to as the most significant and recognised person involved in the school's technology initiative, was characterised as possessing a high level of technical skills and a passion for the integration of technology into the classroom. The *Key Driver* was consistently regarded within the data as being a significant factor contributing to the successful implementation and management of educational technology, with 342 text units and 76 percent of documents being referenced to the *Key Driver* theme in a QSR NUD*IST search.

The *Key Driver* was central to the diffusion of a school technology initiative, as a High Tops teacher made clear:

> Success in technology at this school has a strong correlation with the work of our *Key Driver*. We have been very fortunate to have a very skilful person driving our initiative. I don't think we would be where we are without her (HTint03).

At Garden Vista, the importance of the *Key Driver* was also strongly reinforced, with one teacher suggesting that the "school's success with the implementation and management of educational technology was definitely dependent on a key person, and to a lesser extent, the other members of the technology committee" (GVint03). The level of success attributed to the technology initiative was closely linked to the personal qualities and professional skills of the *Key Driver*. A High Tops teacher described the school driver as, "an extremely skilful, professional person and a wonderful communicator, who is passionately committed to the potential of technology" (HTint04). The *Key Driver*, according to another High Tops teacher, also possessed:

> A strong academic background having completed a Masters in Education majoring in technology. She has been able to apply her study very effectively to the workplace. She has a really clear picture of where we are going and has the ability to bring people on board, and empower them to make important contributions (HTint06).

At Garden Vista, a class teacher viewed the *Key Driver* as, "having done a phenomenal amount of work, with levels of commitment and skill that were truly inspirational" (GVint03). At Western View, a class teacher considered the *Key Driver* as, "possessing enormous knowledge and skill in the development and application of technology in primary schools. I would imagine she would be considered to be one of the leading people in this area in New South Wales, if not Australia" (WVint19). At each site, the work of the *Key Driver* was linked to a high level of internal motivation and dedication. These people were usually passionate about technology and the potential benefits technology could bring to student learning.

Regular references were made to the level of commitment and dedication shown by the *Key Driver,* with teachers suggesting the *Key Driver* was, "extremely committed to technology at this school" (WVint04); "committed to the potential benefits that technology had for learning" (HTint07); and "always willing to give her own time to listen and help" (GVint06). These views were put into context by the *Key Driver* at Garden Vista, who posed the question to herself:

> Why do I give my own time to help with technology?
> I must admit I regularly ask myself this question. I suppose if I were honest I would have to say that I enjoy working in this area and I feel quite competent. By nature when I start something I give it one hundred percent. Technology is an area that demands dedication above and beyond. I suppose what keeps me going is the sense of pride I have in what we have achieved as a school. I love learning new skills in technology, and it is very exciting to be at the cutting edge. I think it is important for the health of our school (GVint02).

A distinguishing quality of the *Key Driver* was 'passion', as referred to by teachers at the three sites, (GVint09; GVint04; HTint05; HTint04; WVint03; WVint07, WVint10). Being a passionate educator was a quality strongly admired and respected by teachers. As a High Tops teacher reported,

> I think it is important for a technology initiative to work that there is a *Key Driver* and ideally a skilled support team. Technology needs a passionate driver, someone who believes in the benefits of technology and has the commitment and enthusiasm to keep the process on track. I think passion is the key. A staff is usually understanding of mistakes or shortcomings if the person involved is doing things for the right reason with the best interests of the school at heart (HTint05).

A new staff member at High Tops, reflecting on what had been learnt during the year, referred directly to the importance of passion in relation to the successful implementation and management of a technology initiative, suggesting:

> What I have learned from being here this year is simple. For an initiative like our Internet project to work there must be someone who has the vision, the knowledge and above all a passion for learning. Most importantly that person must be willing to share the knowledge, infect others with passion and empower others to take leadership. Our driver does that so well, she is a fantastic communicator and always

> makes me feel valued and makes time to help. I don't think our achievements would have been possible without our driver (HTint06).

While each of the identified *Key Drivers* was viewed as being passionate about the integration and management of educational technology by his/her peers, passion on its own was not enough.

Maintaining Balance

According to the *Key Driver* at High Tops, the effort and commitment required to fulfil the role created an ongoing challenge of maintaining dynamic balance; a balance of personal and professional demands and a balance between idealistic and realistic expectations of achievement in the role of *Key Driver*. This balance required the *Key Driver*, “to keep in perspective, to be passionate yet realistic, to be flexible yet structured and to see success as a journey of small failings, and above all not to take things too personally” (HTint03). The *Key Driver* at Garden Vista reinforced this view and went further to suggest that the *Key Driver* needed to find balance in his/her professional life, “Unfortunately the life span of a *Key Driver* will be significantly reduced if they are unbalanced. It is really easy to get totally wrapped up in work and I know I have to make a conscious effort to empower others and delegate” (GVint02).

In essence, leadership in the schools studied demonstrated a commitment to finding and developing a finely tuned but dynamic balance between the factors of implementation, namely, leadership, resources, the learning environment and relationships. The *Key Driver* was recognised as a significant facilitator within this balance process. While the significance of the *Key Driver* to the successful implementation and management of educational technology within the studied schools was undeniable, research participants were mindful of developing too strong a dependence on their respective *Key Driver*. At the same time, they were also aware of not spreading the knowledge base and leadership base too wide, which could result in losing the passionate commitment that comes from a single driver. The complicated and evolving role being faced by the *Key Driver*, however, place expectations on the *Key Driver* that may well be unsustainable.

Key Driver Pressures

Strong concerns about the expectations and pressure being placed on the *Key Driver* were expressed during an in-depth discussion with the school principal at Garden Vista. Coupled with these concerns, was the emergence of a situational dilemma, as the influence the Key Driver had on the successful implementation and management of educational technology created a role that most teachers would feel incapable of filling. As the principal of Garden Vista described,

> I worry about our *Key Driver.* She puts an enormous amount of effort and time into the role. I know she will regularly give some of her weekend to technology issues at the school, I have tried to encourage her not to do this, but her nature is one of total involvement. I am aware, as we discussed in our interview, of the challenge of replacing her if she decides not to continue in the role. It is not just as easy as, skilling another person to take over. People like her come along once in a blue moon and they are almost impossible to replace. In some quarters she may be viewed as being indispensable. We are extremely fortunate to have her, but the magnitude of commitment and competence she possesses creates future problems. In some ways it would have been better to have a person less competent and slightly less dedicated in the role. This may have enabled a replacement to be found more easily. No one will want to try and fill her shoes. I know that sounds like a catch 22 situation but it is a real paradox that I'm faced with. Technology in schools, by its nature, encourages technology-minded and innovative people to be involved. Unfortunately, these people are not always the best managers or administrators and what happens in their head does not always get passed over to action. We have the best of both worlds, as our driver is an action person and a details person (GVobs Wk2Day3).

While the principal expressed these concerns, teachers were resolute in their belief that in the event of the *Key Driver* moving or taking on a different focus, what had been created would continue. As one teacher clearly stated,

> When the driver has a supportive group with them [sic], and they are able to pass on the skill and knowledge they have, I believe there is a great chance that an initiative will continue, it may well slow for a period but hopefully the enthusiasm and belief system will be in place. If you put the responsibility of that on one person, and they [sic] end up doing everything for everyone else, it puts great stress and pressure on the person and I really believe it will eventually fail (GVint10).

Commenting on the indispensability of a person to drive a technology initiative, the *Key Driver* from Garden Vista suggested that “no one is indispensable; I think there would be other people who would pick up and run with it [technology implementation]. That is one of our big challenges, training people to take over” (GVint02). Therein lays a significant challenge confronting the diffusion of an initiative such as technology, namely, the adoption of processes and practices that encourage ownership and a free flow of information. As one High Tops teacher explained,

> The momentum would continue because we have created this year a shared knowledge and commitment to the integration of technology. Our driver has created a framework that does not rely on her skills or her knowledge, but relies on information sharing and support networks (HTint07).

Exploring this point further, a High Tops teacher concluded discussions by suggesting that the "*Key Driver* must empower and skill others to eventually take over. The continued success of a technology program depends on sharing knowledge and skill. Ownership of knowledge cannot stay with one person. The life of the system depends on it" (HTint05).

While the importance of the *Key Driver* to the implementation and management of educational technology was seen as being intrinsic to success, and was strongly reinforced at the three sites, the implications for each school in respect to replacing the *Key Driver* and continuing the technology initiative were substantial. As one Garden Vista teacher suggested,

> One of the things that have concerned me for many years with technology is the transferring of information, or I suppose the better word is knowledge. I have heard of school initiatives in technology and other things collapse when the key person leaves. I know here we have tried to empower staff to become active learners, where knowledge is freely passed on. But at the end of the day someone has to be responsible for it (GVint03).

This point was taken a step further by a Western View teacher who saw the transferring of knowledge to new staff as the school's greatest challenge suggesting:

> The most important thing that I have learnt since working here is not the level of resources that a school has, but the knowledge the teachers have gained. One of the biggest challenges at Western View is the transferring of knowledge to new staff (WVint15).

It became obvious during interviews and discussions that the replacement of the *Key Driver* was a topic that had been given serious thought and discussion. One Garden Vista teacher said, "we have been talking about that [replacement of the *Key Driver*] in staff and we realise that we have to keep educating someone else who can take over and run with the initiative" (GVint09). The difficulty in replacing the *Key Driver*, according to a Garden Vista teacher, was the unrealistic expectations of the role, "Where do you find a replacement that will give their [sic] weekends and evenings to work on technology? They are huge shoes to fill. Given the current levels of support provided to the *Key Driver*, I wouldn't do it in million years" (GVint08).

Strong concerns were also expressed for the *Key Driver* in respect of personal stress. It was acknowledged, during interviews at each school, that the *Key Driver* usually had a passion and enthusiasm for technology (GVint04, WVint03, HTint05, HTint7, HTint08, WVint10). This passion and commitment to the integration and management of educational technology placed great expectations on the *Key Driver* to "keep the process on track" (HTint05).

The point was made, however, that schools do not have a good record in looking after *Key Driver*s and this consequently had contributed to an accelerated rate of burn-out, as a High Tops teacher described:

> Unfortunately, in teaching, when someone shows competence, initiative and, in particular commitment, they tend to get milked. You know they start giving up a lot of their own time working on the project or initiative. Normally this person tends to become more skilled and knowledgeable in this area, and from my experience this person becomes indispensable and extremely valued in the school. Unfortunately, this indispensability does not transfer into release time. The person can quite easily become disillusioned and drop the project cold causing all sorts of problems. I have seen that happen again and again with sport and other new programs (HTint02).

When pursuing this issue of reliance on a *Key Driver*, teachers were quick to point out that, "everyone can be replaced" (GVint11) and "things would continue because we have created a shared knowledge and commitment to the integration of technology" (HTint01). A belief was expressed by a Garden Vista teacher that the established structures would provide a foundation for consolidation, "What we have going here would not fall apart" (GVint11). This point was further expanded upon by another Garden Vista teacher who expressed confidence in the established structures, suggesting a slow down and consolidation with the initiative. "It would not stop because I think she [*Key Driver*] has had an enough of an input on others and put things [processes and structures] in place that our technology initiative would proceed, a little slower, but it would continue" (GVint06).

Impact of the Key Driver

The loss of a *Key Driver* would invariably result in an increased amount of pressure and expectation being placed on the technology team. As one Garden Vista teacher suggested, "the technology team would need a lot of support and technical help, because they would be inheriting, for a time, the *Key Driver* role" (GVint05). The bottom line, according to a Western View teacher, was the development of a critical mass of support for the implementation and management of a technology initiative, with the teacher suggesting that "the belief in the benefits of what has happened with technology here have created a critical mass of support for technology at Western View. That's what will keep things going if we lose our *Key Driver*" (WVint13). The importance of the development of a critical mass was also taken up during another Western View interview when a teacher expressed great confidence in the critical mass pulling teachers along during a transition time, "I believe that we have the critical mass to support, and the enthusiasm present in the school that would enable, and demand, that what was happening, would continue to happen" (WVint05).

A school's ability to implement and manage educational technology will be judged against its ability to respond to change and, in particular, changes to key personnel. While a number of teachers expressed concerns over who the replacement would be, and the possible difficulties that could be encountered if the driver was new to the school, it was felt that the established structures and learning culture would provide direction. As the principal from High Tops stated, "We have created a framework that does not rely on our *Key Driver*'s skills and knowledge, but relies on information sharing" (HTint01). At Western View, this issue created a unique challenge, as the *Key Driver* was the principal. As reported in staff comments during interviews:

> If the principal left, that would worry me a lot. Technology requires a lot of money, and progress here with technology would depend on who replaced our principal. Our principal has demonstrated an extremely high level of expertise and commitment to technology, and a crystal clear vision of where the school was going. While our boss is not indispensable, I wouldn't want to try and walk in her footsteps. I really think finding a replacement for her would create trouble, because, unless we have someone appointed here with a high level of enthusiasm, technical competence and a willingness to be innovative, the process will slow considerably (WVint03).

And

> The technology initiative will not stop completely because we have a strong group of teachers who would want to continue with technology, but what really concerns me is getting the right person to run this school. As the instructional and cultural leader of Western View, the Principal is vital to the continuation of the work that has been started. Even if we were able to recruit an appropriate *Key Driver*, the principal would be the deciding factor on whether the initiative was to be viable and probably in effect, successful (WVint07).

The replacement of the principal could have significant implications for the continued progress of a technology initiative. A teacher from Western View stated, "I believe processes are in place in the school to enable the technology initiative to continue. The level of progress would be strongly dependent on the new principal's leadership" (WVint04). In the event that key personnel changes take place in the school, the principal at High Tops advocates the need to take decisive steps such as, “rethinking the traditional recruitment practices and organisational structures” (HTobs Wk2Day3). Such a rethinking, argues the principal “would require the operation of the team and committee processes” (HTobs Wk2Day3) with these processes vital to the smooth transition of new staff” (HTobs Wk2Day3).

In essence, such a transition will require administrative support, as Sandholts *et al.*, (1997) suggest that technology should become a priority, thereby reducing such problems as insufficient time for continued learning, limited access to technology, and lack of technical support.

CONCLUSION

Leadership emerged as a significant implementation factor closely linked to the ultimate success of a school-based technology initiative. Leadership with the implementation and management of educational technology across the three schools was considered most effective when it was shared. Leadership-sharing also appeared to be closely linked to participatory decision making involving representative groups. This was particularly the case when the group was used to plan strategically and present recommendations to the larger group.

A central feature of leadership at the three schools was the concomitant relationship that existed between leadership and the level of support evidenced in the work environment of each school. Leadership-sharing and a supportive work environment appeared to work as catalysts for each other in the studied schools. This was particularly noticeable, in that the more support offered among colleagues in the workplace, the more possible leadership-sharing was. The proactive sharing of leadership among staff created more opportunities and need for collegial support. This collegial support was enhanced as learning partnerships were formed and teamwork strategies utilised.

Within any school-based technology initiative the leadership demonstrated by the school principal was vital to the level of success achieved, with the principal considered a significant change agent in the integration and management of educational technology. The findings of this study support the earlier findings of the literature review that the role of the principal is key to the successful implementation of educational technology (Costello, 1997; Hoffman, 1996; OTA, 1995; Retallick, 1999; Sandholtz *et al*. 1997; Schiller, 1998). The leadership role of principal was reported to have the strongest impact on the ultimate success of a school based technology initiative when the principal was knowledgeable about technology, technically competent in utilising technology and actively supportive of technology implementation within the school. While these expectations were considered essential for future principals, the demands of such expectations were placing increasing pressure on the primary school principal.

Within each of the research sites the *Key Driver* emerged as a significant leadership factor, exerting considerable influence on the level of success achieved with the implementation and management of educational technology. The *Key Driver* was viewed within the studied schools as being highly skilled in utilising technology within the classroom, while also being enthusiastic and passionate about the potential of technology to enhance learning within the school. The biggest challenge facing these schools in relation to this particular issue was the future replacement of the *Key Driver*. It was acknowledged that the maintenance of a supportive school environment would be crucial to overcoming future challenges in replacing the *Key Driver*.

The findings of this study show that the ability of leadership within a school to nurture and promote a supportive learning environment is essential for the ongoing success of a school-based technology initiative. In such a supportive learning environment, leadership is actively shared, team work practised, and individuals respected as valued team members. The presence of these factors strongly correlates with the ability of an organisation to successfully implement and manage educational technology in the primary school.

CHAPTER SIX

LEARNING ENVIRONMENT FACTORS

This chapter discusses learning environment factors and their place in each of the schools which were the subject of this research. Specifically, the discussion focuses on the learning and pedagogy required to enable successful integration into the life of the school. An analysis of the data indicated that the learning environment factors were directly referenced to 94 per cent of documents with 970 text units retrieved in a QSR NUDIST search. (See Figures 14 and 15). The dominant themes to emerge from the data were related to 'educational change', 'technology planning', 'educational challenges', 'pedagogy' and 'learning' Theses themes are explored in detail in this chapter.

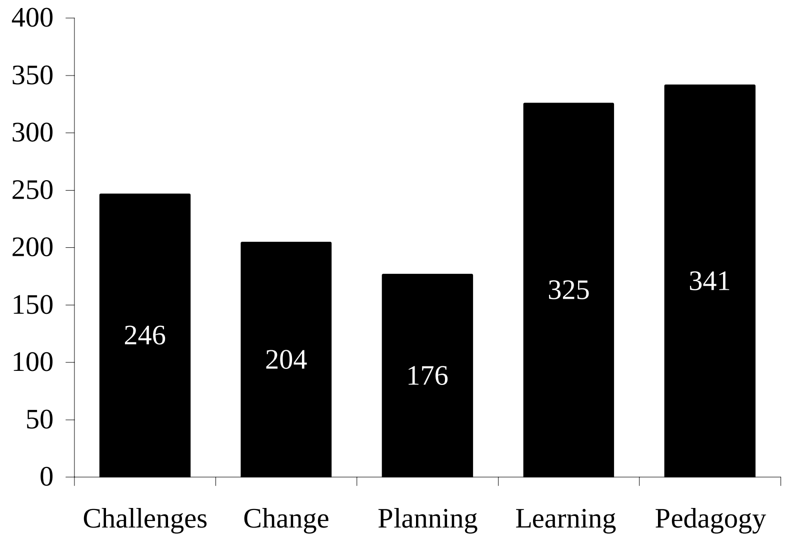


Figure 14

Number of text units referenced to the learning environment sub-themes

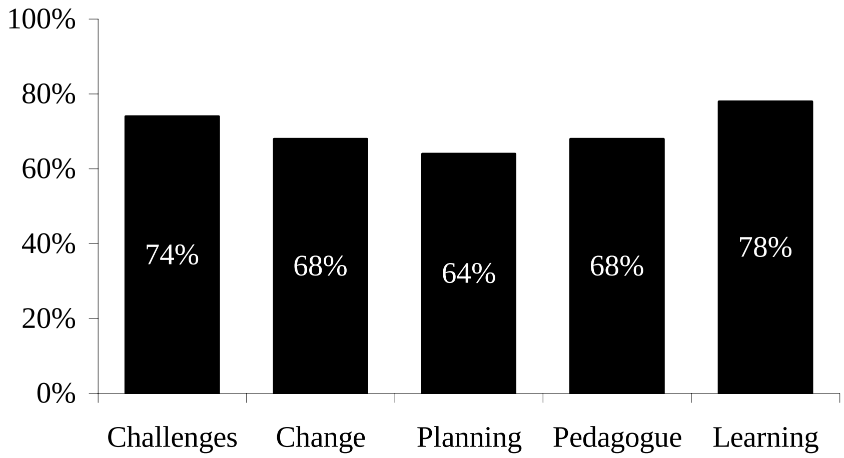


Figure 15

Percentage of documents referenced to the learning environment sub-themes

EDUCATIONAL CHANGE

Implementation and management of an educational technology initiative were considered by teachers at the three schools involved in the research project as a significant educational change. This was most evident in the way such change impacted the mindset and behaviour of teachers, and their subsequent use and utilisation of educational technology. Educational change relating to the implementation and management of educational technology emerged as a significant theme with 204 text units and 68 per cent of documents referenced in a QSR NUD*IST search. This is consistent with earlier findings within the relationships chapter. The significance of such change was reinforced at High Tops, a school that had developed a strong reputation for innovation in the integration of technology. A classroom teacher remarked that a change in mindset was the most essential component in successful integration of technology into the classroom. It was also suggested by this teacher, that those teachers who were experiencing success in integrating technology had embraced this change:

> I suppose one of the real challenges here is the change in mindset. The teachers, like our co-ordinator, [who] appear to be at the cutting-edge of classroom practice and seem willing to run with things. The thing that really impresses me is that people like her (school co-ordinator) can see possibilities in the biggest failures. That is a really positive way to embrace a major change. I think we have developed a bit of a risk-taking learning environment. Through a lot of support and growing levels of confidence, our staff now seems fairly keen, not only to try new ideas, but to adapt them to suit their needs. I know that's what has happened with the project experience (HTint06).

The organisational imperative, according to a High Tops teacher, was to build a foundation that would be flexible enough to embrace the educational changes of the future:

> In ten years from now, God knows what the classroom will be like. One thing is for sure - it will certainly be very different from today. I think new classrooms will be designed and built differently. Classes may be surrounded by a common space, maybe even a number of classrooms joined without walls.
>
> The classrooms will reflect the learning that should be going on to enable students develop the skills, strategies and understanding required for the future. There would be no front with a blackboard, very portable furniture that could be easily arranged into different collaborative group settings. The central feature of this new-age classroom will be a large communication screen, similar to a mini football stadium screen. This screen will be like a giant computer

> screen in the centre of the learning space able to be viewed from either side. Each student and teacher will be connected to the communication centre via their [his or her] mini- personal computer. This communication centre would be able to project their work and divide the screen up into smaller TV like screens.
>
> The teacher in this classroom will not instruct the whole group. They [sic] would be more involved with facilitating and designing learning. Internet would be the most used resource in the school, with the children using it like they do a book today. The class would most probably have a range of students from different classes, and would probably be grouped according to interest or ability instead of chronological age (HTint05).

Given the disappointing and often lethargic response of educationalists (Cuban, 2001; Picciano, 1998; Wilson, 1995) to the demands and expectations of the information age, the view of the future outlined above will require major changes in thinking, even an educational metamorphosis. Education can be regarded as being in a process of metamorphosis with evidence from many parts of the world suggesting that school education is in the process of major change, that "is being moulded by the forces of politics, economics, technology and ecology" (Ellyard, 1998, p. 6). The work of Lewis (2000) reports that studies in Australia (Caldwell *et al.*, 1997; Odden & Odden, 1997), England (Levacic, 1997) and America (Marsh, 1997) indicate a global pattern whereby school educational change will be greatly influenced by the 'information age' (Hough & Paine, 1997) and the 'information revolution' (Caldwell, 1996). Computers and multimedia technology will form a major part of this change process (Dyrli & Kinnaman, 1994a, 1994b, 1994c; Kurshan, 1991; Madian, 1990; Pearlman, 1991; Stinson, 1994).

Given the potential magnitude of such changes, a High Tops teacher put forward a strong case for a practical focus on pedagogy and learning to assist the classroom teacher:

> The biggest challenge in the future classroom will be how the classroom operates, and the role of the teacher. The traditional chalk and talk teacher will be a thing of the past in future classrooms. The teacher will be more involved with designing educational programs that meet the specific needs of individuals. I really think one of the main jobs of the teacher will be diagnosing and communicating, not delivering information. A teacher in the future classroom will not be saying, "take out your text books and copy down page 32." They might be saying, "log onto one of these web sites and try solve this problem, or design a multi-media presentation that explains this concept" (HTint07).

For such a change to become a reality in Australian classrooms will require, according to a Garden Vista teacher, an "unprecedented and enormous change in management process" (GVInt06).

Change Management Process

The implementation and management of educational technology in the primary school were consistently reported by the teachers involved at the three schools under study as a major change-management process. Knapp and Glenn (1996) agree that "bringing about technological changes will not be easy. Schools are complex organisations" (p. 13). Such complexity will require patience and commitment by teachers and administrators as technology is implemented into the life of the school. The Net Gains Report (2000) stated that "authors have found that good integration of technology in the classroom is a slow process, to which the key is the teacher's commitment, proficiency in using the technology itself and good teaching" (Hayes *et al*. 2000, p. 31). This view had also been expressed in a range of research works (ETS, 1999; Gerber, Semmel & Semmel, 1989; Hadley & Sheingold, 1993; Kromhout & Butzin, 1993; Means, 1994; Means & Olson, 1994; Swetman & Baird, 1998; Tavalin & Gibson, 2000; Thomas *et al.,* 1998; Tobin & Dawson, 1992; Yelland, 1999). One Western View teacher put these views into a school context by suggesting that the move into technology was "huge, it involved so many areas and beliefs. It could never be done in isolation. To have any chance of success the implementation must be systematically planned and be an integral part of the learning system at the school" (WVInt04).

Given the magnitude of such change, a number of writers conclude that an increase in the professional demands being placed on the classroom teacher will inevitably occur (Maslach & Leiter 1999; Nias 1999; Schwarzer & Greenglass 1999). Such demands will generate, according to Nias (1999), increased apprehension and stress among many teachers.

Teacher Apprehension and Stress

In this study, the looming prospect of technological change created a deepening sense of apprehension as teachers struggled with the prospect of coping with the current speed of technological change in society. At High Tops, this was articulated by a teacher who stated, "My biggest fear is that we are going to wake up one day and be told we (teaching profession) are so far behind that we have to dramatically change straight away, and enforced change will be thrust upon us. It will become ‘sink or swim’, that is pretty scary” (HTint09). While this was an individual point of view, Roblyer, Edwards and Havriluk (1997) agree that the current position in many schools would reflect these sentiments in that, “everything has changed so quickly, in fact, in education and in society at large; that it is often difficult to determine just what is happening and what response is required of us. We teachers stand before technology as we would a mirror. What we see is determined largely by what we are and what we consider important” (p. 2).

Education, it would seem, is on the precipice of major change, as a Western View teacher explained, “education has to embrace technology and change the way things are done. Society is moving at a rate that may well make traditional teaching irrelevant” (GVint02). The slow progress of technology management and implementation within education, has given rise to issues of ‘rhetoric versus reality’ of technology adoption in schools. This was explained by a Western View teacher, “the time to put the rhetoric about the promises of education technology into reality has well and truly arrived. If serious efforts aren’t made now to achieve this rhetoric reality, it may be too late” (WVint04).

The implications of the rhetoric versus reality of technology implementation were further magnified through the realisation that education, as a whole, is rapidly falling behind and failing to provide the level of technology implementation deemed appropriate by society and is placing an increasing amount of pressure on schools. D'Ignazio (as cited in Wellburn 1991) points out, "businesses have been building electronic highways while education has been creating an electronic dirt road. And sometimes on a dirt road, it's just as easy to get out and walk." (p. 3) Wellburn takes this point further, suggesting that “education has not turned to technology to the same degree as has the business community” (p. 3). This point was reinforced by a Garden Vista teacher who saw the adoption of technology into primary schools generally as being very slow and piecemeal:

> The take up of technology in primary schools has been very slow. This is especially the case when the rate of technological change in business and society generally are considered. Education seems to apply a bandaid approach responding reactively to problems instead of responding pre-emptively and strategically (GVint03).

Evidence of the ineffective use of technology in schools was clearly visible, according to Schiller (1998), who argues that a visit to classrooms and principals’ offices shows that information technology has not yet been integrated into the daily learning activities of schools. The reality in most schools is that computers and other forms of communication technology often remain isolated from the mainstream of learning experience because of teacher apprehension and even phobia about uses of computers in the classroom (Harris, 1999; Russell & Bradley, 1997; Schiller, 1998). Such a situation, argues Meredyth *et. al.* (1999). has resulted in proportionately more students than teachers acquiring advanced computing skills.

Another factor to be considered in relation to the computing skill level of teachers is the availability of computing resources for teachers. While technology resourcing levels have increased significantly in recent years in schools, many teachers, according to Lee (1999), have insufficient computer resources available to them. This fact was seen as a contributing factor in the development rate of teacher skills in using technology, as a Garden Vista teacher explained; "It is really hard to become skilled in using a computer if you don't have a computer at home, and it's nearly impossible to get skilled if you don't have ready access to a computer at school" (GVInt11). This point is emphasised by Lee (1999) who suggested that:

> Ideally, all teachers need their own portable computer that they can readily have with them 365 days a year, 24 hours a day. They need to be able to take that computer to class, to meetings and most importantly, home. They need to be able to move their 'office' with them (p. 38).

The importance of teaching staff having access to technological-based equipment was clearly indicated in a RAND study conducted by Glennan (1998), which indicated that unless the equipment was available to staff immediately after a workshop, so that they could practise and use it for operational reasons within a short time of being trained, the training effort would be wasted. With this in mind, it comes as no surprise to find a High Tops teacher expressing serious concerns about the protracted way education had responded to technological change and the subsequent development of ineffective practices and personnel:

> I sometimes think that the schools are so slow to embrace new things that by the time we do they're almost out of date, and given the speed of change in our society, I think education has really missed the boat with technology. I think schools are faced with a huge challenge, and unless they make significant changes in the way they do things I don't think we will be able to embrace the changes that we need to. I think it's all about moving people out of their comfort zone; it's about taking some hard decisions and then charting a course to do something about that.
>
> I really think there is a lot of dead wood in our education system, and I suppose it is like every system, just like industry, we need to rationalise

> and become more efficient. In industry, this is often called downsizing. In education I don't have the appropriate words, maybe its up-knowledging or becoming organisationally smart, but in a sense, that is what we have to do, we have to become smarter, better able to do what we do (HTint11).

Aspects of these views expressed by the High Tops teacher were reflected in the findings of the Department of Employment, Education, Training and Youth Affairs report, "Digital Rhetorics, Literacies and Technologies in Education (1997)," which concluded that developments in the integration of information and communication technology in schools had virtually stalled, not because of difficulties in accessing sufficient and powerful equipment, but because teachers, in the main, were unconvinced that its use held educational value for students. The authors maintained that the provision of equipment, and a continuous stream of training, were proving problematic, but teacher cynicism still formed a significant barrier to increased utilisation. (Bigum *et al.*, 1997). Although some teachers in the United States have realised the potential of technology, the US Congress Office of Technology Assessment (1995) reported that there "are many teachers who have not seen this potential, teachers whose use of technology is marginal, limited and unenthusiastic" (p. 8). The implication of this, and more recent findings (See Cuban, 1998; Kirkpatrick & Cuban, 1998, Sinko and Lehtinen, 1999) confirm the scale of the challenge facing schools as educational technology is integrated into the learning environment.

Challenges of Change

The enormity of technological change presents a number of complicated challenges for teachers, especially because most have not been properly prepared and the technology has been forced upon them. A Garden Vista teacher declared,

> I think a lot of people were frightened, and are still frightened of technology. I believe the department has to take some responsibility for this. They put the cart before the horse with technology. If you want your staff to be familiar with, and use technology, then you have to educate them, you have to train them. The staff has to develop a realisation of the importance of technology. The technology, in many instances, has been forced upon teachers without the proper training. I think the department took the easy and, what they saw, cost-effective way out. This is not dissimilar to what has happened in other areas. I can remember a number of years ago being handed a brand new literacy scheme and being told to lift the literacy levels of the school. Needless to say that approach was less than effective (GVint09).

The past experiences of some teachers in this study with technology, while limited, were also scarred with memories of poor implementation and management. A Garden Vista teacher explained, “My earliest technology training involved a weekend read of the hardware manual, which resulted in my classroom computer staying unpacked for a term” (GVint04). Another Garden Vista teacher found the first experience of a classroom computer to be stressful and a hindrance to class learning, “I didn’t know how to use a computer; I had no idea how to integrate it into the class lessons. All the kids wanted to do was play games. To be honest, I couldn’t wait to get rid of it” (GVint09). In a follow-up discussion, the teacher revealed that this initial experience had a significant impact on her attitude towards technology; in particular the reluctance to try and be innovative. Following this initial experience, a period of resistance was experienced with the teacher admitting that “it was only through the support and encouragement of my fellow teachers that I was able to give technology another shot” (GVobs Week1Day2).

It appears that positive attitudes toward computers links with teachers' experiences and familiarity in using and utilising technology. As teachers more readily use and utilise technology, Loyd and Gressard (1986) argue that anxiety and fear are reduced. This point was reinforced by Lillard (1985) who claimed that knowledge of the technology being used has a positive impact on teacher attitudes toward technology. At High Tops the findings supported this view with one teacher maintaining:

> Knowing what type of technology is being used is the first step in becoming confident. Having opportunities to become knowledgeable about the technology, through training and the support of other teachers is the second and most important step helping a teacher to become confident which will lead to the development of a more positive attitude towards technology (HTint11).

It has been proposed by Loyd and Gressard (1986) and Summers (1990) that one of the most common reasons for teachers' negative attitudes toward technology is their lack of knowledge and experience in this area. A natural consequence of this lack of experience and knowledge can be seen, according to a Western View teacher, in “unused technology resources” (WVint13).

Many stories were told by teachers in this study of computers sitting unpacked in locked cupboards or in the back of classrooms where they were rarely turned on because teachers did not know how to use them. This has been supported in the more recent work of Fatemi (1999) and a number of earlier studies conducted throughout the 1990’s, (Becker, 1994; Goodson, 1991; Northrup & Little, 1996; U.S. Congress, 1995).

A situation has developed in schools whereby hardware and software have been acquired at an escalating rate, with many teachers not able to use these resources effectively. A survey conducted by Technology Counts (1999) revealed that after almost two decades of new technologies into schools, teachers still do not feel prepared to integrate this technology into their curriculum in rich and meaningful ways. One Garden Vista teacher surmised that this situation occurs because "it [technology implementation] was done *ad hoc*" (GVint02). This teacher went on to suggest that, "with more careful planning and a clear purpose things would have been different" (GVInt02).

THE NEED FOR PLANNING

One of the major impedients to the integration of technology into schools, according to Picciano (1998), is the lack of careful planning. Planning was identified in this study as an important factor in the management and implementation of educational technology in the learning environment with 176 text and 62 per cent of documents being referenced in a QSR NUD*IST search. Given the difficult and often complicated nature of educational technology integration within schools, classroom teachers are often reluctant and unprepared to integrate technology into their classroom. As one Garden Vista teacher suggested, "the reality for many teachers is that they don't put enough time and energy into planning to use technology in their classroom (GVint11). The reason for this, argues Picciano, is that it has become too difficult, "The difficulty of implementing technology into the regular classroom was a central reason why teachers were often reluctant to adopt a school-based technology initiative" (p. 192). Teachers in this study consistently expressed concern and uncertainty about the process of technology integration, with teachers describing the process of integration as "something I was never trained for and find very difficult" (GVint07), and "something that must be planned for" (GVint09; WVint03). This point was emphasised in the work of Schiller (1999) who advised that "without thoughtful technology planning, school leaders face the risk of making expensive mistakes and jeopardizing the education possibilities of students" (p. 7). At High Tops, a teacher expressed consternation in respect to the failed attempts at integrating technology into the classroom:

> I've tried really hard to integrate technology into my classroom. I start off full of enthusiasm and things go well for a while. Eventually things break down and issues of classroom management take over and it becomes too difficult and too disruptive to keep things going. So I revert back to a fairly traditional approach. I now realise that a jigsaw

> approach doesn’t work. It’s a lot more complicated and requires a lot of skill and careful planning (HTint08).

At Western View, a teacher stated that, first and foremost, integrating technology into the classroom required “persistence and commitment” (HTint05). At High Tops, a teacher suggested that the integration of technology into the classroom required, “very good organisational skills” (HTint03). Yet another teacher from High Tops believed that “a clear understanding of the pedagogy issues” (HTint01) was vital to successful implementation. At Garden Vista and High Tops primary schools, teachers believed that the integration of technology must be part of “an ongoing learning process” (GVint08, Htint06, HTint02).

Given these perceptions and the inherent difficulties facing classroom teachers as they attempt to integrate educational technology into their classrooms, it comes as no surprise to read that technology initiatives are “poorly implemented.” (Picciano, 1998; p. 192). This, according to a number of teachers in this study can be linked to the perennial problems of “insufficient time” (GVint05, GVint09; WVint04, WVint08) “limited resources” (GVint02, GVint13, GVint15) and structural issues, such as timetables, location of resources and flexible class groupings (GVint02, GVint05, GVint08, GVint09, Htint04, WVint05). While the impact of such contributing factors is acknowledged by teachers in the study, it is suggested by Hannafin, Dalton and Hooper (1987) that the most significant single educational system barrier for an innovation is the system itself. They believe that teachers will teach in the manner in which they themselves were taught unless significant changes in the system itself are effected.

Unfortunately, such change is not a reality for many teachers, a substantial number of whom are confronted with an educational environment that is slow to change. At Western View, this problem was identified by a teacher, while speaking of the difficulty faced integrating technology into the classroom, given time constraints and limited resources. Such restrictions forced the teacher to revert to a traditional teaching style. This was particularly evident when classroom management issues precluded the adoption of a facilitative approach, as the teacher explained,

> Integrating technology into the classroom is a real challenge for me. I find the time restraints placed on today's classrooms to complete the prescribed content in all the KLA's, plus new areas that are thrown at us almost overwhelming. Something has to give, and quite often it is technology. I know in theory it should make the teacher’s job easier, being able to integrate across KLA's, but, in reality, with one computer in a classroom this is nearly impossible. It still is at the stage of

> requiring a large amount of teacher guidance and set up, and given the demands of the rest of the class, chaos can often result. When this happens, I automatically revert back to a very traditional teaching style, where I deliver to the whole group and kids sit in rows and work (WVint09).

Against the backdrop of a traditional teaching style that is heavily teacher centred, Roschelle *et al.,* (2000), report that "the use of technology as an effective learning tool is more likely to take place when embedded in a broader educational reform movement that includes improvements in teacher training, curriculum, student assessment and a school's capacity to change" (p. 77). For this to happen, Picciano (1998) argues that planning is paramount and, in particular, school-based technology planning.

Technology Plans

The development and implementation of a detailed technology plan was an important factor in successful technology-rich schools. The importance of such a technology planning was strongly reinforced in the interview data in this study with a number of teachers speaking of the critical importance of such planning. At Garden Vista, a teacher emphasised the importance of planning over a school year:

> I don't think you can get by without a clear and logical technology plan. You must have a plan; you must know what you're going to do, why you are going to do it, and how you are going to do it. We only plan twelve months ahead. I don't know how you could plan much further ahead than twelve months because things are changing so quickly (GVint04).

At Western View, the importance of the technology plan was compared to a road map, with one teacher suggesting:

> I think it is vitally important for the school to have a technology plan, a written, formal plan is a bit like a road map, in that, it provides direction. I don't think the plan can be set in cement. It has to be flexible enough to change. The plan is really continually developing in much the same way technology is (WVint05).

Another Western View teacher saw the technology plan as the framework for generating a shared story. This became a reference or focal point to reflect and monitor the achievement of goals set for the integration and management of educational technology. This plan also provided valuable context and direction for new staff:

> We are lucky because we have documented our journey and a new person could read our story and easily have a clear understanding of where we came from, what we have done and where we are headed. I think documentation is vitally important to the continuation of any educational initiative. (WVint19).

A recent publication by the Victorian Department of Education (2001) emphasised the importance of school-based technology planning, recommending the development of a school-based technology plan:

> Essential to the implementation and management process is the development of a Learning Technologies Plan and a series of implementation strategies linked to the schools vision, charter, curriculum plan, level of resourcing and range of teacher skills. (Learning Technologies In Victorian Schools 1998 – 2001, p. 17)

The presence of an articulated plan, outlining future directions and links with strategic planning enables a school to be better prepared to embrace change. While the implementation and management of educational technology will be an integral part of future schooling, Roschelle *et. al*. (2000) report that research studies overwhelmingly suggest that "computer-based technology is only one element in what must be a co-ordinated approach to improving curriculum, pedagogy, assessment, teacher development and other aspects of school structure" (p. 78). The school's technology plan is, therefore, an essential component of the school's strategic plan and, as such, technology planning has an intimate relationship with pedagogy and learning. As a Western View teacher explained:

> Developing an understanding in why technology should be integrated into the classroom, and learning how to most effectively do that, is the real challenge for me. There is no one resource, program or approach that will fit all sizes. Whatever a school ultimately decides, it must be well thought out and planned (WVint18).

The how and why referred to by the Western View teacher, served as key focal points for the developing learning environment and are elaborated in the following discussion on pedagogy and learning.

PEDAGOGY

Pedagogy emerged in this research as a significant factor contributing to the development of the learning environment with 341 text units and 68 per cent of documents referenced in QSR NUD*IST search. As outlined earlier, the classroom teacher is confronted with significant challenges in respect to the integration and management of educational technology. According to Darling-Hammond (1997), Lin, (1995), Pea, (1994), and Resnick and Klopfer (1989), modern educational technology is the way to promote the kinds of learning deemed necessary for the twenty-first century.

Current structures and classrooms, however, are often ill suited for these ends. These beliefs were strongly supported by a High Tops teacher who stated that,

> Schools need to look at how they do things. I don't think the old way works any more. The students of the future need different skills than the students of 20 years ago. So, most importantly, schools need to embrace teaching and learning that encourages independence and knowledge creation. The role of the teacher in the future will change dramatically if predictions become reality. The students will require more of a facilitator than an instructor. For some teachers that I have worked with, this will require nothing short of a revolution (HTint03).

A number of writers (See Dwyer, 1994; Goodyer; 1999; Hadley and Sheingold, 1993; Means, 1994; Sherry *et al.*, 1997; Saye, 1997) argue that this revolution will be facilitated through the adoption of constructivist teaching approaches. This point is supported by Schiller (1999) who suggests that the "use of computers in schools for teaching and learning is best served by a constructivist approach to teaching and learning, in which student-active, teacher-facilitated environments, developmentally appropriate acquisition of concepts and skills, and multi-age grouping in non-graded learning families are emphasised" (p. 5).

The adoption of a constructivist approach, argues Cardio-Kaplan (1999), is closely aligned with the types of learning required in the future and has a concomitant relationship with the integration of technology into the classroom:

> Integrating technology to encourage learners to construct, evaluate, manipulate, and present their ideas, while demonstrating understanding of curriculum concepts and innovative constructs, is contingent upon the pedagogy of constructivism (p 15).

The principal of High Tops put forward a strong case for adopting pedagogy appropriate for the information age of the twenty-first century. He emphasised the development of a shared belief in pedagogy among the staff and a thorough grounding in constructivism,

> One of the things that I believe we did well was to focus on pedagogy. But before any computers were placed in classrooms we spent a lot of time developing skills and sharing knowledge. The challenge for the staff was to develop a pedagogy that would be appropriate for the information age. We went through the process of developing a pedagogy that was flexible and could be applied individually, with groups and within cohorts. The staff was keen to collectively pursue a sound philosophy for the future, a philosophy rooted in constructivism (HTint01).

Such pedagogy, argues Hayes *et al.*, (2000), should be based on "the belief that people actively construct knowledge and enter the classroom with specific goals, interests and understandings" (p 31). Technology, then, is seen as a tool that supports teachers in presenting more complex tasks and material to students, in becoming facilitators rather than dispensers of knowledge, and also in motivating students to attempt more difficult tasks. This is supported by Roschelle *et al.*, (2000) who acknowledge that constructive learning can be integrated in classrooms with or without computers, but that the characteristics of computer-based technologies make them a particularly useful tool for this type of learning (p. 79).

Technology as a Tool to Enhance Learning

The seamless use of learning technologies can create, according to Atkin (1998), "a classroom environment where the *status quo* is challenged and where technology acts as a catalyst for shifts in the relationships between teacher and students and the methods of teaching and learning" (p. 12). This concept of technology as a tool, that becomes ubiquitous within the classroom, was identified at Western View, where a class teacher suggested that "classroom technology is best used as a tool and should be seen as nothing more than any other resource" (WVint04). At Garden Vista, the concept of technology as a tool embraced a range of technologies, with a class teacher including the overhead projector and calculator with the computers as technological resources:

> I think what we have moved into, is more facilitative teaching, as opposed to lecturing. In certain areas, students have to know information, and that has to be directly taught. Once they have developed those key skills and gained the required knowledge, they can be given opportunities and learning experiences to develop the wide range of skills needed for the future. That often involves using technology from computers, to calculators, to overhead projectors. Like all valuable tools, they will be used to find information, analyse the information, and to create meaning with that information (GVint10).

The potential of technology being used as a tool to facilitate learning was also strongly emphasised at High Tops, with reference made by a teacher to the medium's ability to provide real-life scenarios:

> Technology should be a resource to enhance learning and thinking, especially problem solving. Our current technology has the ability to provide real-life scenarios and allow children to be active not passive participants. This is particularly the case with the Web Quest concept (HTint01).

Two High Tops teachers talked about experiences with a web-quest program that modelled the practical application of technology in the classroom and, in particular, the power of real-life problem solving scenarios:

> Teacher 1- “I found a fantastic web site on the weekend that can be used in the space unit. It has amazing real-life problem solving activities that my kids will love.”
> Teacher 2 – “What sort of activities are you talking about?”
> Teacher 1 – “Well, there are heaps of really great learning experiences, like the interactive rocket building program. Students have to make decisions about the type of spacecraft they would like to build. There are a number of missions in the program, or the teacher can create a mission. They have a certain amount of money, and they have to make decisions about their craft and then build it. For example, they have to decide whether their craft will be, a standard rocket or a more versatile craft that can explore the surface of planets. The versatile craft is more expensive and slower. Every decision has a cost and consequence. The whole process is really challenging and the kids will absolutely love it. Once the decisions have been made and the rocket built, the designer has to then write a persuasive report convincing superiors that this craft is a good choice for the mission. The program even provides a template for the writing that can be used in Word (HTobs Day4Wk2).

While there was a strong acceptance among teachers that technology should be viewed predominately as an educational tool, a number of teachers were quick to point out that educational tools have limitations and, as such, teachers should be careful not to become too dependent on them. One Garden Vista teacher predicted that “teachers who use technology exclusively, as the only educational tool, run the risk of losing the art of teaching. I could imagine a day when the network crashes and half the teachers in a school are unable to function” (GVint15).

A salient point picked up by a Western View teacher, and sustained in general discussions in this study, reinforced the importance of maintaining a balance of technology with other learning tools, “There has to be a balance with other learning tools you can't just use computer technology” (WVint04). The development of a balanced approach, utilising a range of tools and strategies, can, according to another Western View teacher, encourage a greater independence in learning; “Teachers should not become too dependent on one method or resource, particularly when technology is concerned. In reality they need to develop independence and flexibility” (WVint13).

A teacher at Garden Vista expressed concern about students becoming too dependent on computer technology and, consequently, losing the flexibility to cope in changing situations, “I am really concerned that students will develop a dependency on the computer. Our students have to be given a range of learning experiences using a range of resources. As educators, we must ensure that skills are reinforced to assist our students to approach learning flexibly” (GVint05). Such views strengthened the belief that technology in schools be viewed as a tool that can be used to enhance learning.

As a tool, technology has the potential to improve learning, a point highlighted in a recent DETYA publication ‘Learning in an online world’ (2000). The authors of this publication recognised the need for and articulated a vision of “improving student outcomes through the effective use of information and communication technologies in teaching and learning" (DETYA, 2000, p. 3). It had been argued earlier (Jones *et al.*,, 1995) that effectiveness was not solely a function of the technology, but rather of the learning environment and the capability to do things one could not do otherwise. Such a ‘toolcentric’ view would appear to have a close relationship with the learning environment evident in the school which, in turn, is directly related to the pedagogy adopted. When such a tool was used as part of a constructivist approach a Western View teacher emphasised that the impact was highly positive on teaching and learning:

> There are teachers around who believe technology is not that beneficial; that their classroom practice provides a much better education than one utilising technology. In some respects, for them, they are probably right. They have never been successful in using technology and tend to steer clear of it. For these teachers, unless technology is integrated properly, it won’t realise the benefits these people need to experience. So if it is done in a slap dash haphazard sort of way, they are probably better off sticking to the traditional, tried, and true methods. On the other hand, a classroom where facilitative teaching happens, where small groups are in operation, where students can work independently on a project and where students are encouraged to solve problems and research, has to be better. Students have to learn more in such a learning environment (WVint11).

Educational technology has the potential, and in an increasing number of cases is heavily responsible for, changing the teacher’s role from information giver to a facilitator, guide and mentor (Dyrli & Kinnaman, 1994b; Kurshan, 1991; Lee & Reigeluth, 1994; Office of Technology Assessment, 1989; Pearlman, 1991; Perkins, 1991; See, 1994). This changing role takes a compelling constructivist view of pedagogy, and places the teacher in a more facilitative role, where students are more in control of their educational destiny. As One Garden Vista teacher described, “I don't see as much whole class teaching, I see more individual work happening, where a teacher is more a monitor and guide, a coach, whatever, but still directing the process through skill development” (GVint01). Compared to the more traditional knowledge-centred approaches to teaching, this changing role is considered by a range of writers including Tam (2000) and Brooks and Brooks (1993) to be more facilitative and focused on the needs of the learner.

Facilitative Approach

While the most effective way of integrating technology into the primary classroom was not clear in the literature, a number of strategies consistent with a facilitative approach and conducive to the integration of technology into the primary classroom were identified in the data. Most significant were peer tutoring and group work. For many teachers, one of the most effective ways to improve the utilisation of educational technology in the classroom was through group work (Newhouse, 2000). This point was corroborated by a Garden Vista teacher, who explained that group work resulted in a differentiated curriculum for students where students were not always doing the same thing at the same time:

> It all depends on how you organise your classroom and structure learning in your room. I have always worked with groups, so children are not doing the same thing at the same time. I always organise a timetable for computer use so that children won't miss out. There is always peer tutoring going on. These strategies are great, but if I'm not organised and well planned it won't work. Some teachers think integrating technology means less planning and work for the teacher. I have found that not to be the case at all. Once children are used to working in groups, being involved in peer tutoring, working on independent and small group projects they don't want to stop. They find traditional teaching boring. The class teacher has to differentiate the curriculum further and this requires careful planning (GVint06).

Utilising the skills and expertise of students and staff to build the knowledge base within a supportive school environment can be extremely valuable in the process of differentiating the curriculum. This point was emphasised in the work of Sinclair (1998) who pointed out that "this kind of knowledge building is particularly effective in a context where learners are actively engaged in constructing something in a social context to which they can attach personal meaning" (p. 1). Within the schools studied in this research, the adoption of peer tutoring emerged as a significant strategy that promoted the successful implementation and management of educational technology.

Peer Tutoring

According to a High Tops teacher, the effectiveness of peer tutoring was reflected in the number of learners who took on the role of peer tutors following a positive learning experience:

> I am a firm believer in the benefits of peer tutoring. When used properly, it has a flow on, or value added effect, which can strongly influence the learning culture of a school. I have witnessed teachers

> who have been the recipients of peer tutoring from a colleague, who are now tutoring new staff. The empowering process appeared to be an incidental consequence of peer tutoring, is now part of what naturally happens here (HTint02).

Again, at Garden Vista, the positive aspects of peer tutoring were expressed by a teacher who stated,

> Sometimes we will get down to the computer room and something will go wrong. I am very fortunate to have a couple of computer experts as students in class, these kids are fantastic, and particularly the ones that have computers at home and they can generally solve the problems we face. If one of my students can't do this or that, one of the student experts will teach them. These children know a lot more than I do, so I use their expertise. The interesting thing that I have noticed is the impact that peer tutoring has on the tutors. From a social, academic and self esteem perspective I have observed positive changes (GVint09).

This empowering effect was further reinforced by a Western View teacher who acknowledged that students learn effectively from other students, resulting often in an empowerment of the learner. Further to this, the teacher also believed that when such a strategy was adopted benefits to self-esteem were possible:

> The strategy I like to use is peer tutoring. This really helps children interact and learn from others operating at different levels. I find it effective. Children often learn quickest from their peers when one student shows another student how to do something in a friendly non-threatening environment. I have seen it work with great success. It really gives students a self-esteem lift when they can help another classmate with their learning (WVint05).

An extension of peer tutoring was explained by a Garden Vista teacher, who reported that she adopted peer tutoring as a form of behaviour modification for a student that exhibited challenging classroom behaviour. The peer-tutoring strategy, in this instance, was reported to be very effective:

> I had a very difficult child who was extremely interested in computers. Because he was very intelligent I was able to use him as a computer expert. This worked very effectively because it made him feel good about himself. This strategy works very well because sometimes the more able children can be the ones that cause the most problems. I have used those children as the peer tutors (GVint06).

The adoption of teaching strategies, such as peer tutoring, supported the seamless use of learning technologies, and appeared to go hand-in-hand with a constructivist philosophy. This interdependent relationship was explained by a Western View teacher:

> I don’t know how you could possibly integrate technology into a classroom without using strategies like peer tutoring and group work. To make technology invisible or seamless requires a differentiation of the curriculum and the creation of small instructional groups. To

> effectively use technology within the classroom requires the adoption of small learning groups where peer tutoring is the norm" (WVint07).

The implementation of a strategy, such as peer tutoring, requires the realisation that an ill-informed view or misunderstanding of the strategy may exist among parents and other members of the school community. As one newly appointed Western View teacher explained,

> One of the great strategies I've picked up from University and from my colleagues here, is peer tutoring, using students to teach other students. I know that some teachers and parents might have problems because they feel a child will maybe miss out, because they're spending their time teaching other students. I actually feel the opposite. I find it's a great way for kids to build up their confidence and skills, because their self- esteem goes through the roof when they realise they are helping someone else learn, and their skills are being validated by the teacher. The challenge I face is to convince those people that don't understand that peer-tutoring is an extremely valuable and effective teaching strategy (WVint11).

The utilisation of strategies that promote a facilitative learning environment, where knowledge is created through collaboration, argues Atkin (1998), will challenge the *status quo* with the "implementation of constructivist strategies acting as the catalyst for shifts in the relationships between teacher and student, and the methods of teaching and learning" (p. 12). In such a learning environment, Brock (cited in Spender & Stewart, 2002) sees students as wonderful learning resources being:

> incredibly bright, and if you give them the tools, they just take off with them. They teach us things. Technology is helping us to move from being fountains of information and knowledge to being collaborative workers with students. We are becoming learners around learners. (p. 34)

This point was raised during a Garden Vista staffroom discussion, "It blows me away to see how smart these kids are with technology. They naturally work in collaborative groups, there are no problems, and they tend to teach me. I learn something new from them everyday" (GVobs Week2Day3). The ability of students and teachers to work effectively in collaborative groups was considered most desirable and a significant factor influencing the successful implementation and management of educational technology.

Collaborative Group Work

Close links appear to exist between peer tutoring and the adoption of group work strategies. A Garden Vista teacher explained this as:

> Technology being used effectively when it is part of group work. When you have groups running in class, you naturally have much smaller

> instructional cohorts. At these times, technology can be introduced to small groups of students. These students can then be introduced to the task that will involve some link with a KLA. The students are then given a collaborative, paired or small group task to complete. They work in these small groups, with peer tutoring naturally occurring. In fact, I see it as the preferred way, students working in small groups (GVint04).

A growing body of research on collaborative or cooperative learning has demonstrated the benefits of children working with other children in collective learning efforts (Johnson *et al.*, 1981; Rysavy & Sales, 1991; Strommen, 1999). A High Tops teacher argued this point further suggesting that, “the benefits of children working collaboratively in small groups were blatantly obvious. These students produced work of a higher quality; they were much happier and more enthusiastic” (HTint11). When children collaborate, they share the process of constructing their ideas, instead of simply labouring individually. The advantages of this collective effort are that children are able to reflect on and elaborate, not just their own ideas but those of their peers as well. A High Tops teacher saw this occurring in her classroom, reflecting that,

> Sometimes I think my students listen more closely to their peers in their groups than they do to me. It is fascinating to observe the group discussions that take place. Once students feel comfortable in their group they generally are willing to express their opinion, and to listen to others. I’m not sure if it is the size of the group, or the sense of belonging they have, but they certainly are more willing to actively participate in their group, than in the whole class (HTint04).

A Western View teacher referred to a positive side effect of collaborative groups, namely, the reduction in the aggressive competition evident in the classroom, “they [students in the class] are starting to view their peers not as competitors but as resources” (WVobs Wk2Day2). Another Western View teacher confirmed this finding claiming that group work enhanced the development of more meaningful working relationships between students because they “have to listen more closely to each other, and have to actively and verbally participate more regularly” (WVint14). The personal and intimate nature of collaborative groups led a Garden Vista teacher to conclude that students prefer the non-threatening, accepting environment of a collaborative group, where,

> Students know if they do something wrong, or they don't know how to do something; generally speaking, they feel comfortable enough to ask for help. Because they are working in a small group, I believe they don't feel as threatened as they often do in a large group setting. This creates fewer problems down the track (GVint02).

Such a learning environment, stated a High Tops teacher, “will be the expected classroom structure in the future” (HTint07). This view was also supported by a Western View teacher who envisaged that the classroom of the future would be one where:

> Small groups were obvious, with students having opportunities to work on independent and small group projects, where students regularly researched to solve problems, not the same problems as everyone else but more individualised. I firmly believe that better learning takes place in this type of classroom. You can't create that sort of learning environment in a traditional classroom (WVint11).

While such a learning environment is focused on improving student learning, there appear to be subsidiary benefits resulting from the integration of educational technology into a facilitative learning environment. Most importantly, teacher enthusiasm for the additional instructional benefits of technology resulted in the provision of a wider range of resources to the classroom, the motivation of learners, provision of new teaching tools and the accommodation of individual learning styles (Dyrli & Kinnaman, 1994a; Office of Technology Assessment, 1995). Such benefits, argue Barron and Orwig (1993), include “multisensory delivery, increased self-expression and active learning, cooperative learning, communication skills, multicultural education, and student motivation” (p. 3).

These benefits are very difficult to measure, particularly using traditional instruments and methods, resulting in the “development of a wide range of learning outcomes that are either not easily accounted for, or are ignored by traditional assessment instruments” (Cuttance & Nicholson, 2000, p. 2). They also suggest that “traditional basic skills tests were not designed to show the value-added dimension that educational technology represents” (p. 2). Consequently, the flow-on effect of technology and the support of learning may not be fully realised for some time. As one High Tops teacher explained,

> I see the benefits of technology in subtle and difficult to assess ways. Like collaboration and peer tutoring, or creative problem solving, they may not jump out in the results of the next test but they certainly provide learning experiences that may help the student make more positive contributions in the changing world they face (HTint09).

During observations conducted in the Garden Vista library, a concrete example of the potential value-added effect of a facilitative approach was demonstrated. Students in the session were paired on the bank of library computers, with the librarian explaining the session task and outcomes. Observing the students, it was clear that they were familiar with this independent structure. Partners worked co-operatively and there was little evidence of time wastage. One of the groups confronted a problem accessing a web-site and, after gaining the librarian's attention, the following interaction took place:

> Student – “We can't get this web site to open. Something must be wrong with the network.”
> Librarian – “Okay let’s think what the problem could be?
> Are other groups having trouble getting access?”
> Student – “No”
> Librarian – “What does that mean?”
> Student – “Their computers are working and ours isn't.”
> Librarian – “What does that mean about the Internet and the network?”
> Student – “They are both working.”
> Librarian – “Good, now let’s rule out those two possibilities. What else stops you getting access?”
> Student – “I don't know.”
> Librarian – “Well, imagine you were sending a letter and it didn't arrive at its destination, and you knew the postman hadn't lost it, and it had a stamp. What else could have happened?”
> Student – “It could have gone to the wrong address.”
> Librarian – “Well done!
> How could it go to the wrong address?”
> Student – “The postman could have made a mistake.”
> Librarian –“Yes, anything else?”
> Student – “The letter had the wrong address.”
> Librarian – “That's just like your site, we have ruled out other possibilities so we now need to look very carefully at the address. Let’s check it again.”
> Student – “Oh! Sorry we missed a forward slash.” (GVobs Wk2 day3).

This interaction, while appearing quite natural, showed the learning approach being adopted, namely a facilitative approach. As Roschelle *et al.,*, (2000) have indicated, “children learn best by actively constructing knowledge from a combination of experience, interpretation and structured interactions with peers and teachers” (2000, p. 79). This point is also reinforced in the works of Bransford, Brown, and Cocking (1999) and Greeno, Collins and Resnick (1996). Such a facilitative approach is reflected in the ensuing discussion with the librarian at Garden Vista, where a clear message was given by the school librarian about the learning approach adopted:

> For me it is all about guiding learning as opposed to dictating the learning students use. No two students learn exactly the same (way), we all have preferred learning styles and I see my role to offer a range of learning opportunities and experiences that encourage independence, creativity and critical thinking. My job is to design learning experiences that encourage this, and to facilitate meaning for my students. Not in a million years will this happen through aimless chalk and talk. I don’t have all the answers, and never will have; I make this very clear to my students. I have experience, enthusiasm, and a willingness to utilise whatever resources and tools I can to make learning meaningful. Technology is the greatest educational tool to do

> this, and one that must become transparent in our school (GVobs Week2Day3).

Continuing discussions with a teacher at High Tops primary school further reinforced the importance of a facilitative approach, where students had control over their own learning. This was strongly borne out in her involvement in a school-based collaborative project, in which the experience was viewed as a teaching revelation that had a positive and lasting effect on teaching practice:

> I must admit, since being involved in the collaborative project I have viewed the integration of technology differently. I have always tried to integrate technology into the class through a class roster and programs linked to Key Learning Areas. It was always a bit hit and miss. We used to get a real spurt and overdose on technology and then leave it alone for a while. I was never very happy with what I was doing; I really needed a structure to apply to the classroom. When our new technology co-ordinator began introducing us to the collaborative project model I began to see how effective this model could be in my classroom. As the staff began to learn more during the collaborative project it became very clear to a couple of us that the adoption of a facilitative approach was the most effective way to utilise technology in our own classroom. Having a broad focus linked to a theme or unit, having a time frame and having publishing and presentation goals were key.
>
> It is really important that kids know their learning is valued. When it is put in a book, or on a piece of paper or even in a folder for very few to see, I think it sends a message that this work isn't valued enough to go on display. When the students know that their work will be used with others, as part of a group project for display on the school home page or to parents using the data projector, it instantly raises expectation and personal ownership (HTint06).

This project clearly demonstrated for a number of High Tops teachers that educational technology can act as a catalyst in the provision of learning environments where constructivist principles are promoted and facilitative teaching strategies are practised. Not only can educational technology "support how children learn, computer-based technology can also improve what children learn by providing exposure to ideas and experiences that would be inaccessible for most children any other way" (Roschelle *et al.*, 2000, p. 84). Modern technology has the potential to open new, previously unimaginable doors to learning. The potential synergy of modern technology, coupled with a supportive and collegial work environment, can provide the opportunity to create real pedagogical change. The realisation of this potential will only be sustainable when, according to a High Tops teacher, "a supportive school environment exists" (HTint02)

Supportive Climate

For teachers to use educational technology in a constructivist manner, they must have opportunities to develop pedagogical knowledge in a supportive climate (Dexter, Anderson & Becker, 1999; Parr, 1999). Consistent with earlier findings, the support, and in particular the creation and maintenance of a supportive learning environment are crucial. As a High Tops teacher stated,

> We have been pretty successful with our project, and the integration of technology. While we have been fortunate to have a very skilled leader and good facilities, more importantly though, is the fact that we all get on so well. There is a great supportive working environment here, and that is the main reason we are, where we are. People are always willing and keen to help (HTint07).

It has been noted that, in general, individualised support from peers and experts encourages teachers to experiment with new strategies for technology integration (NCREL, 1999; Hanby, 2000). Further evidence of this became apparent at High Tops, when a class teacher explained that, "the supportive environment at High Tops was dependent on the sharing of knowledge, skills and time. While the vast majority of support was provided by staff, there were times when support from outside experts was needed" (HTint 09).

The fundamental importance of developing supportive working relationships was further stressed by another High Tops teacher who linked the ultimate success of a technology initiative with the quality of the professional relationships that existed among staff:

> When there is a professional, supportive work environment, as you find here, the job of integrating technology is much more possible. When using technology becomes part of the culture of a school, as it is becoming here, it loses the bells and whistles, and it becomes a tool, a resource that can be used to make teaching and learning easier (HTint09).

While the creation and maintenance of a supportive environment focused on learning appeared to be strongly evident in the technology rich schools under study, there were significant factors that influenced the adoption of technology within schools. As one Garden Vista teacher viewed the situation:

> We have been pretty successful here, with what has happened with technology, but we are only part way there. The work environment here has enabled the changes to happen. To move to the next stage will require a lot more courage and commitment. I really don't know whether everyone is totally convinced that technology and the changes to the way we teach is the only way ahead (GVint15).

Doubts surrounding the potential benefits of technology, and the subsequent changes to pedagogy identified by the previously cited Garden Vista teacher were echoed in literature relating to the adoption of technology (Dede & Loftin, 1994; Mandinach & Cline, 1998; Ponder & Holmes, 1998). Such doubts may explain in part the limited levels of technology adoption in schools that has generally taken place and reinforce the significance of a supportive school environment to the integration and management of technology. Furthermore, discussions linked to the adoption of educational technology also recognise the need for caution and consideration in striking a balance between current practices and new innovations.

Adoption of Educational Technology

While there is much written about the promise of current technology, there has been limited technological adoption in schools. This is reinforced in the work of (Cuban, 1986, 1988, 1993, 1998; Cuban & Kirkpatrick, 1998; Hawkins, 1996; Means & Olsen, 1995; OTA, 1995; PCAST, 1997). It has been pointed out by Watson (1998) that globally there is no hard evidence to show that the ubiquitous use of learning technologies in education lives up to the claims made for them, suggesting:

> The U.K. has a higher ratio of computers per schoolchild than almost any other country, including the US. Yet despite this lead, and the fact that information technology has been on the educational agenda for almost 30 years, it is not clear that IT has made a significant impact on educational standards (Watson, 1998, as cited in Marshall & Ruohonen, p. 189).

Reasons for the poor level of integration are numerous, with The President's Committee of Advisors on Science and Technology (1997) suggesting that the insufficient funds being spent on professional development were contributing significantly, while Colburn (2000) and Hanby (2000) cite a lack of success in integrating technology on deficits and gaps in expertise and support. Further to these reasons a number of teachers expressed concerns and doubts about the adoption of teaching approaches aligned with constructivism, as they were far from convinced that they were effective. One Garden Vista teacher expressed grave concerns over the current trend of casting aspersions on traditional teaching methods:

> I am a very structured, and I suppose a traditional teacher. I have been teaching for a long time very successfully, and I have seen fads come and go. Unfortunately, over the last few years I have seen a worrying trend developing, where traditional teaching is being challenged and viewed as inferior to facilitative teaching. I sometimes feel that if I'm not running ability groups, interest groups and a differentiated

> curriculum that I'm not a good teacher. To be quite honest, I am not convinced that these methods [facilitative methods] are more effective and produce better results. Let alone, has anyone been able to show, or really demonstrate measurable improvements in learning outcomes through the integration of technology (GVint14).

Another Garden Vista teacher echoed similar sentiments, underlining the importance of educational basics:

> I like a highly structured classroom. I suppose the other would be group work sort of thing, where students work at their own pace on contracts and the workstation. In that situation you would have to get to the computer in some part of the day to do your work. It is not the way I have ever worked and it would take a complete overhaul for me to work in that way. I don't know whether I would feel confident about where everyone was up to, and I would be fearful that students would miss out on important instructional time while they were using the computer. I don't know, or haven't been convinced that the other way is better, or more effective.
>
> Children need building blocks, things like tables are important. For a while there, we were going a little bit airy-fairy. They must know their tables. They have to be learnt off by heart by the children. I think we have to go back to a lot of those sorts of things, because you have to have your basics built in. I can see, possibly in high schools things changing. I can't see primary school being terribly much different in the future to the way they are now. I see us going back to a more basic type of education. When they [students] get to high school or university they will have the basics to build on, then they can go on with the high-flying computer technology (GVint05).

At Western View further concern was echoed over the perceived move away from instructional work with a teacher expressing grave concerns for the students at Western View who were in desperate need of instructional teaching:

> To be quite honest, I worry about the view in society that the future teacher will be more a facilitator than a teacher. There seems to be an emphasis away from instructional work, to collaborative and group work. This seems to be a real paradox considering the Department's strategic plan within literacy to move back to basics. The kids here desperately need instructional work. I hope that the classroom of the future will have a strong emphasis on good old-fashioned instructional teaching while utilising digital technologies. (WVint07).

While there isn't conclusive proof that constructivism is the most effective pedagogy for students of the twenty-first century, Roschelle *et al*. (2000), suggest:

> that as scientists have understood more about the fundamental characteristics of learning, they have realised that the structure and resources of traditional classrooms often provide quite poor support for learning, whereas technology – when used effectively – can enable

> ways of teaching that are much better matched to how children learn (2000 p. 79).

While academics debate issues relating to the level of technology adoption in schools and the subsequent effect technology has on student learning, data from this study confirmed the significance of technology to the developing learning environment of each school. How technology will be most effectively integrated into the learning environment of each school appears to be through the adoption of constructivist strategies, in particular, peer-tutoring and group work. While constructivist strategies were strongly evident at each site, research participants were quick to caution against dispensing with the traditional art of teaching. The overriding danger of enforcing a new pedagogy onto an experienced teaching profession was, according to a Garden Vista teacher, creating a situation where “the baby may well be thrown out with the bath water” (GVint05). The strong message emerging from the data was the need to strike a balance. Such a balance, it is argued in the study, will be achieved most effectively through the promotion of a supportive learning environment. The nature of this learning in the twenty-first century generated considerable interest and discussion and emerged as a most influential factor of the learning environment.

LEARNING

As was the case with pedagogy, learning emerged as a significant theme with 325 text units and 78 per cent of documents referenced in a QSR NUD*IST search. Central to any discussion on the successful implementation and management of educational technology is recognition of the fundamental importance of learning. In particular, an understanding of learning in the twenty-first century and the implication this learning has for learners involved in the implementation and management of educational technology. From the industrial logic, the purpose of formal education was to differentiate between those who could learn and those who could not learn in a particular way and in a particular time frame. Under a post-industrial logic, the purpose of learning has changed dramatically, with the central focus on maximising learning for all students. In order to do this, it has been strongly advocated in literature that a change in the mindset and assumptions about learning is required (See Mehan, Villanueva, Hubbard & Linz, 1996; Picciano, 1998; Sandholtz *et al.*, Ringstaff, & Dwyer, 1997; Sizer, 1992; Thornburg, 1999). This point was emphasised by a High Tops teacher who saw learning as a process of personal growth:

> Learning used to have connotations of pass marks and mandated courses that teachers had to do. Today, however, that is changing. Learning is more about the individual needs of the learner. The most fundamental change for me is seeing learning now as an opportunity for growth as opposed to something that had to be done, or a hoop I had to jump through (HTint04).

With learning no longer encapsulated by time, place, and age, Schlager *et al.,* (1998) argue that learning has become a pervasive activity and attitude that continues throughout life and is supported by all segments of society. This point of view is extended further by Spender and Stewart (2002) who point to the pervasive nature of learning, suggesting that the "classroom is just one node of a complex learning environment" (2002, p. 36). This point was also emphasised at Garden Vista, with a teacher acknowledging the changing nature of learning:

> Learning today is anywhere, anyplace and anytime. It is definitely not the exclusive domain of the school. In fact I believe it could be argued that the school is no longer the dominant learning force (GVint09).

The ability to learn anywhere and at anytime has implications for the way students learn. In this respect, Spender and Stewart (2002) suggest that, "learning will become increasingly 'student-centred' with project-based learning being absolutely central to this shift, as it is precisely this type of learning that allows students to be in charge" (p. 86). No longer can knowledge ownership be the sole domain of the teacher. In reality, knowledge has come to be regarded as a key asset of the employee and the student, and their ability to readily acquire, use, and create with it is becoming an emerging core competency of the twenty-first century. This point was brought to the fore at Garden Vista, when the Assistant Principal suggested that:

> Learning is no longer the responsibility of the teacher. The days are well and truly gone when the teacher is the fountain of knowledge. The reality today is that we are co-learners. I can learn from other staff and students. There is no one way to learn or one direction to learn in. The most important thing is that learning continues. For that to happen there can be no ownership of knowledge by staff. Information and knowledge must be freely exchanged. That will be the way forward in the future if we want to keep learning (GVint09).

From an organisational point of view, creating and sharing new knowledge are crucial for innovation processes (Nonaka & Takeuchi, 1995; Ayas, 1996) with employees becoming more and more responsible for their own learning in order to ensure their employability (Filipczak, 1995; MOCW, 1998). Organisations now expect employees to be flexible and adaptable at work. Writers such as Smith, (1998ab), Simons and Zuylen, (1995), and Onstenk, (1997) strongly advocate employees learning continuously to perform new and changing tasks, in particular, learning how to learn efficiently. As such, it is argued that teaching is no longer defined as the transfer of information, while learning is no longer defined as the retention of facts. Rather, teachers challenge students to achieve deeper levels of understanding and guide students in the collaborative construction and application of knowledge in the context of real world problems, situations, and tasks. This point was strongly emphasised by a Garden Vista teacher:

> What is meant by learning today, as opposed to when I was at school, has changed significantly. Learning, for me, was normally linked to being able to remember, most of my learning was by rote. I prepared for the HSC by learning off by heart a range of commonly answered questions. As it turned out one of the questions I prepared and learnt in geography changed slightly from what I expected, consequently I was unable to adapt my answer. I hadn't developed the flexibility in my learning to adapt. As a teacher, I am acutely aware of facilitating learning that enhances flexibility that constructs knowledge into meaning, and is practical in the real world context (GVint12).

Learning, it is has been argued (Lepani, 1997), is as an ongoing and lifelong pursuit, taking place anytime, anyplace and any way. For schools this challenges the traditional way learning had been undertaken and presents the basis of a new learning environment. To quote a Garden Vista teacher:

> The concept of learning has dramatically changed in recent times. Learning is no longer the domain of schools and teachers. Learning is no longer solely linked to students at school or university. Learning is ongoing and lifelong. The students in my class are on the early part of a learning journey. For schools and more particularly, teachers, this has enormous implications (GVint15).

A New Learning Environment

It has becoming increasingly obvious that educating students is no longer the sole responsibility of teachers and that the participation and collaboration of parents, business people, scientists, seniors, and students across age groups are vitally important to the current concept of education (Schank, 1997). At High Tops the benefits of community collaboration were evident when a teacher spoke of the local businesses partnership program, "the involvement of local businesses in an education program at High Tops has been extremely successful, surpassing all expectations" (HTint06). While such levels of community involvement are significant in the development of future learning environments, a Western View teacher argued that school was only one of a number of significant domains that influence student learning:

> School is only one of a number of domains that provide education for students. It is becoming more apparent to me everyday that the

entertainment domain, in particular, has enormous educative power for students" (WVint15).

With this development in mind, Spender and Stewart (2002) caution educators to, "stop thinking of the classroom as the only learning space" (p. 36). Educators are increasingly being challenged to consider and embrace the proposition of new learning environments that hold strong connections to constructivist pedagogy. Learning environments that are ideally student-centred, multisensory, collaborative, inquiry based and focused on a real world context. These learning environments are significantly different from the traditional teacher-centred learning environment. The "National Educational Technology Standards for Students" report (1998) highlighted this point through the comparison of the traditional learning environment and the new learning environment.

Traditional Learning Environments	**New Learning Environments**
Teacher-centred instruction	Student-centred learning
Single sense stimulation	Multisensory stimulation
Single path progression	Multipath progression
Single media	Multimedia
Isolated work	Collaborative work
Information delivery	Information exchange
Passive learning	Active/exploratory/inquiry-based learning
Factual, knowledge-based	Critical thinking and informed decision making
Reactive response	Proactive/planned action
Isolated, artificial context	Authentic, real-world context

Table 2

National Educational Technology Standards for Students report (1998)

The implications of such a learning model, with its emphasis on a new learning environment, place an increasing level of expectation and performance on the teacher. A Garden Vista teacher supporting the move to a more student-centred facilitated learning environment, expressed grave concerns for teachers, forecasting the development of "a huge gap between the teachers that can [work in the new learning environment] and the teachers that can't (Gvint09). The result of such a gap, according to this teacher, will be "educational inequity, with students being disadvantaged by the placement in traditional learning environments" (Gvint09).

Conversely, at High Tops, teachers were excited at the prospect of the new learning environment becoming a reality, with one teacher suggesting that "The way education will need to change in the future, to provide the environment necessary for learning to take place, is really exciting. I can't wait. We are still really in no-man's-land, between the traditional learning and new learning" (HTint09). While the majority of teachers in the study saw the potential benefits of such a learning environment as desirable, a Garden Vista teacher, who had expressed grave concern for the teaching profession, voiced a strong word of caution:

> If we are not careful, we could throw the baby out with the bath water, through the implementation of new practices and approaches, at the expense of the old. To be quite honest, I'm not convinced the newer ways will be more successful than the old. I haven't seen enough evidence. There hasn't been enough study. There has been plenty of rhetoric, but no substance. I am really fearful that our more experienced, older teachers will be in a short time, ear-marked as education dinosaurs, as irrelevant. That would be a tragedy and would have enormous implications to the passing on of the craft of teaching (Gvint14).

While there is a danger of disenfranchising the established skill base of the traditional classroom practitioner, a High Tops teacher argued forcibly that the need for change is much greater than the need to appease:

> We can't wait anymore. We must change the way we work. Our students will be disadvantaged if we don't bite the bullet and meet the information age. That may mean the older more traditional teachers not being able to continue. That is the price that must be paid" (HTint06).

The integration of educational technology into the classroom, like any educational change, will provide schools with enormous challenges and exciting potential. As one Western View teacher stated, "integrating technology is a bit like a double edged sword, with one side being the benefits technology holds for education as a whole, while the other side reflects the great struggle many teachers will face, coming to terms with the integration of technology" (WVint19).

A vital ingredient for implementing such change, improvement and innovation in education, argues Picciano (1998), is a knowledgeable staff. Research has consistently supported this concept (Fullan & Pomfret, 1977; Huberman & Miles, 1984; Joyce, 1990; Joyce & Showers, 1988; Joyce *et al.*, 1989; Pink, 1989; Sheingold & Hadley, 1990). This point was emphasised by a Garden Vista teacher who reinforced the importance of staff being knowledgeable about a school-based technology initiative:

> Implementing a school-based technology initiative, as we have done here, required a level of understanding by the staff. To own the decision and to be able to support the technology initiative, the staff had to be knowledgeable. The way we became knowledgeable was by learning with and from each other. (GVint03)

Furthermore, Gibbs (2000) argues that that schools that can identify and use technology to teach the skills to learners to interpret the mass of information available will provide better learning opportunities that will prepare the learner for life and a future of change. The utilisation of technology to interpret information was considered by a Western Tops teacher as an essential skill for the future learner, “learning in the future will be closely linked to learner’s skill in accessing and analysing information. The most effective tool to do this will be information and communication technology” (WTint13).

Spender and Stewart (2002), argue that the future will require a vision that upholds the importance of learning:

> Inherent in this vision are several key realisations, that we are working to prepare a new kind of student, that we are using brand new tools, for a life that we cannot clearly see, anticipate or describe today; that embedded in these challenges are fantastic opportunities; (Warlick, 2001, as cited in Spender & Stewart)

Recent studies have also revealed that technology offers exceptional opportunities to provide students with more choice and control of their learning, while concomitantly developing higher self-esteem. This finding was reflected in the work of Gregoire *et al.*, (1996) who found that,

> New technologies manage to develop students' interest in learning activities, at least for the time being, and to lead them to devote more time and attention to these activities than in regular classes. Moreover, it is not surprising that they also increase their confidence in their abilities. In turn, this confidence of the students in themselves undoubtedly explains, in part, their spontaneously receptive attitude that a large number of them adopt toward an activity in which technology plays a role and the perseverance that they show in accomplishing this activity. Of course a high level of motivation generally facilitates learning; but it is especially important in situations like the new technologically based learning environments where students are more active in directing their own learning. (p. 33)

The emergence of a new learning environment focused on student-centred inquiry-based learning that is collaborative and facilitative, where real-world context and multisensory experiences are utilised appears to be developing growing support among academics and many practitioners. The findings of this study support the need for such a learning environment, and reinforce the significance of technology as a tool to support this learning environment. While new technologies can be linked to renewed levels of interest and enthusiasm and the promotion of positive attitudes to learning for students, the sustainability and effectiveness of new technologies in this new learning environment can be closely aligned with what the teacher does or does not do (Crowther, 2002).

Teacher as Leading Learner

The teacher is vital to the success, or otherwise, of the adoption and diffusion of new learning environments into the classroom. This point was enthusiastically reinforced by a Garden Vista teacher who argued that “the integration of technology into the classroom by the class teacher is first and foremost dependent on what the teacher does” (GVint 11). Collis *et al.*, (1996) also argues a similar point of view holding that “the teacher is the key figure in the eventual success or lack of success of any computer-in-education initiative” (p21). According to a High Tops teacher this success will not happen if “the teachers aren’t properly trained and supported” (HTint10). Such training, argues Woodrow (1992) needs to be focused on technology as an instructional tool, as well as a professional tool. A Western View teacher differentiated between these types of training and emphasised the integration of technology in the classroom as the greatest challenge facing teachers:

> Teachers need training in the productive benefits of technology [in making them more efficient in their work] and the classroom learning benefits [integrating technology into classroom learning for students]. The most difficult, and the area most neglected in teacher training is the integration into the classroom (WVint16)

Findings from this study indicated that many teachers were unsure how to integrate technology successfully into the classroom, with teachers expressing a lack of knowledge in the use of practical classroom strategies. In one instance, a teacher from Garden Vista explained the difficulty many teachers faced coming from a traditional teacher training background:

> Many teachers won’t be able to cope in this type of learning environment. They haven’t been trained for it. When I did my teacher training, like many thousands of other teachers, it was a very traditional training. We became dependent on the blackboard and straight rows of desks (GVint02).

This point was emphasised by another Garden Vista teacher who saw growing challenges facing the older teachers, particularly when compared with the newly graduated, technically-skilled teachers coming out of university:

> New teachers joining the teaching ranks are naturally more skilled at using technology. They have, in many cases grown up using technology; it is second nature to them. This certainly doesn’t mean they are better teachers, but it does put increasing pressure on older teachers to get on the technology train” (GVint10).

Newly graduated teachers from Western View and High Tops were familiar with and competent in using technology but expressed trepidation about how to integrate technology into the classroom in practice:

> During my training I was never involved in learning that showed me how to integrate technology into the classroom. We did theory and research. I knew how to use a word processor, email and the Internet, but I was never taught how to practically integrate technology into the classroom (WVint12).

And

> When I arrived at High Tops I think the expectation was that as a new graduate, I would know how to integrate technology into the classroom, or have new and innovative ideas. I must have been a big disappointment, because the only way I have been able to integrate technology to the level I do today is by learning from the more experienced teachers here (HTint10).

Exploring this area further, a newly graduated Western View teacher revealed the expectations being placed on her by established staff to possess a high level of technical competence, particularly in respect of integrating technology into the classroom. There was a connection being made between newly graduated teachers and technology competence, and, as this teacher outlined, this should not be taken for granted:

> When I first started here [Western View] the assumption was that I was skilled in using technology. While I had used a computer to type assignments, my skill level was pretty hopeless compared to other teachers here [Western View]. My education in the use of technology came predominately from fellow teachers, at lunchtime and after school (WVint17).

Similar findings were outlined in the work of Fatemi (1999) who found that the integration of technology into the classroom was not directly linked to the age of the teacher. "Teachers who have been in the classroom five years or fewer are no more likely to use technology than those who have been teaching for more than twenty years" (p. 5). This finding was reflected in a common concern expressed by newly graduated teachers in this study for ongoing education of teachers in relation to the implementation and management of educational technology.

Teacher Education

The recurring theme of teacher education was referred to, frequently, by teachers in this study: "the success of our technology initiative has in no small part been built on the education of our teachers" (HTint07). During an interview at Garden Vista, a teacher went to great lengths to explain the importance of ongoing staff education through regular meetings:

> Our education or, I suppose I should say our learning, is a lot about what the staff here believes in, and value. We might be old, and I say that with great respect, but we have been ready to embrace change. It didn't matter what change it was that came along we have always been prepared to look at it, learn about it and then make an informed judgement. If we thought it was worthwhile, then we went with that wholeheartedly. In the ten years that I have been here we have had a staff meeting almost every week where we looked at some sort of educational change, or development. From an ongoing educational perspective, these gatherings have been invaluable and have really helped me accept the fact, that change is part of our educational life. If you want to be at the forefront of education and provide the best for the children, I believe you have to be open and ready to embrace learning, no matter how old you are. The culture of learning just continues, it is something that is here (GVint10).

In the literature, teacher education was regularly put forward as a key element to the success of a school-based technology initiative (Burkholder, 1995; Kearsley & Lynch, 1994; Shermis, 1990; Stoddart & Niederhauser, 1993).

Intrinsic to the adoption of the newly emerging learning environment is the integration of educational technology, in particular the use of classroom computers. This point was reinforced by a Western View teacher, who believed that "to utilise the computer technology that exists here [at Western View], we have to make the most of any learning opportunity that is available. That quite often is as simple as a five minute informal demonstration at lunchtime" (WVint18). Utilising available opportunities for learning with technology was strongly emphasised by Roschelle *et al.,* (2000) who argued that the effective use of computers in the classroom required an increase in opportunities for teachers to learn how to use the technology.

One effect of such learning opportunities is a natural flow-on of teacher confidence in using educational technology in the classroom. A teacher from Western View said that "with all the support that is offered here to become confident in using technology, it makes it a lot easier to use technology in the classroom" (WVint14). The work of Bransford *et al.,* (1996) cites numerous literature surveys that recognised this link and established a further connection between the learning support offered to teachers and student technology achievement. Within this study the development of technology skills seemed to have a strong relationship to the presence of a positive attitude towards learning.

Positive Attitude to Learning

At High Tops having a positive attitude was described by a teacher as:

> The most important thing for our school. We are really lucky here, because we have a great staff and they seem to be positive about any worthwhile program or innovation. The attitude has to be there, we could have one hundred computers online and not have a positive attitude and we would be unsuccessful (GVint04).

In developing computing skills for using technology in the classroom Hignite and Echternacht (1992) argue that a positive attitude was critical to the integration of technology into the classroom. Changing learning attitudes according to a Garden Vista teacher is related to the level of confidence a teacher feels in using technology.

> Initially going back to when I arrived in 1994 I would say there was a resistance to computers in the school and they were not being used effectively. I guess, it is the more you use it, the more confident you become and more likely you are to use it in the classroom. I think most people have embraced the idea of using computers more and more. The incorporation of the computer room I believe was very important in creating the atmosphere and increasing our level of confidence. I think there is a special culture that exists in the school. I can see growth in the way the staff come together and work together more and help each other (GVint12).

According to a Western View teacher, “The increasing level of confidence a classroom teacher experiences with technology the more likely they are to change their attitude to learning” (WVint02). This point is also supported by the work of Marcinkiewicz, (1993/1994) who advocates that changing teachers' learning attitudes will be a key factor in fostering computer integration.

This level of confidence can be strongly influenced by personal experience in using and utilising technology. This point emerged in the earlier work of Gressard and Loyd (1985) who maintained that the potential usefulness of computers has a significant correlation with the development of attitudes toward computers. Unfortunately, according to a number of teachers in this study, negative experiences, particularly in relation to failing equipment, had significantly reduced confidence levels. This was clearly pointed out during observations in the school library at Garden Vista where a frustrated class teacher confronted the librarian with a technical problem that was causing frustration and annoyance.

> Class teacher: "This bloody computer has done it again, all my work, the children's projects are gone. They were there yesterday before we had problems with the network, and now they have disappeared. It is no wonder teachers are slow to use computers when things like this happen."
>
> Librarian: "Okay, let's try and work out what happened. You did save the work onto the server?"
>
> Teacher: "Of course I did, I have been doing it for months."
>
> Librarian: "Do you remember where you saved your work?"
>
> Teacher: "Just forget it, I'm sick of these bloody computers. They are a waste of time." [Teacher stormed out of the library] (GVobs Wk2Day3)

When discussing this situation with the librarian, a number of important issues were raised. Firstly, the librarian was concerned that the frustration experienced by the class teacher could significantly influence his future willingness to integrate technology into his classroom. Conversely, the librarian explained that the outburst did demonstrate a certain amount of familiarity with technical skills and basic operations. She explained,

> Obviously I'd prefer not to have outbursts like that, but there are a couple of positives to emerge. The teacher in question was a non- user [of technology] 12 months ago. The teacher has had students working on projects and class work using technology and the teacher is becoming familiar with the potential of the network (GVobs Wk2Day3).

During the ensuing discussion, the librarian expressed concern over the potential damage that breakdowns and unreliable equipment could have on the attitude of teachers struggling to integrate technology into their classrooms, suggesting:

> A bad experience, a fatal error or network crash can have a major impact on a teacher's attitude. If these problems are happening regularly, technology progress is doomed to fail. It is vitally important that the network and hardware are working and the school has access when needed to quick and skilled outside help (GVobs Wk2Day3).

While positive teacher attitudes toward computers were widely recognised as a necessary condition for effective use of technology in the classroom (Woodrow, 1992), the ability to be flexible and learn from mistakes (Bigum *et al.*, 1997) were directly linked to the sustainability of a positive attitude towards technology. This point was articulated by a High Tops teacher:

> Teachers here seem to be willing to run with things. They are very flexible and adaptable and can see possibilities in the biggest failures. That is a really positive way to embrace a major change, learning from mistakes. At High Tops I think we have developed a bit of a risk taking

> learning environment where we all seem to learn a lot from our mistakes. This is made possible through the level of support that exists here. I think this one of the main reasons why the staff here are keen not only to try new ideas, but adapt them to suit their needs (HTint06).

The positive learning that takes place as a result of mistakes was identified by another High Tops teacher who suggested that some of the most successful learning at High Tops took place from small failures. In fact, the adoption of a 'hold hands and jump' approach to learning had proved highly effective in the development of the school project:

> One of the great qualities of this school is that we are not frightened to get in and make mistakes. We don't expect to get it right first up, in fact, we learn most from the mistakes we make. Often failure is a signpost for success. So it is interesting from our technology work that one of the real successes has come from our failures. We didn't really know how to implement technology successfully. We couldn't find a program that told us what to do. So we decided the best way to implement a school project, and to learn what to do, was to hold hands, and, as the boss says 'jump'. We had to pick up a lot of pieces along the way, but we already had the supportive culture to do that. So we did a lot of just in time learning, and learning from our mistakes, and the end result proved extremely successful (HTint09).

The ability of the schools in the study to keep focused on their respective technology initiatives, was closely aligned to the persistent commitment to improved student learning A High Tops teacher pointed out, "we are a persistent lot here, we don't easily give up if we can see benefits for our students" (Htint11).

The realisation that technology by its very nature is prone to instability and break down precludes the adoption of a languid approach to innovation. As one Western View teacher stated, "one of the key factors of success with a technology initiative is sticking with it and not giving up at the first obstacle. It takes a lot of energy and passion because there are bound to be problems, breakdowns and frustrations, but in many cases an awful lot can be learnt from mistakes" (WVint07).

At Western View, it was also confirmed that the establishment of a positive and supportive environment, where staff felt valued and secure, was central to the maintenance of a dynamic school learning environment. As one teacher explained,

> We have tried really hard to reinforce the belief that success comes from learning about lots of little failures. The only way to make this philosophy work is to create a non-threatening supportive learning environment. I think we have been successful in that. It really is all the informal and impromptu things that happen, that really creates this environment (WVint13).

The development of a positive attitude to the integration and management of educational technology is closely linked to the level of confidence and competence a learner possesses. Findings of this study reinforce the relationship between the positive learning environment within each school and the level of confidence and competence a learner develops in the use and utilisation of technology

CONCLUSION

The earlier discussion clearly demonstrated the important role the learning environment factors play in the implementation and management of educational technology within the primary school. The learning environment emerged as a significant implementation factor closely linked to the ultimate success of a school-based technology initiative. The learning environment within the three schools studied was influenced by change, planning, pedagogy and learning. Each of these factors played a significant role in the formative process of the developing learning environment.

The implementation and management of educational technology was considered to be a significant educational change by the studied schools. This was particularly the case when the increasing expectations being placed on schools by society to create learning environments that integrate twenty-first century learning tools were considered. This technology focused change within the studied schools had a number of far reaching effects with significant implications for the way teachers taught and the way learners learnt.

This study showed that the adoption of constructivist teaching approaches could be effective in promoting a learning environment that was student centred, multi-sensory, collaborative, inquiry based and focused on a real world context. Such an approach could be supported through a range of facilitative strategies, including, peer-tutoring and group work.

The development of twenty-first century learning environments requires a change in the mindset and assumptions about learning. This was reinforced within this study with learning viewed as an ongoing and lifelong process. The findings of this study also challenged the traditional concept of learning and saw learning as not being constrained by time, place or age. The pervasiveness of such learning revealed the learning dominance of the teacher and the classroom being challenged.

A central feature of the learning environments identified in the studied schools was the existence of supportive and collegial relationships among staff. This support provided the basis of the learning environment in each school. Such support was recognised as a catalyst for ongoing learning for teachers with the use and utilisation of technology and the implementation of facilitative teaching strategies.

While the learning environment factors are intrinsic to the implementation and management of educational technology, it would appear that the level of success and the sustainability of that success will be directly related to the interdependent relationship of the key themes identified in the conceptual framework. In the next chapter the resource factors will be explored.

CHAPTER SEVEN

RESOURCES

A review of the data associated with the implementation factor of resources identified in the literature chapter confirmed and supported the complicated and interdependent nature of this factor. As with earlier discussions of relationships, leadership, and the learning environment factors, the interconnectedness of these factors were crucial to the analysis and discussions of data related to this area. Resources were consistently identified as significant by participants with 86 percent of documents and 689 text units retrieved in a QSR NUD*IST search. Of particular significance were the key resource elements of hardware, technical support, internet, time, equity, and training and development. Each of these elements is explored in this chapter.

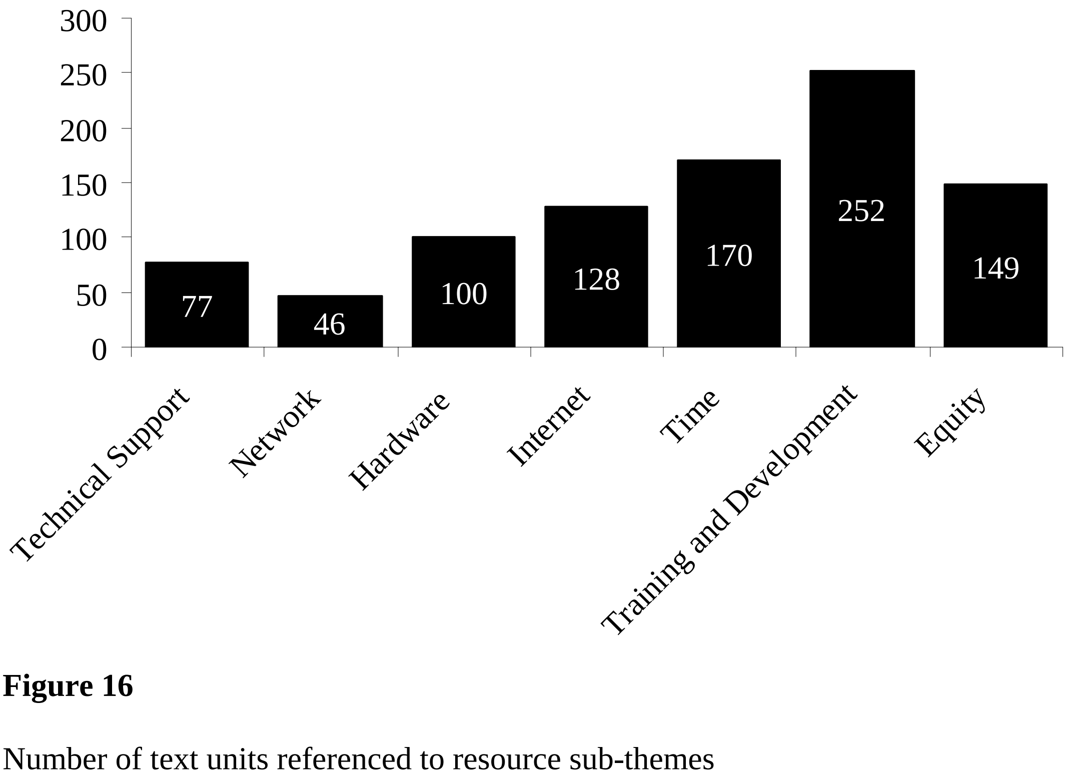


Figure 16

Number of text units referenced to resource sub-themes

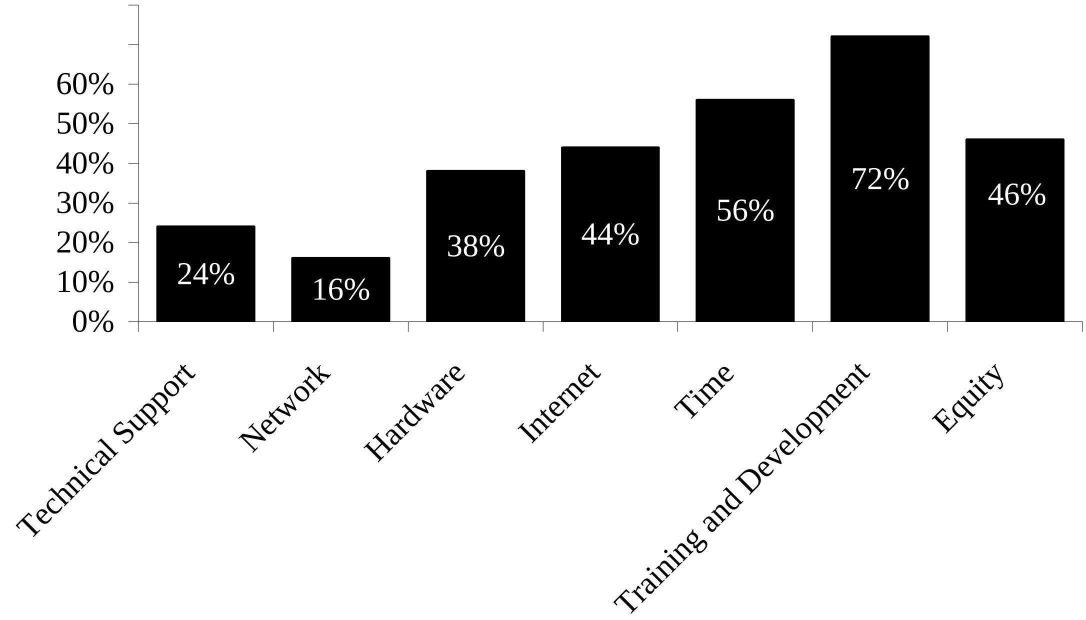


Figure 17

Percentage of documents referenced to resource sub-themes.

HARDWARE

Hardware, and in particular the provision of adequate levels of hardware, was seen as crucial to a technology initiative within a school. One Garden Vista teacher suggested that schools are faced with an uphill battle trying to provide adequate technological resources in a rapidly changing technology market:

> Not too long ago, schools could expect to get a reasonably long life out of the apple 11E or the Amiga computer. I imagine some of these are still working well. Today, that is not the case. We are told to plan for three years maximum before today's top of the line computers reach obsolescence. In a school environment where budgets are always limited, the proposition of turning over all the school computers, let alone increase the ratio of computers to students within three years is almost an impossible task. To have any chance of doing that here would require enormous levels of funding. Unfortunately such funds would probably result in the diversion of resources from other needy areas in the school (GVint01).

Walker (1998), reported that increased access to computers in schools is being brought on by development of ICT skills among children as the fourth 'R', a basic skill, as important as literacy and numeracy. The significance of the development of ICT skills is reflected in the position held by many parents that access to computers correlates with the type of learning required for the twenty-first century (Barlin, 2000). This pressure to provide adequate ICT resources can come, according to a Western View teacher, "at the expense of other school programs" (WVint11).

The challenge of funding the purchase of hardware and other technologies, such as digital cameras, scanners, data projectors and video cameras places increasing pressure on the school to keep up with what is happening in society. As a High Tops teacher pointed out,

> Schools have changed dramatically in recent times. When I was a student schools led the way with technology. Schools were one of the few places that had duplicators, slide projectors, film projectors and computers. Home computers were rare, but in my primary school we had a number of computers. I think the community expected schools to be at the cutting edge of technology. Now, in schools, the reality is quite different. In fact, the situation has almost reversed, with many homes having better technology facilities than schools. School, for many students, is not the place that can provide cutting edge technology that happens at home or in the shopping centre (HTint09).

Findings of a recent survey produced by the National Office for the Information Economy (2002) reinforced the scope of societal pressure being placed on schools to provide high levels of technological resources. The report revealed that Australians are major users of new technology, and this technology is quickly becoming embedded in Australian culture. As stated earlier, Australia is one of the leading countries in the world in terms of Internet infrastructure, penetration and use, ranked third in the world behind the United States and Sweden. According to the Report, Australians are major adopters of ‘Information Economy-enabling Technologies’, such as the Internet, computers and mobile phones, with sixty percent of Australian households owning or leasing a personal computer and fifty-two percent of households being connected to the Internet.

These societal developments have placed increasing pressure on schools to ‘keep up to date’. One great danger is, as a High Tops teacher described, “putting the cart before the horse syndrome” (Htint08). The teacher explained that trends or developments are often pursued by education without sufficient understanding, planning and professional development in place. These findings were supported in the work of Kamil and Intrator (1997) who warn of the dangers faced when technological developments precede educational research:

> It is important to monitor these trends because we are in danger of having rapid hardware and software development overwhelm any input that might come from educational research. The product life cycle of hardware and software is far shorter than the typical timeline for educational research studies (p. 395).

Such rapid technological developments, linked with increased societal expectation to have technology integrated into classroom learning, have created a major resource access challenge. As a Garden Vista teacher explained, “with technology everywhere in society, parents and the broader school community expect similar saturation levels at school. In theory that is great, but in practice it comes down to funding” (GVint11). The level of funding required to resource a school adequately is “astronomical, with many schools unable to provide decent access to technology resources for the teaching staff, let alone the students” (HTint11).

Teacher Access to Computers

Given such high levels of technology adoption within Australia, it is to be expected to find a number of teachers expressing frustration and annoyance at the level of resourcing currently available in schools. One High Tops teacher took this point up at great length during an interview expressing disbelief at the New South Wales Government’s inactivity in providing laptops for teachers:

> The New South Wales Government should provide every teacher in New South Wales with a laptop. If teachers are expected to integrate technology into their professional life they should have access to hardware at school and at home (HTint09).

The importance of teachers having unrestricted access to computers was also strongly reinforced in the work of Lee (1999), who advocated that individual teachers have unlimited access to a portable computer:

> Ideally, all teachers need their 'own' portable computer that they can readily have with them 365 days a year, 24 hours a day. They need to be able to take that computer to class, to meetings and most importantly, home. They need to be able to move their 'office' with them (p. 12).

This point was further supported in the data in this study in the relationship that existed between success with the implementation and management of educational technology and the level of resourcing available. While it was difficult to define an ideal ratio of computers to students, teachers did express support for the goal of creating as low a ratio as possible, with one teacher at High Tops suggesting, “the aim for schools should be one networked computer per student” (HTint05). While participants in the study showed unanimous support for the active reduction in the ratio of computer to students in their respective schools, the reality according to a Garden Vista teacher, centred on making “the most effective use of the technology resources within the school” (GVint14). The most effective use of technology resources led to the recognition of two key options, the computer laboratory and classroom computers.

Computer laboratory and classroom computers

One significant consequence of not having access to sufficient levels of hardware, according to one High Tops teacher, was the ineffective delivery of computing skills, with the teacher suggesting that skills development would be best served through the establishment of a computer laboratory:

> One of the difficulties with technology and using a limited number of computers in the class is instructing to the whole class on a particular skill or practice. I do use the library facility to do this, but I firmly believe that a laboratory with sufficient computers to allow two students to pair share, would allow for much more effective teaching of basic technology skills (HTint03).

Support for the implementation of a computer laboratory was also strongly expressed by a number of teachers, including one Western View teacher who claimed that, “the area most needed is a laboratory facility where we can try and provide a common grounding in skills” (WVint07).

Conversely, another Western View teacher, while acknowledging the benefits of a laboratory facility, preferred that teachers have direct access to computers in the classrooms:

> There has been a lot of talk in the staff room lately about the need to develop a computer laboratory in the school where each class would be allocated a set time each week to work on the school's scope and sequence of technology skills. I think that would be great as long as the computers didn't come from the classrooms. I firmly believe the best way to use and integrate technology is to have computers in the classroom (WVint18).

These sentiments were also strongly supported by a fellow Western View teacher, who suggested that, "integrating technology must focus on the classroom and not the computer laboratory. Students must be encouraged to use technology as a tool, naturally linked to their work, not once a week for an hour in an instructional setting in a laboratory” (WVint14). Studies conducted in the United States report that a growing percentage of school computers are found, not in computer laboratories, as was once the practice, but in classrooms where teachers and students have regular access. Nationally, in the United States, forty-three percent of school computers had been located in computer labs, compared with forty-eight percent in classrooms (Becker, 1998). This trend of increasing computer access within the classroom was evident within the research schools, but wherever possible the increasing level of classroom computers was not at the expense of the library bank or the computer laboratory. This point was illustrated by the Garden vista librarian:

> We have been able to provide more computers in the classroom without losing computers from our lab. This has happened by having a regular computer replacement cycle. As computers in the library and laboratory come off warranty they are replaced with new computers. The old computers are generally working well, so they get moved out to the classrooms and put on the network (GVint02).

The ideal picture, according to one Western View teacher, was to have a computer laboratory supporting established networked classroom computers. This would achieve best teacher access and result in the development of technically skilled students, able to apply these skills contextually in the classroom, and able to contribute to the creation of an enhanced learning environment where:

> The classroom computers could be integrated into the daily life of the students and relate specifically to class work. The laboratory could be used as an environment to instruct and gain basic competency skills in using technology. The benefits for my students and me would be enormous. I really think in this situation I could spend a lot more quality time integrating technology in the classroom if I didn't have to spend as much time instructing children with basic skills. If I knew that every child in my class could open a particular type of program and use it in a particular sort of way, access a saved file on the network, or find a specific piece of information on the internet and be able to send an email, that would enable more time to be used to do productive and higher order work with my kids in the classroom. From a learning perspective the benefits would be enormous (WVint11).

Such learning, as described by the Western View teacher, would be dependent on students also having access to a network environment.

Network Environment

Providing the hardware is only one part of the formula, according to a Garden Vista teacher, “we don't instantly whack in 100 new computers and Internet access and expect everything will be fine, because you have to have the basics right. First and foremost, a well structured technical foundation must be present” (GVint07). To achieve this, a significant number of teachers believed a stable network environment was critical (GVint04, GVint07, Htint02, HTint07, WVint11, WVint18). The significance of such a network environment was brought to the fore at High Tops where a teacher argued that “the utilisation of a network where students have a user name and a password, where they can retrieve and share information and where they have remote access will be the foundation of their future learning and work” (HTint03). Further support for the development and expansion of the school network environment was outlined at Western View with a teacher arguing that the skills needed by a student to access and navigate a network were as important as basic skills in literacy and numeracy:

> Just as the student of the print dominated world needed to be numerate and literate, the student of the digital age must be numerate and literate in the traditional sense as well as the digital sense. This means skills like accessing and navigating a network from home and school becoming the new basic skills (WVint01).

It was recognised in the study that student learning could benefit from the use of a school network. It was also recognised that an effective and stable school network required "time and commitment" (WVint04). Furthermore, an essential component identified by a High Tops teacher for the smooth running of a school network was the availability of a staff member who had "technical expertise and training in the management of the network" (HTint02). While the type of technical support required in schools appeared to be continually evolving, the extent of technical developments in education was progressing at a frenetic pace ss McKenzie (1999) pointed out:

> Schools across North America are rushing to network. Governments and corporations hasten forward with grant support, advice, encouragement, pressure, and products. The Internet is sold as the bridge to the future, and the 'wired' school is all the rage. Access to the Information Superhighway becomes a priority. For some it becomes an obsession. Bill Gates has compared the rapid development of the Internet to the Californian Gold rush of 1849 (p. 1).

As schools are rapidly integrating sophisticated network environments within classrooms, libraries and administration, the potential for technical difficulties escalates. The sheer electronic nature of computers and associated digital technology has resulted in breakdowns and occasions of poor performance which can have significant implications on teacher confidence and their willingness to use the technology in the classroom. This point was highlighted by a High Tops teacher who identified this adverse effect:

> One of the biggest frustrations about technology is the equipment. There are so many things that can go wrong and cause teachers to lose confidence really quickly. This situation is multiplied by ten when the school network is brought into the equation. A new world is opened up to teachers with the introduction of a network. The ability to store and access information and run programs at multiple points in the school is fantastic, but as a teacher becomes familiar and confident with the networked environment, breakdowns or crashes cause chaos (HTint05).

One teacher from Western View viewed these times of chaos as a sign of success, because they indicated that teachers were starting to use and realise the potential of the resource (WVint02). However, most teachers expressed trepidation at the possibility of a network breakdown or crash. As one Western View teacher explained, the experience of a network breakdown can cause considerable stress and anxiety for classroom teachers:

> The more I use (or I suppose utilise is a better way of describing it), the more dependent I become on the network working. For example, when I started using the network to store and run the school-based assessment and reporting program I quickly became totally dependent on the smooth running of the network. Whenever the network crashed my blood pressure would rise and I would become anxious at the prospect of losing, or not being able to access my data. Until I was reassured that the technical issue could be resolved and my classroom assessment data was intact, I would be stressed. To put this in perspective though, I wouldn't alter this situation, that is, revert back to a non-networked environment. Educationally you can't compare a non-networked environment with a networked environment (WVint16).

The difficulty of technology for a significant number of teachers was related to the complicated and technical nature of the network. In the words of a Garden Vista teacher, "if I get the blue screen of death on my classroom computer I reboot and the computer restarts and things are okay, but when there is a problem with the network I'm reliant on someone with technical expertise" (GVint11).

Technical Dependency to Technical Sustainability

The development of dependency on a specific person to troubleshoot the technical problems, created some inherent difficulties for a Garden Vista teacher. In particular, there is the potential for the development of co-dependency, whereby the knowledge becomes too narrowly focused on a single person and the teachers become dependent on this person. The holder of knowledge can develop ownership and become territorial with this knowledge, as a High Tops teacher explained,

> It is very important that a certain level of technical issues be handled at the school level. It is also just as important, if not more important, that the knowledge to do this does not becomes locked with one person. I have seen too many examples over the years where a program or an initiative becomes one person's territory or domain. When this person moves or changes roles the knowledge is not transferred and things flounder (HTint07).

The call then is for leaders to strategically plan for the technical sustainability of the school network. This is especially prudent, considering that the networked school is the technical norm within New South Wales education, with the Department of Education and Training, Catholic Education Commission, and Independent schools aiming for a situation where all schools have internal networks that connect the classroom, library and administration areas of the school. In so doing, multiple Internet access points and individual email accounts are provided. With this situation rapidly becoming a reality, a

High Tops teacher advised school leaders to plan for a stable, technically-sound network to support new technology initiatives:

> For a technology initiative to work in this day and age, the school needs to have a well functioning network that isn't going to be out of date in 12 months, that isn't slow, is very stable and able to cope with the demand of the modern classroom and school. Hand in hand with such a network is technical support. Schools need to have on hand technical support. To be really effective this support should be at two levels, firstly, at a school level where a small group of people are specially trained to deal with the every day maintenance of the network, secondly, external specialists who can provide prompt expert advice and assistance (HTint09).

In recent years, the power and stability of school networks have improved noticeably, with minimum hardware standards and network configurations being suggested, and in some cases mandated (Diocese of Maitland-Newcastle Technical Infrastructure strategic plan, 2001). The establishment of standards relating to the purchase of new hardware and network configurations, have seen marked improvements in performance, as a Garden Vista teacher pointed out, “the speed and power have transformed the potential of the school network, with huge storage space, multiple Internet delivery facilities, individual logons and email accounts” (GVint04). This has promoted levels of sustainability that were previously unattainable and which will, in the future according to Stewart and Spender (2002), “provide access to on-line resources which use a powerful combination of video, multimedia, text and graphics, prepared by specialists in a centralised resource development facility and delivered to individuals or groups by technology” (p. 7). Central to Stewart and Spender argument is the growing significance of the Internet.

INTERNET

A High Tops teacher argues that the school’s network infrastructure is refined and stabilised “the greatest potential will be seen in the adoption of the Internet by teachers in the daily life of the classroom” (HTint02). The potential of this learning space, pointed out a Western view teacher, will be seen in “the provision of resources to students that were unimaginable twenty years ago” (WVint15). The significance of Internet based learning, more regularly referred to as eLearning was strongly highlighted in a summary report presented to the Catholic Education Commission by the Learning Federation’s Manager, Educational Design and Quality Assurance (2002), where it was outlined that “Good eLearning will occur via the use of digital resources, tools and applications on the Internet. The Internet is the medium and eLearning is concerned with applying offline best practice pedagogy to the online environment” (Atkins, 2002, p. 1).

This rapidly changing digital environment will require learners to continue to adapt to meet evolving challenges. A High Tops teacher highlighted this point and emphasised that “today’s students will have to learn how to learn. They will have to develop the ability to find information quickly and to manipulate that information and apply it to solve problems. The most important resource for students to do this will be the Internet” (HTint03). Evidence from Becker (1999) suggests that teachers are aware of the potential of the Internet, with ninety percent of all teachers surveyed in his Internet research project ranking Internet resources as either valuable or essential. Recent developments by the Learning Federation (2003), whereby sixty eight million dollars was allocated to develop online interactive curriculum content for Australian and New Zealand schools, reinforce the significance and potential of the Internet for schools.

While the potential of the Internet is one thing, the conversion of potential into practice creates continuing difficulties and challenges. The difficulty, according to a Garden Vista teacher, is not what the Internet can provide but more importantly, how to apply this resource to the classroom. This teacher suggested that the practical classroom application was the key issue, “I realise the Internet is in its early days in regard to classroom application, and I imagine things will become easier and more user-friendly for the classroom teacher in time, but presently it is too confusing and time-consuming for the average classroom teacher” (GVint06). A High Tops teacher claimed that the challenge of managing the digital information has resulted in the need to streamline and reduce the information overload:

> There is a real need to have some sort of information management system running parallel to the Internet, [perhaps] a place [where] that teachers can set up resources for students to enable quicker and more focused access [and] a system that can create thematic storage, where students can access Internet and offline materials linked to a class theme or focus. [All] with the possibility of accessing these resource banks from home (HTint02).

From a resource perspective, a Western View teacher confirmed that the advent of online access to a networked school environment opened doors to learning that past generations could not imagine, by suggesting that:

> The future for learning rests with the Internet. The ability to provide a wide range of resources to a classroom quickly and cheaply cannot be matched by any other resource. There is a lot of talk that we are moving out of the print age and moving into the digital age, I totally agree. Handwriting and using reference books are not preferred methods for me. I haven’t handwritten a letter or prepared by hand a worksheet for ages, while I virtually never use a non-fiction book, only

> as a last resort. The Internet is now my library and every month it gets bigger and better (WVint14).

Commentators, such as Lepani (1997), have predicted the potential ability of the Internet to transform education, suggesting that schools of the future will become "hi-touch/hi-tech local hubs of the network of lifelong learning services, required by citizens, for equitable participation in the global knowledge society, and its increasingly on-line economy" (p. 12). At High Tops, a teacher reflected on the significance of online access, revealing that the future classroom will be characterised by multiple access-points to the Internet and suggested that, "being able to access the Internet from forty or fifty sites within the school will be the accepted practice in the future. This could create a situation, whereby the Internet will dominate education as the most used resource in the classroom" (HTint06).

This point of view is taken further by Lepani who suggests that schools of the future will imperceptibly embed Internet technology into the working life of the classroom, allowing students to access the real world, interacting with the workplace as a 'community participant' in the wider community. Results from the 'Common Knowledge: Pittsburgh Project (2000)' supported such predictions, finding that a substantial proportion of teachers:

> Increased their amount of work-related communication with others; experienced an increased interaction within and beyond the school; reported increased opportunities for professional development; learned more about computing and the Internet; invested in home computing equipment and had increased professional pride and enthusiasm (Schofield & Davidson, 2000).

The findings of the Pittsburgh project support the general agreement of policy-makers that investments in this area were worth supporting, particularly when the revelations of Spender and Stewart (2002) were considered, namely, "the net generation (under fifteens) are so computer competent (digitally savvy) that, in general, they are more proficient with the medium than most of their teachers" (p. 17). This places great expectation and pressure on the training and professional development of teachers.

TRAINING AND DEVELOPMENT OF TEACHERS

The data in this study revealed that the training and development of teachers was considered the most significant resource theme with 252 text units and seventy two percent of documents referenced in QSR NUD*IST search. A closer analysis of training and development data revealed a number of significant sub-themes, namely, new graduates, staff meetings, TILT training, one-on-one training, and networking. These are represented graphically in figures 18 and 19 and are then discussed

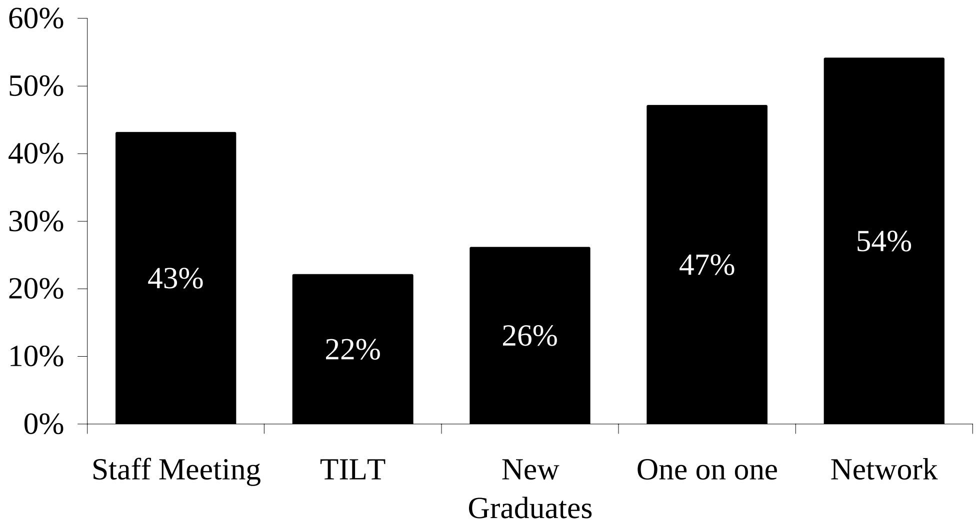


Figure 18

Number of text units referenced to training and development sub-themes

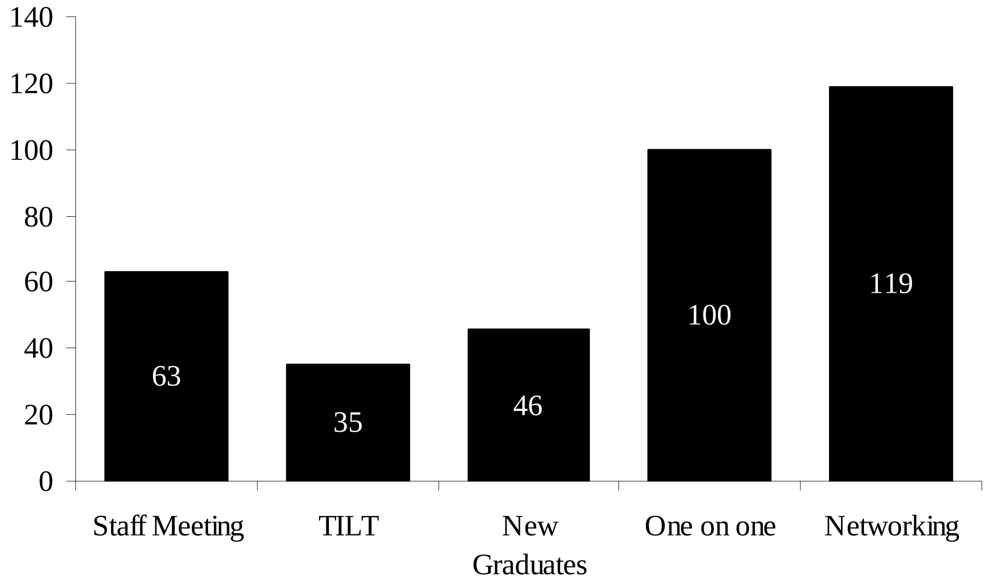


Figure 19

Percentage of documents referenced to training and development sub-themes

As outlined in earlier discussions, a recurring theme in the literature relating to the integration of technology into the classroom is teacher education (Burkholder, 1995; Kearsley & Lynch, 1994; Shermis, 1990; Stoddart & Niederhauser, 1993). Since the teachers are the ones who will implement the technology, Burkholder argues that training should focus on them. He contends that training should include strategic plans necessary to integrate the use of technology in the classroom. Discussions at Western View confirmed the need for focused training for teachers, with one teacher expressing grave concerns for the teaching profession at large as society's expectations in respect of the integration and management of educational technology mature and develop:

> Many teachers, I believe, feel like a poor swimmer being thrown into the deep end of the pool, in regards to technology. It has become more about survival than good practice. In retrospect, starting at the shallow end with floaties would have been the logical way to start. The assumption that teachers will know how to use technology let alone integrate technology into the daily practice of the classroom defies common sense. As parents and society at large see technology being integrated more and more into every day life, it is natural that schools follow suit, or lead the charge. This places huge pressure on the classroom teacher, who, in many cases doesn't have the knowledge, skills and confidence to integrate the technology available (WVint05).

The integration of computers into education requires an improvement in the instruction of teachers. This has been identified in the work of a growing list of writers (Burkholder, 1995; Kearsley & Lynch, 1994; Loyd & Gressard, 1986; Picciano; 1998; Shermis, 1990; Stoddart & Niederhauser, 1993; Summers, 1990 and Woodrow, 1992). The core of such a view is succinctly presented in the findings of an international study involving children, teachers, and computers, where it was stated that,

> Teachers are the main gatekeepers in allowing educational innovations to diffuse into the classrooms. Therefore one of the key factors for effecting an integration of computers in the school curriculum is adequate training of teachers in handling and managing these new tools in their daily practices (Collis *et al.,* 1996, p. 31).

The findings of this study supported the findings of Collis *et al.,* and reinforced the significant impact teacher training and professional development have on the level of success realised with the implementation and management of educational technology in the primary school. It was further argued in this study that the diffusion and adoption of an educational technology initiative will require significant, if not revolutionary changes to the way teachers work, as outlined in the chapter on the learning environment factors. An important ingredient for implementing such a change, argues Picciano (1998), is the development of a knowledgeable staff. Research has consistently supported this concept (Fullan & Pomfret, 1977; Huberman & Miles, 1984; Joyce, 1990; Joyce & Showers, 1988; Joyce, Murphy, Showers & Murphy; 1989; Knapp & Glenn, 1996; Pink, 1989; Sheingold & Hadley, 1990). At High Tops, strong connections were made between a knowledgeable staff and success with a school- based technology initiative. One teacher pointed out,

> We have been pretty successful with our project and the experience has instilled a lot of confidence in the staff. I honestly believe the staff now has the knowledge and confidence to continue further initiatives. This wouldn't have been possible without the expertise of our Assistant Principal. Her ability to share her knowledge and empower others was crucial to the success of the project. Along the way we all gained new knowledge and developed skills and we are now in a position to pass these on to others (HTint03).

Regardless of the nature of change, whether it be introducing a new teaching technique or implementing a major technology initiative, the individuals involved must understand, and to a degree accept, what is expected and what is going to be done. Neglecting to develop understanding among the people who will ultimately influence the success or failure of an initiative will likely jeopardise the implementation of any new projects. This is particularly the case with technology initiatives where a growing number of researchers have suggested that the lack of high quality teacher training was a major factor impeding the integration of technology in education (Kearsley & Lynch, 1994; Shermis, 1990; Stoddart & Neiderhauser, 1993; Picciano, 1998). Recent surveys pointed to the fact that after almost two decades of introducing new technologies into schools, teachers still did not feel prepared to integrate technology into their curriculum in rich and meaningful ways (Technology Counts, 1999). According to a teacher from High Tops, the reason for this was linked to the reality that there was no one way or best way to integrate technology into the classroom:

> There is no one best way to integrate technology into the classroom, as there is no one best way to teach and train teachers in the integration of technology. To have the best chance of success, training and development need to be varied, recognising different styles of learning. Teachers have to be given the professional development opportunities to acquire a repertoire of strategies that can be used in the classroom to integrate technology (HTint05).

While the importance of teacher training and development is undeniable, and is intricately related to the successful implementation and management of technology, the most effective method or strategy to do this is a matter of conjecture. Picciano (1998) strongly advocates variety and the recognition of multiple paths of learning:

> That as much as possible, programs should be designed that provide some variety of activities (i.e. lectures, demonstrations, discussions, hands-on, work-shops etc.) and that take place over an extended period of time to allow participants to practise and experiment (p. 196).

The data in this study supported Picciano's claim and suggested that no one method or strategy was ideal when implementing and managing educational technology. While a single method or strategy was not identified as the most effective, the data did indicate that a certain quality, when present, was conducive to successful staff professional development and training, namely support. As identified in earlier chapters, support focusing on leadership, relationships and learning environment factors support, and in particular the creation of a supportive work environment, was crucial to the successful implementation and management of educational technology.

Professional Development Support

A common thread emerging in the interviews and discussions relating to teacher professional development and training was the support offered by colleagues in the work place. At Garden Vista, the principal summarised the success of the school in relation to training and development, very simply as, “support is the answer here, it doesn’t matter what the program or inservice, staff here know that they can get help. No questions asked, people are always willing to give their own time to help. This can make all the difference” (GVint01). Similarly, at High Tops, teachers spoke of the level of support offered, referring regularly to the importance of informal support, one teacher described informal support as the most important and effective training that a teacher can experience:

> Structured training and professional development are really important and I’m not trying to suggest the opposite, but real learning and understanding happens (sic) for me from informal experiences. It is very empowering when a teacher gives their [his or her] own free time to explain or demonstrate something. It makes me feel special and valued to know that my colleagues will give their time to help me. It doesn’t matter how insignificant or stupid the question is. It’s a bit like the rock thrown in the still pool. It creates an ever-widening circle or ripple. The giving of support creates a similar effect. By giving help freely in a non-judgmental way, it can empower the receiver, who will then be more likely to help others in a similar way (HTint12).

In essence, this support was fundamental to a harmonious and collegial staff. One Western View teacher described it as “a sort of informal professionalism” (WVint11), where staff “model and share professionally in an unstructured spontaneous way” (WVint11). These points were also advocated by Jones (2002):

> Collegiality, through engaging in continuous, concrete and precise dialogue about ongoing teaching activities; observing one another in action and providing feedback; planning, designing, studying and evaluating curriculum; and teaching one another what each knows about teaching and learning are all essential to any staff development program (2002, p. 13).

This ‘learning from colleagues’ and ‘learning by doing’ were identified by principals as important strategies and a favoured model for computer-training, according to Russell and Bradley (1997). While Current research and thinking point to the need for professional development models to incorporate a support structure (McKenzie, 2001), individualised support from peers and experts encourages teachers to experiment with new strategies for technology integration (Hanby, 2000; NCREL, 1999). One High Tops teacher put this into context by suggesting that collegial support was the main reason why she continued to try new classroom practices involving the integration of technology:

> When it comes to integrating technology into my classroom I will give most things a try. That wasn't always the case. At my last school there wasn't a supportive environment like here, and whenever I tried something new I was on my own. Most of the staff were very comfortable keeping things the same. Innovation was subtly frowned on. When I came to High Tops, I couldn't believe the change in mindset. Innovative practices were encouraged, the staff was really eager to help out, not out of self-interest or hidden agendas but out of professional learning. Working in such an environment makes the integration of technology so much easier (HTint08).

The potential of everyday experiences being opportunities to provide learning for teachers was also emphasised by Retallick, Cocklin and Coombe (1999), who maintain that, because the learning is informal it is not always perceived by teachers to be professional development. As such, professional development can encompass many forms of learning, including workplace learning. The importance of workplace learning, in particular the use of one-on-one learning experiences was highlighted by a number of respondents in this study.

One-on-one Learning

The use of one-on-one learning, whereby an expert, or a person with 'superior' knowledge and skills worked closely with a less skilled or knowledgeable person, was identified as a significant and effective strategy for learning how to use and integrate technology into the classroom. One Western View teacher explained, "I have learnt through many inservices and training programs that the best and most effective learning for me with technology happens in a one-on-one learning environment" (WVint14). This teacher went on to warn that elaborate presentations and demonstrations were ineffective without one-on-one practical application:

> Whiz-bang power point presentations, multi-media extravaganzas and high-powered speakers are a waste of money if the classroom teacher doesn't have a chance to use the technology. I normally forget most of what has been said the next morning and I can almost guarantee that within a week of attending a presentation I will have very little retention of the program. On the other hand, if I get an opportunity to

> apply what has been said in practice, as soon as possible after the presentation, I will usually remember a lot more. Not only will I remember it, if I can see educational value, I will normally try and use it in the classroom (WVint14).

These views were supported by a RAND study conducted by Glennan (1998), indicating that unless equipment was available to staff immediately after a workshop, so that they could practise and use it for operational reasons within a short time of being trained, the training effort would be wasted. Unfortunately, according to a Garden Vista teacher, most of the formal professional development experiences available to teachers involved larger groups in a lecture or demonstration format:

> Most of the professional development courses I have attended in recent times have been in a larger group setting where the presenter tended to lecture. It was more chalk and talk than actual hands on (GVint09).

Such large workshops, argues Schiller (1999), were of limited use in preparing teachers to use computers unless they were supplemented with individual and small group interaction on a continuing basis. These findings were supported by the work of U.S. congress (1995) that recommended follow-up support with staff development:

> Staff development is most effective when it is individualised. This means matching learning opportunities to the needs of specific teachers so they can choose what they need to know, how they wish to learn and the time frame in which they will learn it. Follow-up support and coaching after the initial learning experience is essential to effective staff development (U. S. Congress, 1995, p. 159).

Within New South Wales, the Department of Education and Training developed a co-ordinated professional development program entitled ‘Technology in Learning and Teaching’, better known as TILT. This program provided introductory technology instruction and experiences for classroom teachers and was considered significant by participants in this study.

TILT

This program initially enabled 15,500 teachers in the State Education Service to be involved in an introductory technology training program. Further developments of the program have been directed at enhancing the TILT program through the implementation of a more advanced skills program known as TILT Plus. This program was designed to try and respond to the need for assistance with the integration of technology into the classroom. Department of Education and Training (2000) stated:

> The emphasis has moved to classroom integration, as 15,000 places were to be available from 2000-2003 on the 50-hour TILT Plus training

> program, which offered a diversity of courses embedded in curriculum subject areas, infrastructure development and leadership (p 8).

The benefits of the TILT program were identified by participants in this research in a number of ways. The principal of Garden Vista saw the program contributing to the development of a learning community in which with teachers look to take more responsibility for their own learning:

> A number of staff had completed the TILT course and staff had subsequently started to become more involved and more interested in using and integrating technology. The best thing from my perspective was that teachers have started to take more responsibility for their own learning needs (GVint01).

Another Garden Vista teacher saw the TILT program as a positive introductory motivator for teachers, relating the experiences of a fellow Garden Vista teacher who was initially resistant to the integration of technology into the classroom but, following his involvement in the TILT program, became a vocal advocate and enthusiastic user of technology:

> A colleague I teach with was initially very anti-technology and wouldn't touch computers, wouldn't even turn them on in his class. We sent him off to the TILT course and things changed dramatically. The teacher bought his own computer, and now has the works going in his room. He really is into it with the kids in his room. I can’t say that the TILT course was totally responsible for this change, but I certainly believe TILT provided the professional development experience this teacher needed to get him started (GVint02).

The provision of personnel and significant funding for the TILT program was seen as promising signs for the advocates of technology in primary schools. As one High Tops teacher summarised, “The large financial commitment the department has made with the implementation of TILT was an encouraging sign for the future” (HTinv03). The effect, however, of producing a generic program for all teachers could be seen in the creation of inherent and potentially harmful consequences, warned a Western View teacher, “TILT, for some teachers, might be just what they need, but for a teacher that was confident the program is really limiting and basically a waste of time” (WVint11). Other teachers from Western View and High Tops also expressed concerns at the effectiveness of the delivery of a generic professional development program for the integration of educational technology. A High Tops teacher suggested,

> The TILT program, by its very nature, is ineffective. No, one program can provide all the professional development needed for classroom teachers to integrate technology. No two people are the same, and their professional development and learning needs will likewise be different. TILT, when supplementing other school based initiatives or formal

> professional development, can potentially be a very effective tool, but a school cannot put their staff through TILT and feel they have provided adequate professional development in using and integrating technology (HTint09).

It became increasingly clear during the study that that no single approach to integrating technology into the classroom or one technology application was most effective. Professional development and training, in regard to the implementation and management of educational technology, were extremely complex and, where possible, needed to be individualised to meet the needs of classroom teachers. This flexibility and configurability of professional development were clearly evident at Western View where the newly graduated teachers were used as a professional development resource for more experienced teachers:

> At Western View we try and learn from each other. This is particularly the case with teachers fresh from university. Their skills and expertise in using technology is (sic) incorporated into our staff professional development program. This is really helpful for older and more experienced teachers (WVint04)

Newly Graduated Teachers

The influence of the newly graduated teacher in the technology area was appreciated by a Western View teacher:

> While Western View does suffer a little from inexperience the upshot of having a young staff can be seen in the technical skills they possess. A lot of the new teachers have grown up with technology. The Internet and Email are nothing new. This creates a natural willingness to use technology. In fact most of these teachers would be lost if technology wasn't available to them (WVint14).

Similarly, at Garden Vista, the principal expressed anticipation at the prospect of the staff benefiting and acquiring skills in using technology through the employment of newly graduated teachers:

> My staff is extremely experienced, with a significant number of teachers having taught for twenty or more years in a variety of schools. Unfortunately, one of the consequences of having a stable experienced staff is that we don't see too many younger teachers. In the next couple of years there is a definite possibility that we will see younger, newly graduated teachers join the staff. This is a very exciting prospect, particularly in relation to technology, as these teachers will have grown up with technology and will possess new skills and knowledge that all the staff will benefit from. As you have younger teachers coming out who are more proficient in using technology, and those older teachers moving out of the system, new ideas and new approaches will filter into schools. The younger people will have grown up with technology,

> and will see technology as part of their lives. They will naturally be more proficient at using technology (GVint01).

There existed a general expectation within the three schools that newly graduated teachers would be more highly skilled and more competent in the use of technology than the older more experienced teachers. The data strongly confirmed the higher skill level achieved by newly graduated teachers as opposed to experienced teachers, with more recently graduating teachers [less than five years experience] having more skill in using technology and higher levels of use than more experienced teachers. The three beginning, or first year teachers interviewed, demonstrated a much higher rate and level of use of Internet and email than any other experience group. The comments from a High Tops teacher were consistent with remarks on the tertiary experience of the first year teacher:

> I couldn't imagine studying at university without a computer, the Internet and email. It's the standard that everyone expects at Uni. I did all my assignments with a word processor; I used email to communicate with other students and lecturers. I even submitted work through email, and I used the net for research, finding out course information, accessing my results and surfing (HTint10).

While younger, and/or less experienced teachers were more skilled in using software programs, accessing the internet and utilising email than older and more experienced teachers, this skill did not significantly link with the effective integration of technology into the classroom, as previously suggested in the work of Fatemi (1999). A newly graduated teacher from Western View explained this anomaly simply as, "We were never taught how to. New teachers know how to use a word processor, or use the Internet, but we were never taught how to integrate technology into a classroom of thirty students with limited resources" (WVint12). Learning 'how to' for one first year teacher at Western View, took place on the job by learning from good teachers:

> After 10 months at Western View I can now say that I feel much more confident about how to integrate technology into the classroom than when I first started teaching. I have learnt through the help of more experienced teachers and, in particular, watching good teachers in action. I have gone back to my own room and through a process of trial and error implemented practices that I feel work pretty well, and let me integrate technology into my classroom. They aren't anything fancy; they really are common sense things. Establishing routines, teaching students how to work in small groups, designing individual project work that let students be creative, and using the students to teach students (WVint16).

Teachers indicated that little to no formal training had been received during initial teacher training in respect of the integration and management of educational technology. As a first year teacher from High Tops explained,

> During my training we did one subject dealing with technology but it was more to do with technical stuff and different programs. There was no input on how to integrate technology into the classroom.
> At school I used a bit of technology, not a lot. I certainly didn't use it the way we do here. This year has really opened up my eyes to the potential technology has for education. The future of education I think lies in utilising technology (HTint10).

The provision of time for teachers to learn from and with each other was intimately connected with this emerging professional development need of teachers. As an executive teacher at Garden Vista indicated, “the provision of time is desperately required for professional development initiatives to gain professional credibility” (GVint02).

TIME

Integration of technology into the curriculum, particularly at the primary school level, is improving, according to Picciano (1998), but still requires the attention of administrators. A range of studies (U.S. Congress, Office of Technology Assessment, 1995; Becker, 1994; Picciano, 1998; Sheingold & Hadley, 1990) indicated that resources, especially for release time were needed for teachers and curriculum co-ordinators to do the detailed curriculum design work necessary for successful integration. This issue, according to Picciano (1998), relates directly to the need for on-going teacher training. At Garden Vista the importance of teachers having access to time to learn from colleagues was highlighted:

> The majority of teachers at Garden Vista are very experienced classroom practitioners. Most of these experienced teachers haven’t undertaken formal study in education since graduating from college. The most effective training for these teachers, and in fact the entire staff with technology has been through collegial training. This training recognises the importance and value of learning and training with teachers by providing time in the form of classroom release for teachers to work together. This training responds directly to the needs of the learner while empowering the teacher trainer. Because the training takes place in a non-threatening and familiar environment with a trainer the teacher feels comfortable with, teachers are very keen to participate (GVint11)

The ability of a school to provide time for teachers to train and learn with technology rests, according to a High Tops teacher, with “budget priorities” (WVint03). This teacher went onto to argue that “the level of commitment to technology within a school can be seen in the professional development budget for technology” (WVint03). Glennan (1998) argues that thirty percent of a school technology budget should be allocated to staff development, and this should take place on-site and just-in-time. Such an investment reinforces the importance of the classroom teacher to the implementation and management of educational technology, maintaining that the teacher’s role is pivotal, in that he/she has the strongest impact on whether students learn or not (Crowther, 2002; Dorman, 1984; Hill, 1995; Reynolds, 1995). It appears as though “countries around the world are investing large sums of money in informational technology in schools and colleges, believing that it can transform both the learning outcomes of students and, indeed, the whole nature of student educational experiences” (Jones, 2002 p. 7). Without substantial funding for professional development, and in particular teacher release time, the educational returns from investments in information technology will be restricted. The need to utilise funding to provide teachers with time to learn becomes crucial, as Armstrong and Casement (2001) advocates, “more time and money should be spent doing hands-on learning in primary education” (p. 9).

The provision of time for teachers to be involved in hands-on learning appears particularly significant when the fundamental tenet of staff development, advocated by Picciano (1998), is considered, namely, “that one learns by doing, therefore a portion of any technology training must be hands on” (p. 196). A High Tops teacher corroborated this, “training, in particular training in the use of technology, must be practical and hands on. If it isn’t, it will be a waste of time (HTint04). The best type of hands on training was reported to take place when, “collegial support was readily available” (WVint14).

While the benefits of collegial support and teachers teaching teachers is undeniable and documented in earlier chapters, the sustainability of such collaborative learning processes was strongly influenced by time, with “teachers spending large amounts of their own time training colleagues, the long-term prospects are dependent on the goodwill of teachers” (GVint02). The preservation of such goodwill will, in part, according to a Western View teacher, “require the allocation of significant amounts of in-school release time” (WVint08). If this does not happen, a Garden Vista teacher warns of endemic stress and burnout as classroom teachers are faced with this challenge of time:

> One of the biggest inhibitors to embracing technological change is time. I read the other day that teaching is a ‘time-challenged’ profession. How true, each year it becomes harder and harder to do the

> basics. We seem to be inundated with new curricula, special events, and 'the flavour of the month' special interest projects. Research is constantly unearthing new information on the needs of children, including things like high levels of obesity, child sexual assault, alcohol and other drug dependency, global warming etc. As educators, we are compelled to respond to these important needs, but we still only have the same time. I am working longer hours and I still seem to be chasing my tail. My work time has increased but the student's school time has stayed the same. The reality is that I am now probably doing a lot more things half well. With the growing expectation that teachers integrate technology into the classroom added to the already bursting workload of the teacher, something has to give. I only hope that the system gives, by giving teachers more release time to learn (GVint01).

Teachers often see time as a scarce commodity that is constantly juggled and manipulated to fulfil the daily challenges of teaching. The findings of this study also recognised a connection between time for teachers to learn and train with technology and equity for students in primary schools. This point was highlighted by a Western View teacher who argued that the potential learning benefits offered to a student through the integration of technology into the classroom were related to the time provided for teachers to be trained in the use of technology:

> It is simple really, if teachers aren't given adequate time and training our students will become increasingly disadvantaged. This is obvious when you look at schools that are doing great things with technology because these schools give their teacher's time and opportunities to learn. The students in these schools are advantaged because the commitment to technology is reflected in the level of resources in the school and teacher learning is reflected in the learning environment created in the classroom (WVint01)

EDUCATIONAL TECHNOLOGY AND EQUITY IN PRIMARY SCHOOLS

Equity in the implementation and management of educational technology was identified as a significant theme, with 149 text units and 46% of documents being referenced in a QSR NUD*IST search. Within this theme two distinct focus areas emerged, namely, equity related to the access of resources and equity related to learning. From a resource perspective, a Garden Vista teacher stated that "adequate access to computers in the classroom was vitally important" (GVint04). A Western View teacher went further by predicting failure for schools that were technologically under-resourced, "schools will simply fail to provide adequate education for students in the future if access to sufficient technology is not available" (WVint02). The danger of not providing adequate technology facilities is the development of what Thornburg (1998) refers to as the ‘digital divide’:

> The digital divide is real, and the financial have-nots are also the informational have-nots. Given the importance of information technologies in the future, this gap can produce a permanent underclass and further expand the gap between the haves and the have-nots. For this reason alone it is essential that access to powerful information technologies is provided in every classroom, library, and other places where people from all backgrounds gather (p. 1)

The very concept of access to equitable levels of technology within schools revealed a number of complicated and interrelated issues, as a High Tops teacher explained:

> Technology creates for me some serious equity issues. While technology has the ability to break down distance barriers; and enable people to work from just about anywhere; the cost of technology is often prohibitive for the poorer countries of the world or the underprivileged members of society. I suppose this places a great responsibility on schools to provide learning opportunities for those students, in particular, who do not have access to technology. Unfortunately, the schools that require the most support are quite often unable to access the community financial support required to help. It becomes a bit of a vicious cycle, therein creating an ever widening gap between the haves and the have nots (HTint03).

The potential impact of such a gap is far reaching and presents huge implications and challenges for schools, as a High Tops teacher pointed out:

> I really see a greater gap developing between the have and the have-nots, not only economically, but also in a knowledge sense. There will be those people in our society that [sic] will embrace technology and a new ways of learning with open arms, and they will have enormous power to access knowledge in our world. On the other side of the coin, there will be a growing group of people who will not embrace technology and will not develop the strategies and skills needed to be learners of the 21st century. These people will become more and more disadvantaged, and that will lead them to become more economically disadvantaged. Eventually that will impact on their ability to find work. This cycle will develop and deepen (HTint09).

Schools play an essential role in responding to these societal challenges, as one Western View teacher stated, “our school facilities and quality staff give our students the opportunity to be on an equal footing with other students in other schools” (WVint06). While resource levels were key, a Garden Vista teacher was quick to point out that the role of the teacher was crucial and not to be underestimated, “The classroom teacher creates the learning environment in the classroom; initiatives will only work when the class teacher supports them” (GVint09). Unfortunately, according to a Western View teacher, students can be disadvantaged by being placed in a classroom where a teacher chooses not to use technology resources, thereby creating an inequitable learning environment:

> There are classes, I know, where my children have gone to school where teachers hate using computers. These are classrooms where computers are rarely, if ever, turned on. Now these things have to change. I really think that those teachers who aren't willing to embrace new technologies should not be in the teaching game any more. I know it sounds pretty hard, but I think it’s our responsibility. I think these kids that aren't getting to utilise technology in their learning, because the teachers are frightened or are incapable of using them, are really being disadvantaged, and I don't think its fair (WVint04).

This situation was not an isolated occurrence, according to a Garden Vista teacher, who claimed that in a many classrooms the technology was redundant and not applicable to the students’ real world experiences:

> The crazy thing about the education system is that while society is well aware of the benefits of technology, individualised learning and the use of the Internet, schools are really slow to do it. Many teachers rarely use technology, and when they do it is out of date and redundant. I think it’s almost a crime for these kids in these classes, it's an injustice, and it is inequitable. These kids aren’t getting prepared for life in the future. They must come into contact regularly with technology, with the technology that's out in the world now, not the technology that was out 5 to 10 years ago (Gvint09).

McCarthy (2002), identified a need for policy makers, in the interests of students, to address the digital divide and to support teachers who do not have the necessary training or materials. This will require staff development programs with adequate levels of resourcing that are strategically designed and supported throughout implementation.

CONCLUSION

It can be seen from the resource discussions that resources are vital to the successful implementation and management of educational technology in primary schools. The study showed that resources and there use were quite complicated and interrelated with a number of other factors, in particular, hardware, professional development, the Internet, time and equity. While the provision of classroom computers was an important resource theme, the findings of this study highlighted the significance of a range of resource factors that influence the level of success achieved with a school-based technology initiative.

As recorded earlier in this chapter, the research project and discussions flowing from it, reinforced the importance for implementation and management of educational technology that schools have adequate levels of hardware supported by a flexible network. The significance of networked hardware within the primary school were accentuated when the growing educational importance of the Internet and the potential the Internet provides for students to have remote access to learning resources were taken into account.

Explicit within the findings of the resource data was the need for the provision of relevant professional development for the staff within a primary school. The provision of adequate professional development was a challenge that was directly related to the allocation of school funding to provide adequate release time for teachers to learn with and from colleagues and to be involved in technology-based training programs. Furthermore, a commitment to the integration and management of educational technology within the studied schools was demonstrated in the provision of ICT professional development and physical resources. These resources were, in turn, considered significant within this study, in promoting a twenty-first century learning environment within the primary school classroom. It was also argued that failure to provide the physical and human resources needed to implement and manage educational technology would create inequality in the education a student receives.

In conclusion, the study revealed that school success in implementing and managing educational technology were clearly dependent on the successful interaction of resources with leadership, relational and learning environment factors. Discussions in this and the previous three chapters clearly showed the interdependent and complicated relationships that existed between the key factors of the conceptual framework. The following chapter draws together these findings by responding to the stated research questions outlined in chapter one.

CHAPTER EIGHT

KEY THEMES RELATED TO RESEARCH FINDINGS

A discussion of the key themes of the conceptual framework in chapters four, five, six and seven revealed the significance of the identified factors to the success of the implementation and management of technology in primary schools. Within this chapter, discussions centre on what happened in the three schools in this study that enabled therr successful implementation and management of educational technology to take place. The discussion focuses on the four key research questions. These questions were:

1. Why have these schools been successful in implementing and managing educational technology?

2. What factors have helped and hindered the successful implementation and management of educational technology?

3. What are the indicators and effects of successful implementation?

4. What were the particular contributions of leadership to the successful implementation and management of educational technology?

QUESTION 1. REASONS FOR SUCCESS

Involvement of schools in this research took place through the advice of reputational experts, as to the view of success with school-based technology initiatives. The three schools Garden Vista, Western View and High Tops provided valuable data to help answer the research questions.

The experiences of success with the implementation and management of educational technology was not the result of any one factor or influence. Quite the contrary, success at these schools occurred through an ongoing process of interaction and dynamic balance of the core factors of implementation identified in the conceptual framework.

The findings indicated that, first and foremost, each of the schools recognised the potential of technology to improve and enhance the quality of teaching and learning for students. This recognition of potential was the prime motivator for teachers to use technology in the classroom and was strongly evident in the level of commitment and ownership teachers demonstrated in the technology program or initiative within each school. The sharing of ownership among staff closely linked to the vision of each school.

The work of Costello (1997) and Hoffman (1996) also highlighted this linkage, concluding that the sharing of ownership in an educational initiative was an integral part of a broader educational vision. Within this study, the sharing of ownership in the technology initiative was regarded as a pre-requisite for success with the ongoing management of educational technology.

The analysis of data highlighted the significance of staff taking ownership of a school-based initiative. Findings showed that ownership was more likely when staff relationships were positive and supportive. Downes (as cited in Jones, 2002) supported this relationship arguing that, “teachers will be a critical element in determining just how successful the application of technology will be in improving the learning outcomes of students” (p. 9).

The interdependent relationship of the implementation factors of the conceptual framework directly influenced the involvement of staff at each of the schools with their technology initiative. Earlier discussions highlighted this link and showed that success in the implementation and management of educational technology was a complex task involving many explicit and implicit aspects of school life. In many respects, it constituted a dynamic balancing act whereby each school’s success with technology closely links with its ability to balance the relational, learning environment, leadership and resource factors of school life.

The findings also revealed consistent and rich information relating to the development and promotion of a supportive work environment in the three schools. Teachers characterised this environment as a place where, everything seemed to fall into place. There was a strong connection between the supportive work environment and the success of a school technology initiative, with the supportive work environment influencing the level of interaction between the factors of implementation

The development of a supportive work environment was contingent on an underlying expectation among staff of involvement and openness to new ideas and change. The staff at the three schools reflected an expectation of involvement and an openness to change by ‘having a go at things’ and being willing to get their ‘hands dirty’. This active involvement promoted learning and developed working relationships among staff, while engendering among them a sense of co-responsibility to participate. An accepted expectation of involvement and commitment by the staff in the school-based technology initiative reflected the pervading culture of involvement identified from data. Furthermore, the level of staff participation and involvement in each school's technology initiative positively influences the success with the implementation and management of educational technology in the curriculum and pedagogy of each school.

An important perspective was that success with technology was consistent with success in other areas of school life within the research schools. Success was viewed holistically relating to many areas of school life, including assessment and reporting; literacy and numeracy achievement; catering for individual learning styles; and the creation of a positive learning environment. The findings of this study were consistent with the work of a range of writers (Hawkins & Honey, 1990; Hawkins & Pea, 1987; Newman, 1990; Pea, 1987; Pea & Sheingold, 1987) and suggest that the success of Garden Vista, High Tops and Western View primary schools can only be fully understood as part of multiple interacting factors in the complex life of each school. In particular, the maintenance of success with a school-based technology initiative appeared to be shaped by the supportive work environment within each school, which, in turn, facilitates the process of interaction and dynamic balance of the implementation factors.

QUESTION 2. FACTORS THAT HELP AND HINDER

The data showed that no one factor was primarily responsible for the successful implementation and management of educational technology within the three schools. Conversely, no one factor was responsible for the hindrance of the implementation and management process. The analysis identified a combination of factors relating to the learning environment, leadership, relationships and resources as prerequisites to the success or otherwise of educational technology initiatives in the three schools.

The creation of a supportive work environment was the most significant factor in the successful implementation and management of educational technology and closely linked to each of the other key factors of implementation. Such a supportive work environment was synonymous within this study with the school being a 'good place in which to work'. Findings also highlighted the significance of congeniality and collegiality among staff to the ongoing maintenance of the supportive work environment. Sergiovanni (1999) emphasised this point and showed that the combining of congeniality and collegiality reinforced work-enhancing values and norms. When these values and norms were linked to the sharing of goals and strategic planning, the possibility of implementing and managing educational technology in these schools was enhanced.

Collegiality and congeniality augment the effectiveness of the school-based technology initiative at the three research sites. This was evident in the friendly, harmonious and flexible relationships among staff at Garden Vista, High Tops and Western View primary schools. Sergiovanni (1999) concluded that, “loyalty, trust and easy conversation that result in the development of a close-knit social group” (p. 141) characterise collegial and congenial relationships. Congeniality was enhanced further by the existence of high levels of collaboration among teachers. Such collaboration, according to Sergiovanni (1999), was shown in “mutual respect, shared work values, co-operation and specific conversation about teaching and learning (p. 142). The findings of this study reinforced the characteristics Sergiovanni outlined, and further highlighted the positive effect these characteristics have on the experience of success with the implementation and management of educational technology. Most noticeably, the findings demonstrated a strong link between the way a staff worked together and the ongoing success with a school-based technology initiative.

The way staff work together also influenced the effectiveness of planning with technology. The findings showed that school-based planning with technology was most effective when staff worked together collegially and when decision making was shared. The findings also showed that technology planning that was formulated through hierarchical and non consultative processes hindered the ownership and ultimate long term management of a technology initiative. The level of planning that occured with technology affected the experience of success with the technology initiative. Of particular importance to this study was the formulation of documentation, more specifically a school technology plan. The three schools emphasised the importance of a school-based technology plan and suggested that the plan was an important feature contributing to the successful implementation and management of educational technology.

This emphasis on technology planning was strongly supported by Education Victoria:

> Essential to the implementation and management process is the development of a Learning Technologies Plan and a series of implementation strategies linked to the schools vision, charter, curriculum plan, level of resourcing and range of teacher skills. (Learning Technologies In Victorian Schools 1998 – 2001, p. 17)

While the development of a technology plan in which staff demonstrated ownership was a significant feature contributing to the successful implementation and management of educational technology, the level of support available for the school-based technology initiative was key to the ongoing success of the technology plan. The level and type of support available was shaped by the leadership in the school, in particular, the role of the principal and the identification and empowerment of a *Key Driver* (not usually the principal).

The support of the principal and *Key Driver* was fundamental to successful implementation and strongly correlated with the success of a school-based technology initiative. Conversely, reductions in the level of support by the principal and/or *Key Driver* created substantial obstacles to the implementation and management process. Leadership was central to success, and shared leadership was the key to maintaining success with a school-based technology initiative.

When teachers shared leadership in the studied schools, decision making was characterised as being collaborative. Teachers involved in this study reported high levels of ownership in, and commitment to, the technology initiative in their school when they had active involvement in decision making and leadership. Crowther (2002, *et al*.,) supported the sharing of leadership in schools and identifies the significance of shared leadership, in particular parallel leadership, to the management of change within schools. He argued in favour of school leadership structures that promote shared leadership and focus on teachers who may not have formal leadership roles. He pointed out that such leadership sharing, or 'parallel leadership,' can encourage teachers to work towards a common purpose and, in so doing, supported one another. The findings also highlighted the constraints placed on a school-based technology initiative when leadership sharing was not practiced. The three schools demonstrate the practical application of leadership sharing in the representative committee structures in operation. Within these committees, staff members took on leadership roles such as, committee co-ordinator and secretary and were responsible for reporting information and proposals to the whole staff for discussion and ratification.

The sharing of leadership within the school encouraged teachers to work closely together as part of a community of learners implementing, assessing and redesigning what happens in respect to the implementation and management of educational technology. As staff in each school worked together they became more open and responsive to change, in particular technologically-driven change. Being responsive and open to technological change involved the subtle and ongoing interaction and dynamic balance of the implementation factors, with the primary focus on the enhancement of student learning outcomes. This required the modification of leadership to allow for the parallel growth and sharing of leadership among staff at each school. Leadership sharing was highlighted in this study with the involvement of staff in a range of leadership roles, and teachers linking the success achieved in their school-based technology initiative with the sharing of leadership in the school.

In summary, the successful implementation and management of educational technology is helped and hindered by a range of factors. The findings of this study showed the most significant of these factors are the development and fostering of a supportive work environment, the sharing of leadership and the practice of collaborative decision making. A strong link was found between the level of each of these factors and the ongoing success with the school-based technology initiative, with low levels of collaborative decision making, shared leadership and a supportive work environment hindering the implementation and management of technology.

QUESTION 3. INDICATORS AND EFFECTS

The indicators of successful implementation of educational technology within the research schools are closely aligned with:

Changes to pedagogical practices in the classroom;
The sharing of knowledge and skills by staff;
High levels of technology use by staff;
Increasing levels of resourcing and support for the technology initiative;
Creative applications of technology;
The development of a reputation as a leader in technology; and
The recognition of the school as a catalyst for change, focused on technology.

Change in classroom pedagogy.

A prime focus of the research was on the learning environment focusing on teaching and learning. The findings highlight this focus and emphasise the significance of a pedagogy that facilitated the integration of technology into the classroom. The findings establish a strong link between successful classroom integration of technology and the type of teaching pedagogy adopted by the classroom teacher. This linkage is most noticeable through a movement from traditional approaches where the teacher dominates, to more facilitative approaches to teaching.

The development of facilitative approaches to teaching was connected in this study to an underlying belief in the principles of constructivist learning theory (Cognition and Technology Group at Vanderbilt, 1996; Darling-Hammond, 1997; Pea, 1994; Resnick & Klopfer, 1989). Teachers in the research schools highlighted this point and emphasise the importance of pedagogical approaches that are student centred and contextual. Constructivist approaches were enhanced in each school by the integration of technology. Research findings offered support for the integration of modern technology within a constructivist framework suggesting that:

> The structure and resources of traditional classrooms often provide quite poor support for learning, whereas technology when used effectively can enable ways of teaching that are much better matched to how children learn (Roschelle *et al.*, 1998, p. 79).

The translation into practice of constructivist principles by teachers in the research schools involved the embracing of change and the adoption of facilitative approaches to teaching. This change highlighted the enthusiasm and support staff showed for technological driven change. This enthusiasm and support was strongest when the technology initiative demonstrated a positive effect on the achievement of learning outcomes. When the technology was used as a tool to support learning, the greatest effect on the achievement of learning outcomes was experienced. The adoption of a 'toolcentric' approach to technology in the classroom required a change in classroom pedagogy with teachers in this study favouring a student-centred facilitative learning environment.

This move to a facilitative approach required teachers to make significant transformations to the process of learning and teaching in their classroom. In particular, teachers referred to learning focusing on a context that was real and meaningful for students, while also being multi-sensory, collaborative and inquiry-based. These changes to learning required rethinking by educators of how teachers teach and how students learn, with teachers in this study highlighting instructional groupings within the classroom, the differentiation of the curriculum and diffusion of the Internet into classroom learning as key focus areas for future development.

This change in classroom pedagogy resulted in teachers being involved in a process of ongoing learning. The findings strongly reinforced the significance of ongoing learning, in particular the practice of learning from and with colleagues. The schools in this study actively pursued and promoted collegial learning and the success of each school's technology initiative was greatly influenced by this learning. The change in classroom pedagogy is enhanced through the active sharing of knowledge and skills which is promoted in each school through collegial learning.

Sharing of knowledge and skills

The sharing of knowledge, skills and experiences in teaching by staff reduced the barriers that can impede the successful implementation of a school-based technology initiative. The findings highlighted the significance of such sharing and pointed to the valuable learning that takes place when teachers learn from the mistakes experienced with the use and utilisation of technology. This learning was closely linked to the supportive work environment in the school and, as stated earlier, was most effective when the supportive work environment was collegial and congenial.

Findings underline the significance of the support generated through collegial learning, with teachers in each school more willing to integrate technology into the classroom when support from colleagues was available. This sharing of knowledge and skills was highlighted in each school in a steady increase in the usage of technology resources by staff.

High levels of technology use by staff

Increasing levels of technology usage by staff was evident in each of the research schools. This increase in usage was consistent in each school and was characterised by an increase in teacher confidence in utilising technology in the classroom. The level of confidence and competence with technology strongly influenced the way class teachers used technology in the classroom. The findings emphasise this relationship and highlight the strong connection between teacher confidence with technology and the integration of technology into the classroom. Furthermore, as staff became more confident and competent in using and utilising technology, there was a reported increase in the willingness among staff to experiment with technology. Such experimentation was considered significant by teachers because it encouraged classroom innovation with technology. The findings highlighted a strong link between experimentation and classroom innovation with technology and the level of support in the school working environment.

The increased use of technology heightened the need by teachers to access more technology resources; this was particularly the case as classroom teachers became aware of the depth of applications of educational technology. Access to the Internet was identified as a priority resource access area for teachers, with high-speed Internet connectivity a pressing resource issue in each of the research schools.

The use of Internet based resources and web tools link closely in each of the schools to the type of learning most effective for the twenty-first century (Markauskaite, 2003). The Internet was used most effectively as a learning resource when high levels of connectivity were available in the school. While the access speed to the Internet influenced the classroom diffusion of the Internet, the utilisation of the Internet as a tool to enhance learning requires more than high speed connectivity. The diffusion of the internet into the classroom appeared to be most effective in the research schools when leadership was supportive; the focus of teaching and learning was on pedagogical approaches that were constructivist; relationships among staff were collegial and supportive; and resource allocations were adequate to implement professional development programs that supported the integration of the Internet into the classroom.

Increased levels of resourcing and support for the technology initiatives

The growing need for resource support for the diffusion of technology, in particular Internet-based technology into the classroom is reflective of the expanding resource challenge schools face as technology initiatives are implemented. The allocation of resource support for a school technology initiative by the school principal and leadership team was a strong indicator of success. Ongoing success requires commitment by the leadership team to the technology program in the school; such commitment was evident in this study through the resource allocation made by each school to reduce the ratio of computers to students and increase the speed and capacity of the school technology network. The findings also showed that while increasing the level of resourcing is vitally important to the viability of a school-based technology initiative, the level of success achieved with the management of the technology initiative related closely to the support available to staff within the school.

Support from colleagues was a fundamental indicator of success in these schools with the implementation and management of educational technology. The level of collegial support in each school influenced the way resources were deployed, leadership was shared and teaching and learning strategies implemented. The delivery of resources to support the technology initiative was most effective in this study when it occurred in a supportive work environment where teachers worked collegially. This was highlighted with the provision of new computer hardware or the allocation of teacher release time for professional development; both were more effective when collegial support was available for teachers. Furthermore, when teachers experienced a supportive and collegial work environment, they were more willing to apply creative solutions to utilise technology in the classroom.

Creative applications of technology

The research schools were able to apply creative solutions to use technological resources effectively. At High Tops, a puzzle box [small technology resourced room] used technology tools to promote higher order thinking. At Garden Vista, teachers in stage one classes combined their technology resources and used technology as a specific learning centre work-station during mathematics and theme work. Creative applications, such as the puzzle box and learning centre, were seen as indicators of success with the classroom integration of technology.

The ability of the three schools to identify and respond creatively to educational needs and problems through the integration of educational technology was a fundamental purpose for using technology, and linked directly with the achievement of student learning outcomes. The findings highlighted this purpose and recognised the flow-on effect that occurred when technology was implemented and managed successfully. Responding to educational needs through the application of technology was considered a public sign of success in each school and helped build a reputation in each school as a leader in technology.

Development of a reputation as a leader in technology

The development of a reputation as a leader in the use of technology often reflected itself in a greater sense of pride in nominating by teachers. In each school there was a strong sense of pride and ownership by teachers in the directions taken with the technology initiative.

While a reputation as a leading technology primary school brought a certain amount of esteem to the school and teachers in the school, maintaining this reputation required careful management to avoid placing undue stress on teachers and students. This was particularly the case at High Tops primary school, with the principal reporting the development of a ‘tall poppy syndrome’ with neighbouring schools placing subtle pressure on him to reduce the public and innovative profile of the school. This required the principal to remain resolute in his commitment to the technology initiative in the school while, at the same time, maintaining an informed position on the development and progress of the technology program. Maintaining a clear focus on the direction the school takes in respect to technology, while continuing to be innovative with the adoption of technology requires strategic thinking and careful planning. Central to such thinking and planning was the effect the technology innovation had on student learning outcomes. Within each of the schools the technology initiative had a sustained positive effect on students learning outcomes. This sustained effect helped to further develop the reputation of the school as a leader in technology and in so doing had a flow on effect to other schools.

Catalyst for change

The three schools in this study were catalysts for change for other primary schools implementing school-based technology initiatives. Cuttance and Stokes (2000) reported that schools leading in technology were beginning to use information and communication technology infrastructures as the ‘glue’ that supports the teaching, learning and administration. In this context, the research schools viewed technology as a tool and an enabling framework to amplify, extend and transform learning, and also to provide the latitude, understandings, resources and skills to do so. Transforming learning through the integration of technology provided a reference point for other schools and established a standard or benchmark for future technology-based initiatives in primary schools.

The findings indicated numerous effects and indicators of the successful implementation of educational technology in the primary school setting. Of particular note was the impact these indicators had on the achievement of student learning outcomes. This was reinforced and highlighted through the development of the significance of teaching and learning factors within the learning environment. The strong focus on teaching and learning within the learning environment combined with the scale of influence of the supportive work environment necessitates a review of the conceptual framework following discussions on the contributions of leadership.

QUESTION 4. CONTRIBUTIONS OF LEADERSHIP

Leadership emerged as a significant factor in the implementation and management of educational technology. As discussed earlier, the leadership within each school strongly influenced the development of the teaching and learning practices and beliefs in each school, with the sharing of leadership among staff a key finding of the study.

Shared Leadership

The Leadership within the three schools revolved more around collaboration than hierarchy. The findings supported the work of Sergiovanni (1999) who argued that quality leadership requires the "building and enhancing of norms of collegiality and providing the organisational arrangement that encourage collaboration" (p. 145). McLaughlin and Mei-Ling Yee (1998) also supported the work and argued that a collegial school environment enhances the level of opportunity and also the capacity for teachers, resulting in greater stimulation at work and higher levels of work motivation.

Promoting collegial relationships in the school requires the commitment and support of the principal. The sharing of leadership and the empowerment of staff to take leadership roles in the school initiative was a key role of the principal. The findings supported this role and highlight the significance of the role of the principal to the level of success experienced with the implementation and management of educational technology. The fundamental importance of the relationship of the principal to the experience of success with a school technology initiative was supported by the work of Hall *et al.*, (1980) who argued that "a most important factor to explain the quality and quantity of change in schools is the concerns of the principal and what the principals did and did not do" (p. 26). NCES (2000) provide further support for the role of the principal, describing the leadership of the principal as one of the most important factors influencing the effective use of technology in classrooms.

Principal Leadership

Implementing and managing a technology initiative has implications for the principal when the expectations of educational authorities and society, at large, are taken into account. These expectations create a situation that requires the principal to be knowledgeable about a wide range of technology issues (D'Orsa, 1996). While the principal will not be expert in all aspects of technology, he/she must, according to Lee (2001) and Gurr (2001), understand what is available, where to get advice and assistance, particularly in relation to the developing technical infrastructure.

Support from the principal was identified by teachers in the study as a key indicator of principal leadership. This support took the form of release time from face-to-face teaching, school-based training, professional development opportunities and the allocation of funds from the annual budget to purchase physical resources. The findings also highlighted a strong link between the support a principal provides for the technology initiative and his/her belief in the potential benefits technology makes to the achievement of student learning outcomes.

The principal, therefore, exerted significant influence on the management and implementation of educational technology. The leadership of the principal in a school-based technology initiative reflected his/her personal belief in, and commitment to technology. Furthermore, the principal was most influential in ensuring the sustainability of the technology initiative in each school. However, the principal does not necessarily have to be the *Key Driver* of this change

Role of the Key Driver

The *Key Driver's* role is central to the implementation and management of technology within the primary school. The contributions of the *Key Driver* are significant with teachers endorsing and highlighting the importance of the role. For many teachers, the *Key Driver* metaphorically 'injects the technology initiative with passion'. There are a number of important challenges and consequences emanating from the findings of this study that have specific implications for a school-based technology initiative. The most noticeable implication was the management of the initiative by the *Key Driver.*

A significant number of teachers considered the expectations for role of the *Key* Driver as unrealistic, often requiring large amounts of time out of school to fulfil the role. As such, the replacement of the *Key Driver* was a topic given much thought and discussion by teachers. Demands on the role of *Key Driver* also created a situational dilemma, whereby many teachers felt incapable of filling the role. This situation in certain circumstances develops co-dependency between the *Key Driver* and staff, with the *Key Driver* developing a sense of indispensability as he/she controls the higher level technical skills and knowledge within the school, while at the same time the staff are dependent on the *Key Driver* for technical skills and knowledge.

The findings of this study emphasised the important contributions of the *Key driver* to the implementation and management of educational technology. Furthermore, the role of *Key Driver* was most effective within a shared leadership environment where knowledge and skills were shared. The institutionalisation of the beliefs and practices of leadership sharing (Crowther, 2001, 2002) is also central to the ongoing sustainability of technological driven change in the schools in this study.

As with leadership, resources, relationships and teaching and learning factors were central to the successful implementation and management of educational technology in the primary school. To maintain the integrity and contextual relevance of the data the conceptual framework became a reference point and a framework for validation in the study.

VALIDATING THE CONCEPTUAL FRAMEWORK

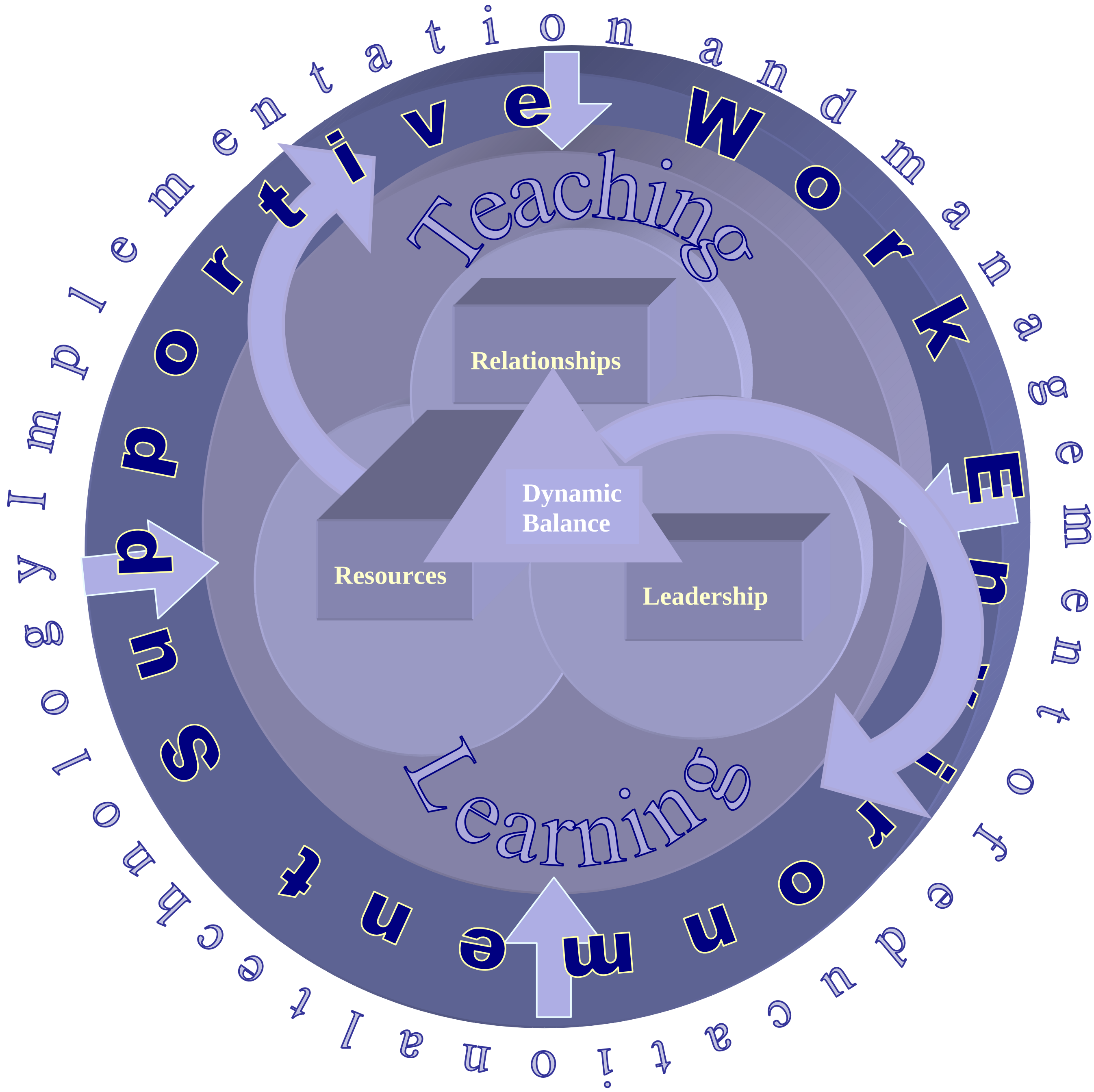
Themes emerging from the data reinforced the foundation principles of the conceptual framework, namely that success with the implementation and management of educational technology was contingent on the interdependent relationship between the implementation factors. While there was consistent support in the data for the interdependent relationship of the implementation factors of the conceptual framework, the emergence of teaching and learning as the dominant focus of the learning environment, coupled with the significance of the supportive work environment, necessitated a critical review of the conceptual framework.

The findings highlighted the significance of the supportive work environment in each school and showed consistent links between the success of each school-based technology initiative and the collegial support in the schools' work environment. Furthermore, the success in each school was reflective of the level of interaction and subsequent strategic planning that took place involving the implementation factors. The findings indicated that this interaction and planning was most effective within a supportive work environment. Within this environment the successful implementation and management of educational technology was supported through the collaborative and collegial teamwork of staff.

As stated earlier, these findings necessitated a review and redesign of the conceptual framework in order to reflect the key relationships of the supportive work environment to the implementation and management of educational technology and the significance of the teaching and learning factors. The SupportIF model (Figure 20) of implementation represents this redesign.

Figure 20

SupportIF Model of implementation



The model is presented through a cross-section of interlinking three dimensional spheres. The three dimensional modelling is used to show the complexity and depth of the school environment while recognising the dynamic nature of the educational change faced by the school. The shape of the model also symbolises the ongoing process of implementation and management. The title of the model, SupportIF highlights the existence of an interdependent relationship between the supportive work environment and the implementation factors.

The three dimensional layers of the model reflect the significance of the supportive learning environment and the teaching learning factors, as well as the connectedness and close levels of interdependence between each layer.

Influences and pressures are exerted on the primary school when educational technology is implemented. These pressures and influences are shown as blue arrows in the model and are representative of the range of influences and pressures the school faces, including school community expectations, mandatory curriculum requirements and educational policy. These pressures and influences, together with the shared beliefs of the staff, provide the initial impetus to implement a school-based technology initiative.

The ongoing implications and effects of the technology initiative are dynamic, complex and interrelated and require strategic management. This complexity was evident at Garden Vista with the integration of computer hardware, software and peripheral digital technology. While these resources were considered important to enhance the achievement of student learning outcomes at the school, they also created a range of effects and implications for the implementation factors that required careful management. The effective utilisation of these resources required the adoption of teaching and learning strategies that were constructivist; the provision of professional development for staff; the sharing of knowledge and skills among staff; the adoption of parallel leadership practices within the school; and the active promotion and support of collegial relationship between staff. Garden Vista adopted implementation strategies that were flexible, focused on the educational needs of students, and built around the supportive work environment that existed in the school.

The first and primary layer of the SupportIF model is the supportive work environment. This environment ‘encloses’ the implementation factors and pervades each of the implementation factors. The next layer represents the teaching learning factors and is portrayed as a larger sphere than the leadership, resources and relationship factors. The size differential symbolises the fundamental connection and relationship between the achievement of student learning outcomes and the implementation factors.

The findings emphasise the achievement of student learning outcomes as the core purpose of the technology initiatives in each school. As such, the leadership, relationship and resource factors are embedded within the domain and influence of the teaching and learning factors.

Three smaller interconnecting spheres representing the leadership, relationship and resource factors are contained within the teaching and learning sphere and symbolise the interdependent relationship of the implementation factors. These spheres symbolise the synergetic relationship that exists between the implementation factors, with each factor having influence on, and being supported by the other factors. The interconnectedness of these factors reinforces the foundation of the conceptual framework, namely, that success with the implementation and management of educational technology is contingent on the interdependent relationship of the implementation factors. The findings highlight that each of the implementation factors are connected to each other with their core focus on the achievement of student learning outcomes. Each factor, while vitally important to the successful implementation and management of technology, is dependent on the remaining factors for the success of the technology implementation.

Change and growth is achieved in this model as the implementation factors interact. This interaction results in a need for dynamic balancing and redesign of the relationship of the implementation factors. A triangle and two arrows are used to capture the essence of the dynamic balance of the redesign process. This redesign can be simple involving small change, such as adjustments to the school library timetable to accommodate project-based learning, or more complex, as in a whole-school approach to the integration of ICT into classroom pedagogy.

The redesign firstly involves the work environment, this effects the dynamic balance of the implementation factors leading to redesign. This process is dynamic and responsive to identified needs within the school. During the earlier stages of the Garden Vista technology initiative, the need for staff to share technology skills was identified and aspects of the implementation were redesigned to allow structured collegial sharing. Release time was provided for teachers to work in small groups with the *Key Driver* developing individual technology skills.

To create time for the *Key Driver* to work with class teachers, some teachers were required to take responsibility for the preparation and delivery of the class library lesson. The enthusiastic support of the redesign was linked to the perceived flow-on effect for student learning. Following an initial trial of the redesign new needs were identified and further redesign was initiated. The redesign involved more competent technology users foregoing allocated training time to allow teachers with greater needs to have extra time training. As with the earlier redesign, this redesign was enthusiastically embraced. This process of dynamic balance and redesign was ongoing at the three schools and for many teachers this process occurred naturally in their school. The supportive work environment was reported to have a pervasive influence on all aspects of school life, and while difficult to accurately describe, teachers referred to the process of dynamic balance and redesign in terms of the way teachers worked together.

The dynamic interaction of the implementation factors identified changes, adjustments and modifications to the technology initiative that needed to be taken to enhance student learning outcomes. Responding to such needs takes place through the balance and redesign process leading to the implementation of new practices and approaches at the school. At High Tops, the implementation of a school-wide technology project resulted in ongoing dynamic balancing and redesign occurring through staff supporting one another and working together to improve learning outcomes for students. This focus on student learning outcomes also involved the widespread adoption of leadership sharing practices, as well as the identification and implementation of constructivist pedagogical approaches in the classroom and in-school professional development. Responding to these needs required the redesign of school practices and the implementation of specific strategies, in particular; the establishment of a representative committee structure within the school; the introduction of teacher mentoring of classroom strategies with the integration of ICT; and the development of teacher experts in technology skill areas. The success of these changes directly related to the level of support in the work environment at High Tops Primary school.

The SupportIF model of implementation posits that success with the implementation and management of educational technology is closely related to the leadership, relationships, resources and teaching learning factors. While each of these factors is important and exerts a 'sphere of influence' on the success of the technology initiative, it emphasises the level of success is directly related to the interdependence and dynamic balance of these factors and the effect the technology implementation has on student learning outcomes. Ultimately the sustainability of success with the implementation of educational technology in the primary school setting is reliant on and shaped by the supportive work environment in the school.

This chapter has integrated the findings from the data presented and discussed in chapters 4 – 7 and integrated the findings for the four research questions. The data and findings were also used to analyse and validate the conceptual framework used in the study.

CHAPTER NINE

CONCLUSION

The purpose of this final chapter is to conclude the study by briefly revisiting the methodological approach, conceptual framework and the outcomes of the data chapters. Also considered in this chapter are implications for policy and practice, and suggestions for future research.

METHODOLOGY

The choice of the research methodology was governed by its potential to provide answers to the research theme and questions. A qualitative methodology was adopted, more specifically, an ethnographic approach that sought to capture Geertz's (1973) concept of thick description, and elicit the meanings that those in the study used to explain their behaviours (Duignan, 1981; Fetterman & Pitman 1986; Polkinghorn, 1995; Wolcott, 1982).

To achieve this goal of thick description, the researcher initially spent two weeks in each school gathering data. A further two weeks was spent completing follow-up visits and data gathering. During the weeks in the field, the interviewer conducted forty-six in-depth interviews with principals, executive teachers, teacher librarians and classroom teachers. Data were also collected through the study of documents and non-participant observations.

Analysis of the data was facilitated by the use of the computer program QSR NUD*IST. This program was used as a tool to assist with qualitative analysis. In this research project, it proved to be an invaluable tool assisting the researcher with the reduction and display of data in the study.

CONCEPTUAL FRAMEWORK

The development of the conceptual framework for this research emerged from the writings and research of many authors and researchers (Brooks & Brooks, 1993; Dwyer *et al.,* 1991; Handy, 1995; MCEETYA, 2002; McKenzie, 1999; Nias, 1999; Picciano, 1997; Schiller 2003, 1998; Treagust & Rennie, 1993; The Boulder Valley Internet Project and Wheatley, 1992). Underpinning the development of the conceptual framework was a belief that the successful implementation and management of a major change, such as educational technology in a primary school, was directly related to the interdependent relationship of leadership, resources, relationships and teaching and learning factors. The extensive presentation of literature reviewed in chapter two reinforced and supported the identification of these four factors and recognised their fundamental importance to the implementation and management of educational technology in the primary school setting.

Validating the conceptual framework highlighted the complicated processes involved in the implementation and management of educational technology in the primary school. The validation of the conceptual framework also identified a strong link between successful implementation and management of educational technology and the dynamic balancing and redesign of the factors of implementation. The balancing and redesign process was shaped by and facilitated through the supportive work environment in each school

The SupportIF Model of Implementation (Figure 20) developed from the validation process. This model embodied a number of key finding of the research; firstly, that support was a pre-requisite for the interdependent relationship of the implementation factors; secondly, the implementation and management of educational technology was a dynamic and ongoing process; thirdly, the supportive work environment was the most significant factor influencing the sustainability of success with a school-based technology initiative; and finally, growth and change with a school-based technology initiative required continual dynamic balance and redesign of the implementation factors. The development of the conceptual framework was reinforced in the findings and discussions of the factors of implementation.

Relationships

Relationships had a pervasive influence in the findings and were identified at each school as the cornerstone of success for the technology initiative. The supportive work relationships were a pre-requisite, and acted as a catalyst for the successful implementation and management of the school-based technology initiatives at Garden Vista, High Tops and Western View primary schools. The relationship between staff was the most crucial to the ongoing management of technology in the primary school, with these relationships most effective when they were collegial and supportive.

The work relationships in each school influenced the staff's perception of their school, with teachers consistently viewing their school as a 'good place' to work because, first, and foremost, a supportive work environment was present. This environment was characterised by collegiality and leadership density, where staff felt accepted and valued. In such a work environment, congeniality was also considered extremely important and appeared to enhance the supportive work environment in each school.

Leadership

Leadership emerged as an influential factor within this study. Of particular note was the significance of the school principal and the *Key Driver*. Both roles strongly influenced the level of success achieved with a school-based technology initiative. Furthermore, the findings highlight the crucial role of the principal and *Key Driver* in transforming leadership within the school.

These developments were reinforced at the three schools by a changing application of leadership, with leadership being characterised more by collaboration and sharing than hierarchy and power (Crowther, 2001; Crowther *et al.,* 2002; Sergiovanni, 1984, 1986, 1996). Fundamental to leadership within the three schools was the close link between leadership and the sharing of an educational vision. This vision was enacted at each school through the belief and practice of leadership that was collaborative and shared.

Teaching and Learning Factors

The redesign of the conceptual framework, outlined in chapter 8 identified the preeminence of teaching and learning as the prime focus for the Learning Environment. To describe these factors more accurately, teaching and learning was used within the SupportIF conceptual framework (Figure 20). The teaching and learning imperative confronting the three research schools was acutely focused on the belief that the integration of educational technology into the classroom would enhance the achievement of student learning outcomes. This belief had a strong nexus with findings in the literature review that highlight the integration of educational technology into the classroom as the way to promote the kind of learning deemed necessary for the twenty-first century (Darling-Hammond, 1997; Lin, 1995; Pea, 1994). The adoption of constructivist teaching strategies by the classroom teacher was the most effective way to create this learning environment in the research schools. This finding supported a range of authors (Dwyer, 1996; Goodyer; 1999; Hadley & Sheingold, 1993; Means, 1994; Saye, 1997; Sherry *et al*., 1997).

The data also revealed that the successful adoption and diffusion of new approaches to teaching and learning within the classroom were intimately linked to the classroom teacher. This is significantly amplified when the utilisation of new technologies are considered, as Collis *et al.,* (1996) argues, “the teacher is the key figure in the eventual success or lack of success of any computer-in-education initiative” (p21). For teachers to use educational technology in a constructivist manner, the data supported the premise that they required opportunities to construct pedagogical knowledge in a supportive climate (Dexter, Anderson & Becker, 1999; Parr, 1999). Consistent with earlier findings, the support and, in particular, the creation and maintenance of a supportive learning environment was crucial to the teaching and learning factors.

Resources

As with relationships, leadership and teaching and learning factors, resources emerged as highly significant and encapsulated the key themes of training and development, time, equity, Internet and hardware. A review of the data associated with the resource theme confirmed and supported the complicated and interdependent nature of this theme. Technological developments in society placed increasing pressure on the research schools to ‘keep up to date’; which in turn placed increasing amounts of pressure on the provision of technological resources in the school.

The rapidly changing digital environment required the learners to adapt continually to meet the evolving challenges of the digital age. For classroom teachers in the research schools, this involved facilitating learning, in particular, supporting students to learn how to learn. The ability to find information quickly and efficiently, to manipulate that information and apply it to solve problems, and inform decisions was considered a key learning skill for the future by teachers in this study. The development and refinement of these digital age skills was closely related to the utilisation of the Internet and the training and development of teachers to facilitate such learning. The findings of this study reinforced the importance of training and development to the ongoing success of a school-based technology initiative.

IMPLICATIONS FOR PRACTICE

This research project has a number of implications for practice, most noticeably, that the implementation and management of educational technology is a complicated and dynamic process that involves the interaction of the interdependent factors of implementation identified in the conceptual framework for this study. Building on the findings of Treagust and Rennie (1993), this study established and supported the dynamic and interdependent balance between resources, leadership, relationships and teaching and learning factors. The findings highlighted the significance of the adoption of a process approach to implementation whereby the factors of implementation were involved in an ongoing process of dynamic balance and redesign which was shaped and facilitated by the supportive work environment within the school.

A corollary of this implication would be the need for school administrators and planning groups to plan for technology implementation using the conclusions of this study. Furthermore, the findings of the study show a close relationship between the success of a technology initiative and the supportive work environment in the school. This finding would have direct implications for the management of the technology initiative, in particular, the utilisation of the supportive work environment in the school to support and sustain the school-based technology initiative. For school administrators and technology planners, this has implications for the promoting and enrichment of the supportive work environment within the school to facilitate the redesign phase of the SupportIF model. This is significant for this study because, at this point of the model, changes are informed by practice, which in turn, are intimately linked to the level of support in the school work environment.

The ownership in a school-based technology initiative by staff was strongly influenced by the supportive work environment. The level of ownership was reported to be greatest when school practices were built on collegiality, and where leadership and knowledge were shared. While not essential, congeniality was considered by research participants to be an important and valued characteristic of the work environment and, when combined with collegiality, was reported to sustain the supportive school working environment. In light of this finding, the adoption and support of practices that promote collegiality and congeniality among staff need to be considered and planned for as a way of enhancing the supportive work environment within the school. In particular, the allocation of resources to support practices that create a sense of belonging and teamwork, such as staff reflection days, celebration meals, sporting events, birthday morning tea celebrations and social outings.

The findings indicate that teachers were most collegial when they shared common goals and were respected professionally. When staff members felt professional respect from their work colleagues they reported being more willing and able to share leadership and make worthwhile contributions to the achievement of shared goals. Conversely, school practices that were built on hierarchy and power tended to counteract the positive effect of collegiality. High Tops, Garden Vista and Western View primary schools consistently reinforced the adoption of strategies that enabled the active sharing of leadership and the subsequent development and maintenance of an informal supportive work environment. In particular, the findings supported the establishment of a school technology committee and other representative school committees where membership was broad and inclusive, and members were actively involved in decision making and the formulation of school policy.

While the teachers involved in the study were strongly committed to the integration of technology into the life of their respective school, and the use of technology as a tool to enhance learning, the application and integration of technology within classroom pedagogy surfaced as an issue of shared concern. Experienced teachers expressed hope in the younger 'computer savvy' teachers leading the way, while the newly graduated teachers felt unprepared to integrate technology into a classroom with limited levels of resources.

Teachers regularly associated the integration of technology to the development of 'good old fashioned' teaching skills, highlighting the importance of planning and classroom organisation. The most effective way to develop and enhance these skills was reported in the study to occur through working with colleagues. Teachers confirmed the importance of sharing with colleagues practices and experiences in using technology in the classroom. This sharing reinforced the value of collaborative learning and, more specifically, the valuable learning that took place when staff supported each other and learned from mistakes. These findings have direct implications for the training and development of new and continuing teachers, most noticeably, the utilisation of classroom teachers recognised as being experienced and successful with the classroom integration of technology within the induction program for new and beginning teachers.

This study also highlighted the significance of the principal and the *Key Driver* to the level of success with the implementation and management of educational technology. The findings bring to light the need for future principal recruitment practices to reflect the importance of principals as educational leaders that possess an understanding of the implementation and management of educational technology. The findings of this research went further suggesting the principal of the future will need to be technically competent. The findings also suggest that technical competence will embrace a clear understanding of the process of educational technology implementation and the development of personal competence in using technology in the professional role as principal. The principal was viewed as the most important model of technology. As such, an implication of this study relates to the need for educational systems to provide professional development for principals, focusing on the implementation and management process of educational technology.

While the principal, by virtue of his/her position, emerged as the most significant leadership factor in the implementation and management of educational technology, the importance of the *Key Driver* cannot be overstated. The *Key Driver* exerts considerable influence and provides invaluable support within each of the schools. Each school lauded the contributions made by the *Key Driver* toward the successful implementation and management of education technology. The findings of this research strongly reinforce and support these contributions and recognise the vital importance of primary schools having a recognised *Key Driver* in a school-based technology initiative. This has implications for employing authorities, with specific recruitment strategies for school technology *Key Drivers* identified as a significant need in the study. Furthermore, consideration needs to be given to the allocation of system-wide resource support for the primary school *Key Driver.*

At the same time, the findings also highlighted the need for schools to avoid developing co-dependency on the *Key Driver*. In some respects it was a ‘catch 22’ situation, whereby the greater the ability and competence of the *Key Driver* the less the perceived need for support of this person. This relationship had the potential for developing codependence, resulting in the development of a knowledge and skill gap between the *Key Driver* and the school staff. Teachers in the study recognised the challenges a widening skill and knowledge gap created for the classroom teacher. When the *Key Driver* changed roles or moved schools, the organisational challenge of replacing the *Key Driver* were further complicated by the skill and knowledge gap. This was consistent with the findings of Treagust and Rennie (1993) in their study of Western Australian Technology high schools, and raises important questions for principals and system administrators as they struggle with the replacement and appointment of a *Key Driver*.

The findings of this research indicate that the *Key Driver* needs to be identified and specifically recruited, with the appointment of the *Key Driver* being linked firstly, to his/her understanding of the implementation and management of educational technology and secondly, to the level of skill in using technology. Furthermore, the findings reinforce the importance of the *Key Driver* being supported by a small group of teachers who collectively possess the knowledge and skills to continue the initiative in the event that the *Key Driver* leaves the position. This may well require the allocation of release time and specialised professional development for this targeted support group.

Consistent with the findings at each of the research sites, was the importance of professional development, in particular professional development that was practical and contextually linked to what was happening in the classroom. While formal professional development was seen as essential, the findings strongly endorsed the importance and effectiveness of informal professional development. This form of professional development was quite often spontaneous, 'just in time' and delivered according to need. It generally took the form of a teacher taking time to demonstrate to a colleague how to do something on the computer, or the sharing of work with other teachers in response to an identified need. The findings of this study highlight the preference of teachers being involved in training and professional development that was collaborative and focused on peer support, and suggests to school administrators and planners that contingencies are put in place through planning and budgeting to use and develop the informal professional development network within the school.

These findings can inform professional development practices in schools, in particular, professional development linked to the implementation and management of educational technology. The findings can alert schools to the value of informal professional development through the promotion of a supportive work environment. This, in turn challenges principals and school administrators to implement strategies and adopt practices that promote leadership sharing, collegiality and encourages congeniality.

RECOMMENDATIONS

There is a need for:

1) School administrators and technology planners to adopt a process approach to implementation and management of educational technology, whereby the factors of implementation are involved in an ongoing process of dynamic balance and redesign;

2) School administrators and technology planners to adopt strategies and practices that promote and enrich the supportive work environment within the school;

3) The promotion of practices and the implementation of strategies within the school are founded on collegiality and leadership sharing;

4) School principals to allocate resources to support practices that create a sense of belonging and teamwork among staff, such as staff reflection days, celebration meals, sporting events, birthday morning tea celebrations and social outings;

5) The establishment of a school technology committee and other representative school committees where members are actively involved in decision making and the formulation of school policy;

6) The utilisation of classroom teachers recognised as experienced and successful with the classroom integration of technology within the induction program for new and beginning teachers;

7) The provision of targeted professional development for principals, focused on the implementation and management of educational technology;

8) The recruitment practices for the primary school principal to recognise, as essential employment criteria, technical competence, with principals demonstrating an understanding of the process of educational technology implementation and management while being a competent user of technology in his/her professional role;

9) The allocation of system-wide resource support for the primary school *Key Driver;*

10) The targeted recruitment of school *Key Drivers* focused, primarily, on an understanding of the implementation and management process of educational, and, secondly, on the level of skill in using technology;

11) The establishment of a *Key Driver* support group within schools;

12) The provision of targeted professional development for the *Key Driver* support group; and

13) School administrators and technology planners to put contingencies in place through the allocation of resources to develop and utilise the informal professional development network within the school.

SUGGESTIONS FOR FUTURE RESEARCH

In light of this study, several implications for future research are identified and briefly discussed.

This study proposes a conceptual framework for the implementation and management of educational technology. It would be helpful to conduct further qualitative research on this framework within primary schools. Research could be extended to validate the framework with the implementation and management of educational technology in secondary schools. The framework could also be applied to non-technological change initiatives within schools.

As stated in chapter three, research into the implementation and management of technology in primary schools is extremely limited and requires further research to establish a range of data from a variety of settings. This particular study focused on three schools that were considered successful by reputational experts with the implementation and management of educational technology. Future studies could look at different sample variables, such as, socio economic status, school size, and school location.

The findings of this study highlighted the significance of the supportive work environment within schools and related this environment directly to the level of success achieved with the management of technology. Further research could examine in detail the supportive work environments within primary schools, in particularly, schools identified as possessing supportive work environments.

The findings established the importance of leadership to the successful implementation and management of educational technology. In particular, the significance of the principal and the *Key Driver* were highlighted. Further study could focus on both of these dimensions. Research into the evolving role of the primary principal in respect to the implementation and management of technology would provide valuable information for education systems and prospective principals. A further possibility for research focusing on a comparative study of the desired level of technical competence as perceived by the key stakeholders in the school as opposed to the actual levels of technical competence possessed by the principal would also be valuable.

The importance of the *Key Driver* to the success of a school-based technology initiative was strongly reinforced throughout the data. The role was synonymous with ongoing success of the school-based initiatives within the study. Unfortunately, the role is particularly demanding and stressful with potential for burnout. Studying identified *Key Drivers* in a range of educational fields within the primary school setting and comparing the non-technical *Key Driver* with the technical *Key driver* could provide valuable comparative data.

The recommendations can be thus summarised:

a) Further qualitative research in primary schools be undertaken to validate the conceptual framework;

b) Further research using secondary school technology initiatives be undertaken to validate the conceptual framework;

c) Further research validating the conceptual framework to be undertaken in a range of non-technological based change initiatives;

d) Future research examining the supportive work environment within other primary schools;

e) Further research examining the role of the primary principal in respect to the implementation and management of technology;

f) Further research examining the role of *Key Drivers* in a range of educational fields within the primary school setting; and

g) Further research comparing the role of Key Drivers in school-based technology initiatives with Key Drivers in non-technology based school initiatives.

CONCLUDING REMARKS

This research project sought to develop an understanding of how educational technology was successfully implemented and managed in New South Wales primary schools, and was based on the assumption that valuable data can be gathered by studying schools that have been successful with the implementation and management of technology. The findings of this study showed that the implementation and management of educational technology was a dynamic process that was both complex and unique to the environment in which it was taking place.

While each school studied was distinctive and possessed its own unique culture, the findings of this study highlighted the importance of the interaction of the interdependent factors of the SupportIF model of implementation, namely, leadership, resources, relationships and teaching and learning factors. In doing this, the findings of the study revealed the prime importance of the supportive work environment in each of the research schools, and linked this environment to the level of success realised with the implementation and management of technology. The findings suggested that the sustainability of a school-based technology initiative rests with a school's ability to balance these key factors and to redesign in light of shared practice. Tantamount to the success of this process is the supportive work environment in each school which shapes and facilitates the level of interdependence between the factors of implementation and characterises the relationships within and between implementation factors. In effect, the supportive work environment reinforces Aristotle's premise that:

> The whole is characterised not only by its parts, but by the relations between the parts as well (Aristotle, 1024a).

To this end, the findings of this study showed that the process approach of technology implementation and management outlined in the SupportIF Model is most successful when a supportive work environment exits. The synergy generated when the implementation factors interact within a supportive work environment is considerable and needs to be encouraged. In short, school administrators and technology planners need to understand the significance of the supportive school work environment and recognise the relationship of the supportive work environment to the level of success achieved with the implementation of a school technology initiative.

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ppendix 1:

Primary School Selection Guide

	Level of Development		
Attributes	Formative	Consolidate	Highly Developed
Viewed by the local community and educational peers as being a leading school in the use of technology			
Technology integrated across Key Learning Area.			
Constructivists teaching strategies being used in the classroom - peer tutoring, collaborative group work, integrated projects, learning centres etc.			
Addresses specific learning needs of students through the use of educational technology			
Promotes creativity and the use of higher order thinking skills using technology.			
Addresses specific administrative needs through the use of educational technology (e.g. Programming, assessment and reporting)			
Has a technology plan			
Has or uses a sequential outcome based technology scope and sequence.			
Professional development and training related to educational technology			
Budgets for ongoing maintenance, upgrades and staff training and development			
School networked - administration - classrooms – library, laboratory			
Is connected to Internet – classrooms, library, administration, laboratory			
School home page, updated regular			
Technology co-ordinator or reference person appointed, has role description and is provided with supported in school			

Appendix 2:

Parkway Primary School

	Level of Development		
Attributes	Formative	Consolidate	Highly Developed
Viewed by the local community and educational peers as being a leading school in the use of technology			
Technology integrated across Key Learning Area.			
Constructivists teaching strategies being used in the classroom - peer tutoring, collaborative group work, integrated projects, learning centres etc.			
Addresses specific learning needs of students through the use of educational technology			
Promotes creativity and the use of higher order thinking skills using technology.			
Addresses specific administrative needs through the use of educational technology (e.g. Programming, assessment and reporting)			
Has a technology plan			
Has or uses a sequential outcome based technology scope and sequence.			
Professional development and training related to educational technology			
Budgets for ongoing maintenance, upgrades and staff training and development			
School networked - administration - classrooms – library, laboratory			
Is connected to Internet – classrooms, library, administration, laboratory			
School home page, updated regular			
Technology co-ordinator or reference person appointed, has role description and is provided with supported in school			

Appendix 3:

Floraville Primary School

Attributes	Level of Development: Formative	Consolidate	Highly Developed
Viewed by the local community and educational peers as being a leading school in the use of technology			
Technology integrated across Key Learning Area.			
Constructivists teaching strategies being used in the classroom - peer tutoring, collaborative group work, integrated projects, learning centres etc.			
Addresses specific learning needs of students through the use of educational technology			
Promotes creativity and the use of higher order thinking skills using technology.			
Addresses specific administrative needs through the use of educational technology (e.g. Programming, assessment and reporting)			
Has a technology plan			
Has or uses a sequential outcome based technology scope and sequence.			
Professional development and training related to educational technology			
Budgets for ongoing maintenance, upgrades and staff training and development			
School networked - administration - classrooms – library, laboratory			
Is connected to Internet – classrooms, library, administration, laboratory			
School home page, updated regular			
Technology co-ordinator or reference person appointed, has role description and is provided with supported in school			

Appendix 4

Northern Heights Primary School

	Level of Development		
Attributes	Formative	Consolidate	Highly Developed
Viewed by the local community and educational peers as being a leading school in the use of technology			
Technology integrated across Key Learning Area.			
Constructivists teaching strategies being used in the classroom - peer tutoring, collaborative group work, integrated projects, learning centres etc.			
Addresses specific learning needs of students through the use of educational technology			
Promotes creativity and the use of higher order thinking skills using technology.			
Addresses specific administrative needs through the use of educational technology (e.g. Programming, assessment and reporting)			
Has a technology plan			
Has or uses a sequential outcome based technology scope and sequence.			
Professional development and training related to educational technology			
Budgets for ongoing maintenance, upgrades and staff training and development			
School networked - administration - classrooms – library, laboratory			
Is connected to Internet – classrooms, library, administration, laboratory			
School home page, updated regular			
Technology co-ordinator or reference person appointed, has role description and is provided with supported in school			

Appendix 5:

Main Street Primary

Attributes	Level of Development		
	Formative	Consolidate	Highly Developed
Viewed by the local community and educational peers as being a leading school in the use of technology			
Technology integrated across Key Learning Area.			
Constructivists teaching strategies being used in the classroom - peer tutoring, collaborative group work, integrated projects, learning centres etc.			
Addresses specific learning needs of students through the use of educational technology			
Promotes creativity and the use of higher order thinking skills using technology.			
Addresses specific administrative needs through the use of educational technology (e.g. Programming, assessment and reporting)			
Has a technology plan			
Has or uses a sequential outcome based technology scope and sequence.			
Professional development and training related to educational technology			
Budgets for ongoing maintenance, upgrades and staff training and development			
School networked - administration - classrooms – library, laboratory			
Is connected to Internet – classrooms, library, administration, laboratory			
School home page, updated regular			
Technology co-ordinator or reference person appointed, has role description and is provided with supported in school			

Appendix 6:

Eastern Plains Primary

	Level of Development		
Attributes	Formative	Consolidate	Highly Developed
Viewed by the local community and educational peers as being a leading school in the use of technology			
Technology integrated across Key Learning Area.			
Constructivists teaching strategies being used in the classroom - peer tutoring, collaborative group work, integrated projects, learning centres etc.			
Addresses specific learning needs of students through the use of educational technology			
Promotes creativity and the use of higher order thinking skills using technology.			
Addresses specific administrative needs through the use of educational technology (e.g. Programming, assessment and reporting)			
Has a technology plan			
Has or uses a sequential outcome based technology scope and sequence.			
Professional development and training related to educational technology			
Budgets for ongoing maintenance, upgrades and staff training and development			
School networked - administration - classrooms – library, laboratory			
Is connected to Internet – classrooms, library, administration, laboratory			
School home page, updated regular			
Technology co-ordinator or reference person appointed, has role description and is provided with supported in school			

Appendix 7:

High Tops Primary

	Level of Development		
Attributes	Formative	Consolidate	Highly Developed
Viewed by the local community and educational peers as being a leading school in the use of technology			
Technology integrated across Key Learning Area.			
Constructivists teaching strategies being used in the classroom - peer tutoring, collaborative group work, integrated projects, learning centres etc.			
Addresses specific learning needs of students through the use of educational technology			
Promotes creativity and the use of higher order thinking skills using technology.			
Addresses specific administrative needs through the use of educational technology (e.g. Programming, assessment and reporting)			
Has a technology plan			
Has or uses a sequential outcome based technology scope and sequence.			
Professional development and training related to educational technology			
Budgets for ongoing maintenance, upgrades and staff training and development			
School networked - administration - classrooms – library, laboratory			
Is connected to Internet – classrooms, library, administration, laboratory			
School home page, updated regular			
Technology co-ordinator or reference person appointed, has role description and is provided with supported in school			

Appendix 8:

Western View Primary

Attributes	Level of Development: Formative	Consolidate	Highly Developed
Viewed by the local community and educational peers as being a leading school in the use of technology			
Technology integrated across Key Learning Area.			
Constructivists teaching strategies being used in the classroom - peer tutoring, collaborative group work, integrated projects, learning centres etc.			
Addresses specific learning needs of students through the use of educational technology			
Promotes creativity and the use of higher order thinking skills using technology.			
Addresses specific administrative needs through the use of educational technology (e.g. Programming, assessment and reporting)			
Has a technology plan			
Has or uses a sequential outcome based technology scope and sequence.			
Professional development and training related to educational technology			
Budgets for ongoing maintenance, upgrades and staff training and development			
School networked - administration - classrooms – library, laboratory			
Is connected to Internet – classrooms, library, administration, laboratory			
School home page, updated regular			
Technology co-ordinator or reference person appointed, has role description and is provided with supported in school			

Appendix 9:

Garden Vista Primary

	Level of Development		
Attributes	Formative	Consolidate	Highly Developed
Viewed by the local community and educational peers as being a leading school in the use of technology			
Technology integrated across Key Learning Area.			
Constructivists teaching strategies being used in the classroom - peer tutoring, collaborative group work, integrated projects, learning centres etc.			
Addresses specific learning needs of students through the use of educational technology			
Promotes creativity and the use of higher order thinking skills using technology.			
Addresses specific administrative needs through the use of educational technology (e.g. Programming, assessment and reporting)			
Has a technology plan			
Has or uses a sequential outcome based technology scope and sequence.			
Professional development and training related to educational technology			
Budgets for ongoing maintenance, upgrades and staff training and development			
School networked - administration - classrooms – library, laboratory			
Is connected to Internet – classrooms, library, administration, laboratory			
School home page, updated regular			
Technology co-ordinator or reference person appointed, has role description and is provided with supported in school			

Appendix 10: Letter to School Principal

Dear Principal

I am writing to introduce myself and invite (school name) to be part of an important educational research project. My name is Doug Ashleigh and I am presently studying with the Australian Catholic University in the Doctor of Education Program. Last year my research proposal gained approval from the research ethics committee and I plan to commence gathering data for my proposed research during terms three and four of 1999.

The title of the research is an exploration of primary schools in New South Wales that have successfully implemented and managed educational technology. Within this field there is a definite lack of research on the implementation and management of educational technology in the primary school setting. This study will aim to describe and analyse how key schools have become successful and maintained success in the implementation and management of educational technology. Using a sociotechnical systems approach the relationship of organisational factors, human requirements and the technological resources of each school will be studied and possible links established to the leadership exercised in each school. The research will study three New South Wales primary schools that are considered to be successful in the implementation and management of educational technology. To gather the required data I will need to spend two weeks in each school conducting interviews and gathering data. At the conclusion of the study a comprehensive report of my findings will be presented to the participating schools. Confidentiality of participants will be strictly observed in the reporting process.

It is hoped that the best practice witnessed in the participating schools will provide important information and insight that will be invaluable to primary schools throughout New South Wales. At the same this research has the potential to provide great opportunities for positive reinforcement and widespread recognition of the developments in the field of educational technology.

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I thank you for your time and I look forward to the prospect of working with (school's name). I will make contact with you in the coming weeks to discuss this invitation.

Yours sincerely

Doug Ashleigh

B.Ed, Grad Dip RE, M.Ed

Appendix 11: Letter to prospective research participant

Dear (prospective participant)

I am writing to introduce myself and invite you to be part of an important educational research project being conducted at (school's name) this year. My name is Doug Ashleigh and I am presently studying with the Australian Catholic University in the Doctor of Education Program. Last year my research proposal gained approval from the research ethics committee and I plan to commence gathering data for my proposed research during terms three and four of 1999.

The title of the research is an exploration of primary schools in New South Wales that have successfully implemented and managed educational technology. Within this field there is a definite lack of research on the implementation and management of educational technology in the primary school setting. This study will aim to describe and analyse how (school's name) has become successful and maintained success in the implementation and management of educational technology. Using a sociotechnical systems approach the relationship of organisational factors, human requirements and the technological resources of each school will be studied and possible links established to the leadership exercised in each school. The research will study four New South Wales primary schools that are considered to be successful in the implementation and management of educational technology.

To gather the required data I will need to spend two weeks in each school conducting interviews and gathering data. All participants in the project will be individually interviewed, interviews will be audio taped to enable a true and accurate recount of the interview to be gained. At the conclusion of the study a comprehensive report of my findings will be presented to the participating schools. Confidentiality of participants will be strictly observed in the reporting process.

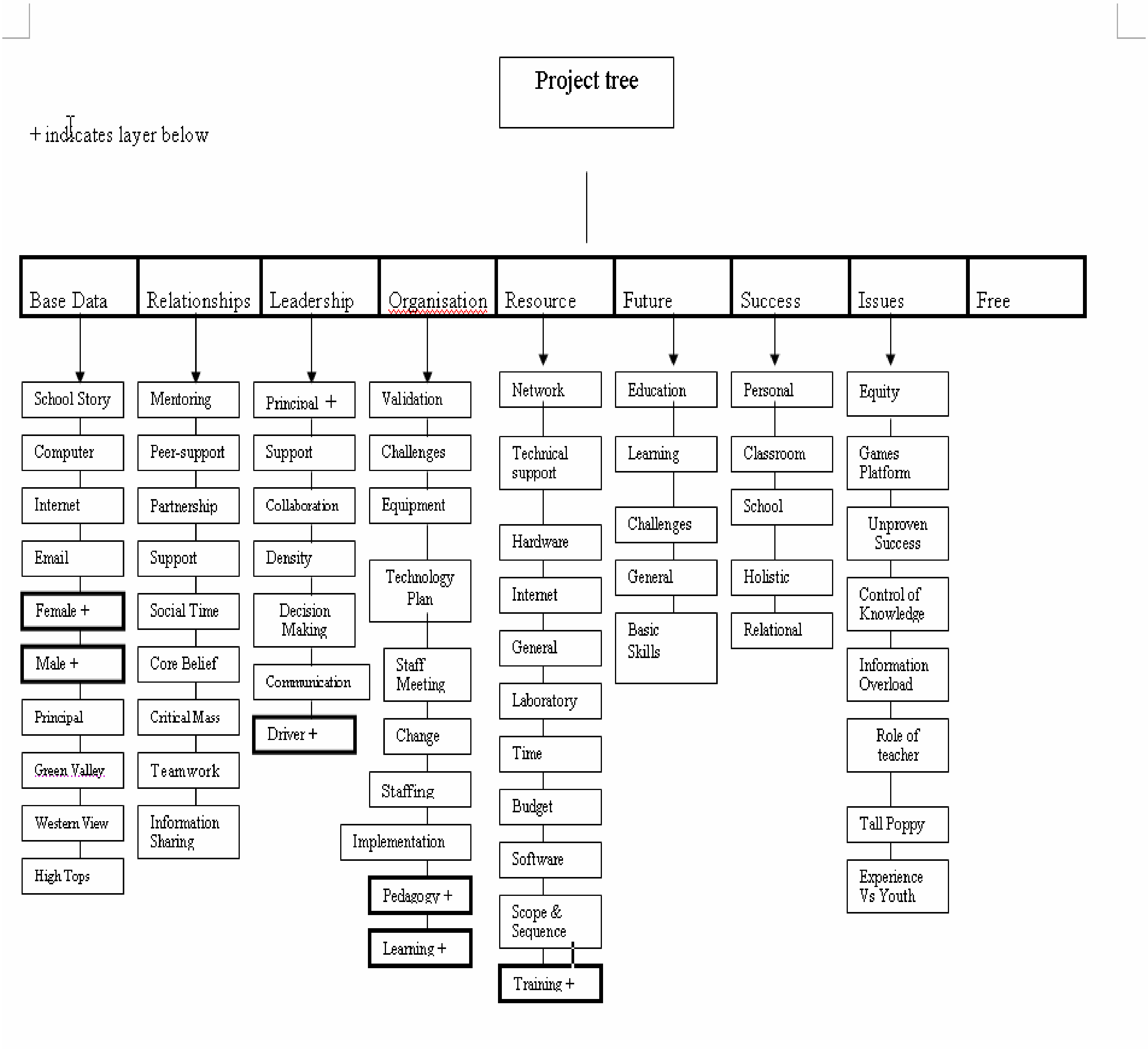
I will be visiting (school's name) from (dates of visit) and I would welcome an opportunity to conduct an interview with you. If you would like to part of this research project please complete the attached consent form and return in the self stamp addressed envelope.

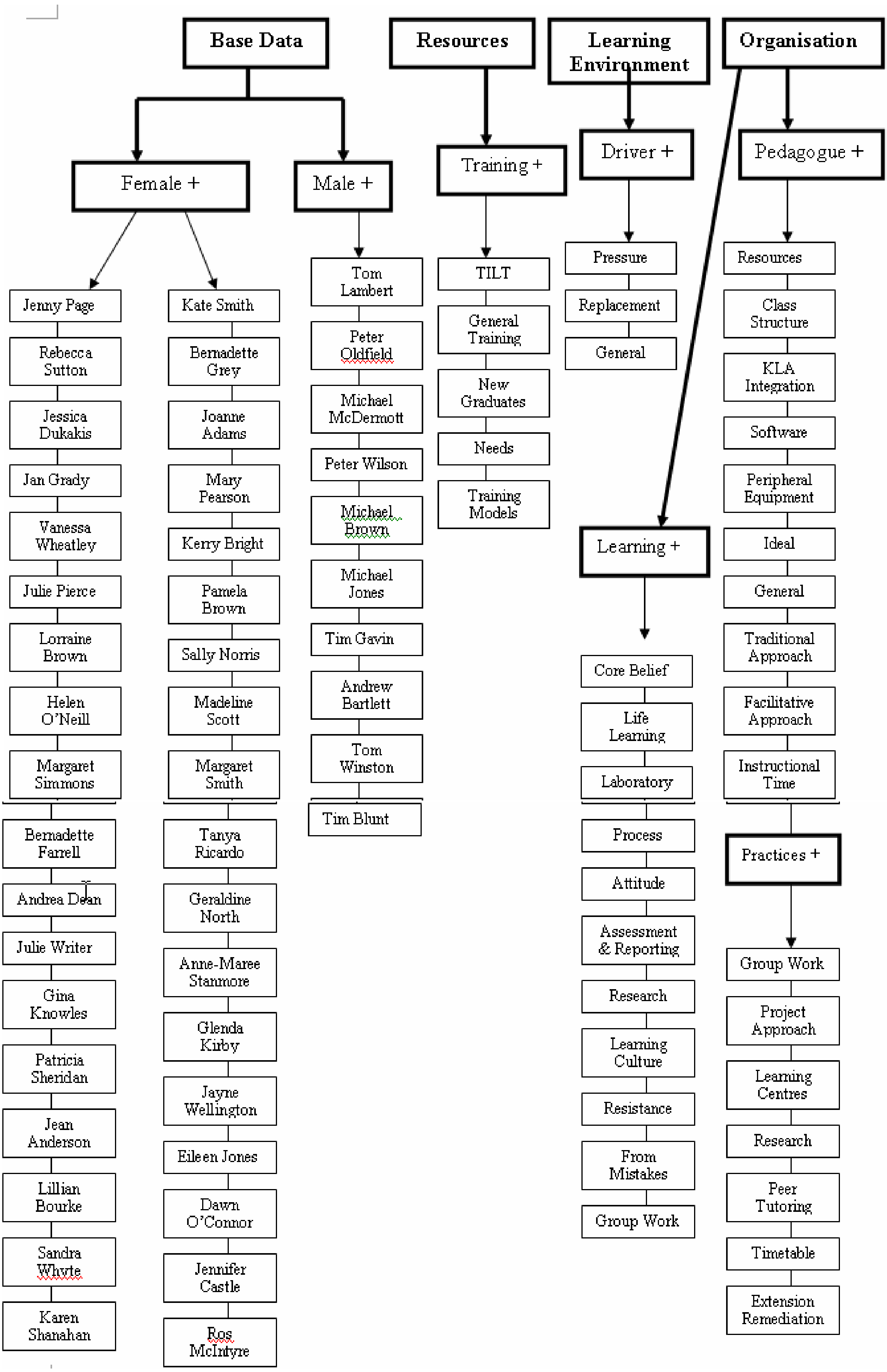
I sincerely thank you for your assistance and I look forward to the possibility of working with you.

Best wishes

Doug Ashleigh
B.Ed, Grad Dip RE, M.Ed.

Appendix 12


Project tree
+ indicates layer below
Base Data
Relationships
Leadership
Organisation
Resource
Future
Success
Issues
Free
School Story
Computer
Internet
Email
Female +
Male +
Principal
Green Valley
Western View
High Tops
Mentoring
Peer-support
Partnership
Support
Social Time
Core Belief
Critical Mass
Teamwork
Information Sharing
Principal +
Support
Collaboration
Density
Decision Making
Communication
Driver +
Validation
Challenges
Equipment
Technology Plan
Staff Meeting
Change
Staffing
Implementation
Pedagogy +
Learning +
Network
Technical support
Hardware
Internet
General
Laboratory
Time
Budget
Software
Scope & Sequence
Training +
Education
Learning
Challenges
General
Basic Skills
Personal
Classroom
School
Holistic
Relational
Equity
Games Platform
Unproven Success
Control of Knowledge
Information Overload
Role of teacher
Tall Poppy
Experience Vs Youth



Base Data
Resources
Learning Environment
Organisation
Female +
Male +
Training +
Driver +
Pedagogue +
Jenny Page
Rebecca Sutton
Jessica Dukakis
Jan Grady
Vanessa Wheatley
Julie Pierce
Lorraine Brown
Helen O'Neill
Margaret Simmons
Bernadette Farrell
Andrea Dean
Julie Writer
Gina Knowles
Patricia Sheridan
Jean Anderson
Lillian Bourke
Sandra Whyte
Karen Shanahan
Kate Smith
Bernadette Grey
Joanne Adams
Mary Pearson
Kerry Bright
Pamela Brown
Sally Norris
Madeline Scott
Margaret Smith
Tanya Ricardo
Geraldine North
Anne-Maree Stanmore
Glenda Kirby
Jayne Wellington
Eileen Jones
Dawn O'Connor
Jennifer Castle
Ros McIntyre
Tom Lambert
Peter Oldfield
Michael McDermott
Peter Wilson
Michael Brown
Michael Jones
Tim Gavin
Andrew Bartlett
Tom Winston
Tim Blunt
TILT
General Training
New Graduates
Needs
Training Models
Pressure
Replacement
General
Learning +
Core Belief
Life Learning
Laboratory
Process
Attitude
Assessment & Reporting
Research
Learning Culture
Resistance
From Mistakes
Group Work
Resources
Class Structure
KLA Integration
Software
Peripheral Equipment
Ideal
General
Traditional Approach
Facilitative Approach
Instructional Time
Practices +
Group Work
Project Approach
Learning Centres
Research
Peer Tutoring
Timetable
Extension Remediation

1.

Appendix 14:
Interview Guide

1. Background

(a) How long have you been teaching?

(b) In what schools have you taught?

(c) How long have you worked at this school?

(d) Do you have access to a computer outside of school hours?

(e) Do you have Internet access outside of school hours?

(f) Do you use email outside of school hours?

2. Relational Factors

(a) Describe the working relationships that exist here?

(b) What happens here that lets the school technology initiative be successful?

(c) How are professional relationships developed here?

(d) How do the staff support one another at this school?

(e) How can a supportive work environment be created in a school?

(f) Can you give an example of a situation that you have experienced that reflects the working relationship that exists here?

3. **Leadership**

(a) Is success in technology at this school dependent on a key person?

(b) What role does the principal play in the implementation and management of educational technology at this school?

(c) What effect does the principal's level of confidence and competence in utilising technology have on the school's technology initiative?

(d) As a classroom teacher how are you supported in the school's technology initiative?

(e) Is leadership shared at this school?
(If so, how?)

(g) How are important decisions made at this school?

4. Resource

(A) What resources do schools need to integrate technology into the classroom?

(b) What are the most significant resource issues confronting classroom teachers as they attempt to implement and manage educational technology?

(c) How do you learn, in respect to educational technology, at this school?

(d) What type of technology training do you find most effective?

(e) Can you give an example of a situation that you have experienced that reflects the way you learn most effectively with technology?

(f) What needs to happen at this school to enable classroom teachers to be better prepared for the future challenges of the information age?

5. Learning Environment

(a) How can technology be integrated into the classroom?

(b) Can technology be integrated across the curriculum?

(c) Can technology enhance learning and thinking? If so, how?
(What implication does this have for classroom teachers?)

(d) Much is written about classrooms of tomorrow and the role technology will play. What are your thoughts on the classrooms of the 21^{st} century?

(e) Can technology effect the achievement of learning outcomes for students?

(f) Does the school have a technology plan?

(g) How was it developed?

6. Success / Challenges / the Future

(a) What challenges do you face personally in relation to the integration of technology into the classroom?

(b) With the value of hindsight, what changes would you recommend to the school's technology committee in relation to the school's technology initiative?

(c) What advice would you offer a school embarking on a school based technology initiative?

Appendix 14:

Print out from QSR NUD*IST of all nodes, their definition and the number of text units indexed.

```
**********************************************************************
*********
(1)                     /Base Data
*** No Definition
**********************************************************************
*********
(1 1)                   /Base Data/school
*** Definition:
Garden Vista, High Tops, and Western View

0 text units indexed
**********************************************************************
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(1 1 8)                 /Base Data/school/Garden Vista
*** Definition:
Garden Vista Primary School

2343 text units referenced
**********************************************************************
*********
(1 1 9)                 /Base Data/school/Western View

*** Definition:
 Western View Primary School

2445 text units referenced
**********************************************************************
*********
(1 1 10)                /Base Data/school/High Tops
*** Definition:
High Tops Primary School

1517 text units referenced
**********************************************************************
*********
(1 2)                   /Base Data/home comp

*** Definition:
Does the participant have a PC at home
108 text units referenced
**********************************************************************
*********
(1 3)                   /Base Data/internet
*** Definition:
Does the participant have Internet access at home?
114 text units referenced
**********************************************************************
*********
(1 4)                   /Base Data/Email
*** Definition
Access to and usage of email

143 text units referenced
**********************************************************************
*********
(1 5)                   /Base Data/Female
```

Appendix 14

```
***  Definition

Female participants
4898 text units referenced
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(1 5 1)                 /Base Data/Female/Jenny Page GV
*** No Definition
250 text units referenced 2

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(1 5 2)                 /Base Data/Female/Rebecca Sutton WV
*** No Definition

92 text units referenced
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95 text units referenced
**********************************************************************
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*** No Definition

118 text units referenced
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124 text units referenced
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107 text units referenced
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113 text units referenced
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*** No Definition

140 text units referenced
**********************************************************************
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*** No Definition
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Appendix 14

113 text units referenced
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*** No Definition

115 text units referenced
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128 text units referenced
****
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138 text units referenced
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56 text units referenced
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133 text units referenced
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105 text units referenced
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(1 5 18)   /Base Data/Female/Kate Smith GV
*** No Definition

110 text units referenced
****
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Appendix 14

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113 text units referenced
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111 text units referenced
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Appendix 14

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*** No Definition

210 text units referenced
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*** No Definition

68 text units referenced
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*** No Definition

170 text units referenced
****
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*** No Definition

120 text units referenced
****
(1 6) /Base Data/Male
*** Definition:
Male participants

1407 text units referenced
****
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*** No Definition

Appendix 14

228 text units referenced
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(1 6 2)   /Base Data/Male/Peter Oldfield GV
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*** No Definition

120 text units referenced
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*** No Definition

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*** No Definition

189 text units referenced
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*** No Definition

103 text units referenced
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105 text units referenced
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*** No Definition

169 text units referenced
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****
(1 7)   /Base Data/Principal

Appendix 14

*** Definition:
School Principals

578 text units referenced
****
(2)   /Relationships
*** Definition:
Impact and effect people have on one another

891 text units referenced
****
(2 1)   /Relationships/Peer Support
*** Definition:
Provision of assistance and or support by colleague or student

156 text units referenced
****
(2 2)   /Relationships/Mentoring
*** Definition:
Provision of one on one instruction to a teacher.

8 text units referenced
****
(2 4)   /Relationships/Enthusiasm
*** Definition:
Excitement and interest in relation to educational technology

13 text units referenced
****
(2 5)   /Relationships/Partnership
*** Definition:
Working relationship characterised by mutual co-operation

170 text units referenced
****
(2 6)   /Relationships/Support
*** Definition:
Free provision of help, assistance and or time to a colleague

367 text units referenced
****
(2 7)   /Relationships/Time
*** Definition:
Time spent socially with colleagues

144 text units referenced
****
(2 8)   /Relationships/Core Belief
*** Definition:
Essential and most important belief

222 text units referenced
****

Appendix 14

****

(2 9) /Relationships/Critical Mass

*** Definition:

The level of support required for a specific result to occur - i.e. the integration of educational technology

46 text units referenced

****

(2 10) /Relationships/Teamwork

*** Definition:

Cooperative effort by the members of a group or team to achieve a common goal

137 text units referenced

****

(2 11) /Relationships/Information Sharing

*** Definition:

The free and open sharing of information

88 text units referenced

****

(3) /Leadership

*** Definition:

The process of influencing the behaviour of other people toward group goals

891 text units referenced

****

(3 1) /Leadership/Principal

*** Definition:

Influence that the principal has on the achievement of group goals

444 text units referenced

****

(3 2) /Leadership/Technical Competence (Principal)

*** Definition:

Technical competence of the school principal

78 text units referenced

****

(3 3) /Leadership/expectations (Principal)

*** Definition:

Leadership expectations of the principal in respect to educational technology.

261 text units referenced

****

(3 4) /Leadership/Support

*** Definition:

Support, assistance and time provided by leaders

Appendix 14

****
282 text units referenced
****
(3 5) /Leadership/Collaboration
*** Definition:
Working together

29 text units referenced
****
(3 6) /Leadership/Leadership Sharing
*** Definition:
The level of leadership sharing that occurs

217 text units referenced
****
(3 7) /Leadership/Decision making
*** Definition:
The processes of making decisions

79 text units referenced
****
(3 8) /Leadership/Communication
*** Definition:
The exchange of information, opinions and behaviour

88 text units referenced
****
(3 9) /Leadership/Driver
*** Definition:
The identified key person in respect to technology

342 text units referenced
****
(3 9 1) /Leadership/Driver/Pressure
*** Definition:
Demands placed on the key driver

55 text units referenced
****
(3 9 2) /Leadership/Driver/Replacement
*** Definition:
Replacement of the key driver

116 text units referenced
****
(4) /Resources
*** Definition:
Means that can be physically used to assist the integration and management of educational technology

689 text units referenced
****
(4 1) /Resources/Technical support

Appendix 14

****
*** Definition:
Specific support related to technical issues

77 text units referenced
****
(4 2)   /Resources/Network
*** Definition:
The school network

46 text units referenced
****
(4 3)   /Resources/Hardware
*** Definition:
Educational technology hardware i.e. computer systems and peripherals

100 text units referenced
****
(4 4)   /Resources/Internet access
*** Definition:
Access to and usages of the Internet

128 text units referenced
****
(4 6)   /Resources/Laboratory
*** Definition:
Computer laboratory

18 text units referenced
****
(4 7)   /Resources/Time
*** Definition:
Provision of time

170 text units referenced
****

(4 8)   /Resources/Budget
*** Definition:
Budget provisions for technology

12 text units referenced
****
(4 9)   /Resources/Software
*** Definition:
Software resources

9 text units referenced
****
(4 10)   /Resources/Scope & sequence
*** Definition:
Technology skills based scope and sequence

Appendix 14

****
17 text units referenced
****
(4 11)   /Resources/Training and Development
*** Definition:
Provision of training and development

252 text units referenced
****
(4 11 1)   /Resources/Training and Development/Staff Meeting
*** Definition:
Training and development in the staff meeting

63 text units referenced
****
(4 11 2)   /Resources/Training and Development/TILT
*** Definition:
Technology in Learning and Teaching Program

35 text units referenced
****
(4 11 3)   /Resources/Training and Development/New Graduates
*** Definition:
Newly graduated teachers

46 text units referenced
****
(4 11 6)   /Resources/Training and Development/One-on-One Model

*** Definition:
Training using a one on one approach

100 text units referenced
****
(4 11 7)   /Resources/Training and Development/Network Model
*** Definition:
Training using a network approach

119 text units referenced
****
(4 12)   /Resources/Equity
*** Definition:
Resource equity with educational technology

149 text units referenced
****
(5)   /Learning Environment Factors
*** Definition:
Structures and practices that influence the integration and management of educational technology

Appendix 14

****

970 text units referenced

****

(5 1) /Learning Environment Factors/Validation

*** Definition:

The recognition and acknowledgement of effort and / or achievement

20 text units referenced

****

(5 2) /Learning Environment Factors/Challenges

*** Definition:

Difficulties faced implementing and managing educational technology

246 text units referenced

****

(5 3) /Learning Environment Factors/Change

*** Definition:

Technologically driven change

204 text units referenced

****

(5 4) /Learning Environment Factors/Planning

*** Definition:

Systematic preparation for the implementation and management of educational technology

176 text units referenced

****

(5 6) /Learning Environment Factors/P & C

*** Definition:

Parents and Citizen's committee

3 text units referenced

****

(5 8) /Learning Environment Factors/Staffing

*** Definition:

The arrangement of staffing

16 text units referenced

****

(5 10) /Learning Environment Factors/Pedagogue

*** Definition:

Teaching philosophy and beliefs

341 text units referenced

****

(5 10 1) /Learning Environment Factors/Pedagogue/Limited Resources

*** Definition:

12 Limited resource issues

Appendix 14

****
 (5 10 2)   /Learning Environment Factors/Pedagogue/Classroom Structure
*** Definition:
Struucture of classrooms and their relationship to pedagogue

56 text units referenced
****
(5 10 3)   /Learning Environment Factors/Pedagogue/KLA Integration
*** Definition:
Integration of educational technology in and across Key Learning Areas

52 text units referenced
****
(5 10 4)   /Learning Environment Factors/Pedagogue/Software
*** Definition:
Software - pedagogical applications

22 text units referenced
****
(5 10 6)   /Learning Environment Factors/Pedagogue/Ideal
*** Definition:
Ideal relationship of pedagogue and technology

16 text units referenced
****
 (5 10 8)   /Learning Environment Factors/Pedagogue/Traditional Approach
*** Definition:
Traditional approach to teaching

32 text units referenced
****
(5 10 9)   /Learning Environment Factors/Pedagogue/Facilitative Approach
*** Definition:
Facilitative approach to teaching

88 text units referenced
****
(5 10 10)   /Learning Environment Factors/Pedagogue/Missing Instructional Time
*** Definition:
The loss of instructional time in a facilitative environment

13 text units referenced
****
(5 10 11 1)   /Learning Environment Factors/Pedagogue/Practices/Group Work
*** Definition:
Two or more students working together

Appendix 14

****
89 text units referenced
****
(5 11)   /Learning Environment Factors/Learning
*** Definition:
The process of gaining understanding through the creation of meaning

325 text units referenced
****
(5 11 1)   /Learning Environment Factors/Learning/Core Belief

****
*** Definition:
Essential beliefs related to learning

61 text units referenced
****
(5 11 2)   /Learning Environment Factors/Learning/Life learning
*** Definition:
Learning that is viewed as not being constrained by time or place

36 text units referenced
****
(5 11 4)   /Learning Environment Factors/Learning/Process
*** Definition:
Learning as an evolving dynamic process

30 text units referenced
****
(5 11 5)   /Learning Environment Factors/Learning/Positive attitude
*** Definition:
Attitude held about learning

42 text units referenced
****
(5 11 6)   /Learning Environment Factors/Learning/assessment Reporting
*** Definition:
Assessment and reporting

10 text units referenced
****

Appendix 14

(5 11 8) /Learning Environment Factors/Learning/Learning Culture
*** Definition:
The learning culture that exists in a school

17 text units referenced
****
****
(5 11 9) /Learning Environment Factors/Learning/Resistance
****
****
*** Definition:
Resistance to learning

61 text units referenced
****
****
(5 11 10) /Learning Environment Factors/Learning/From Mistakes

****
****
*** Definition:
The process of learning from mistakes

28 text units referenced
****
****
(5 11 11) /Learning Environment Factors/Learning/Passion
*** Definition:
Drive and enthusiasm for learning demonstrated

27 text units referenced
****
****
(6) /Future
*** Definition:
Predictions about the future, particularly in respect to the integration of educational technology

192 text units referenced
****
****
(6 1) /Future/Education
*** Definition:
Future predictions - education

53 text units referenced
****
****
(6 3) /Future/Challenges
*** Definition:
Future challenges predicted to face schools

98 text units referenced
****
****

Appendix 14
****
 (6 5)   /Future/Basic Skills
*** Definition:

Future predictions related to basic skill levels required by students

35 text units referenced
****
 (7)   /Success
*** Definition:
The level of success viewed by participants

Text units referenced
****
(7 1)   /Success/Personal
*** Definition:
Individual success

143 text units referenced
****
(7 2)   /Success/Classroom
*** Definition:
Classroom success

26 text units referenced
****
(7 3)   /Success/School
*** Definition:
School success

59 text units referenced
****
(7 4)   /Success/Holistic
*** Definition:
Holistic success

26 text units referenced
****
(7 5)   /Success/Relational
*** Definition:
Relational success

28 text units referenced
****
(8)   /Issues
*** Definition:
Emerging issues

169 text units referenced
****
(8 1)   /Issues/Equity Access
*** Definition:
Issue - equity and access

Appendix 14

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**********************************************************************
*********
63 text units referenced
**********************************************************************
*********
(8 2)                   /Issues/Games Platform
*** Definition:
Issue - Games platform

12 text units referenced
**********************************************************************
*********
(8 3)                   /Issues/Unproven success
*** Definition:
Issue - Unproven success

28 text units referenced
**********************************************************************
*********
(8 6)                   /Issues/Role of Teacher
*** Definition:
Issue - Role of the teacher

34 text units referenced
**********************************************************************
*********
(8 7)                   /Issues/Tall Poppy
*** Definition:
Issue - Tall poppy

15 text units referenced
**********************************************************************
*********
(8 8)                   /Issues/Experience Vs Youth
*** Definition:
Issue Experience V's Youth

26 text units referenced
**********************************************************************
*********
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