Science and Mathematics Education Centre

An Analysis of the Impact of an E-Classroom Environment on the Social, Cognitive and Affective Elements of Student Work Practices

Garry W. Falloon

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ABSTRACT

This thesis documents the findings of an intrinsic case study examining the impacts of a digital or e-classroom environment[1] on the social, affective, and cognitive development of a group of 33 year 5 and 6 students, in an urban primary school in Northland, New Zealand.

It examines the manner in which the e-classroom concept was developed and implemented, the rationale behind its development, and the role of key players in this process. It further examines the impact of this environment on student work processes and practices, and identifies the unique blend of teacher philosophy, curriculum design and organisation, and computer application that comprised the learning environment for these students.

Results of this study indicate particular issues associated with the successful operation of this e-classroom. These issues relate to such aspects as difficulties in managing and monitoring student progress when engaged in the multiplicity of learning tasks enabled by such an environment, the importance of student group composition and selection, the limitations of computers in supporting important knowledge development, and the manner in which students interact with and manipulate the features of software.

The thesis concludes by presenting an analysis of the impact that these, and other vital areas of student engagement with computers, have on the effectiveness of utilising technological resources in this manner. It presents a series of recommendations for changes to improve the effectiveness of the learning environment in this e-classroom, and identifies a series of considerations for other schools considering undertaking similar initiatives.

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[1] A digital or e-classroom refers to a learning environment in which there is sufficient access to computers for students to undertaken all curriculum activity using them either as individuals or in small groups.

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CHAPTER 1
Introduction

1.1 Background to Computer Use in New Zealand Schools

Computer use in New Zealand schools is still in its early stage of development, having been implemented progressively over the past two decades to varying degrees at all levels of the education system (Wenmoth, 1999). Many institutions have invested considerable amounts of time and money in this area. This investment has focused on the provision of hardware and software for staff and students, developing school network systems for classroom and administrative purposes, implementing school-use policies for monitoring access to electronic resources and databases such as the World Wide Web, and investing in staff professional development in the use and operation of these technologies.

Such moves have been actively supported by centralised administrative agencies such as the New Zealand Ministry of Education (1993, 1998, 2002) and the Education Review Office (1999, 2000, 2001), in addition to a number of corporates, private trusts, and other sector interest groups. Such groups see the development of students with high levels of computer and 'information literacy', and an ability to access economic opportunities in an increasingly globalised marketplace, as vital to the future economic well-being of the country. Although the Ministry of Education has been highly vocal in advocating such support from very early on, tangible assistance by way of specific funding and organisational support for professional development and the establishment of school infrastructure, did not happen until the late 1990's, with the publication of 'Interactive Education' (Ministry of Education, 1998) – the New Zealand Information and Communication Technology Strategy for Schools. This document and its subsequent revision 'Digital Horizons' (Ministry of Education, 2002), was the first attempt by centralised government to provide schools with any sort of coordinated direction related to the planning, implementation and use of Information and

Communications Technologies (ICT) within curriculum. The strategy focused primarily on computer use, and was accompanied by a limited amount of budget allocation which was targeted specifically at teacher professional development, assistance with networking and associated infrastructural requirements, and the provision of technical advice and assistance through the establishment of a free-call help desk.

Despite the advent of 'Interactive Education' (Ministry of Education, 1998) and 'Digital Horizons' (Ministry of Education, 2002) most schools still struggle in finding a place for computers within their programmes. Typically, they suffer from the legacy of bad decisions and unclear or misdirected objectives relating to computer implementation and purpose, which were the hallmarks of the early implementation period between 1988 and 1998 (Anderson, 1995). Schools are still unsure, and many are somewhat sceptical, as to why they have computers in their classrooms in the first place. They see this area as a potential 'black hole' into which considerable amounts of funding can be poured, with little or no apparent return on their investment for their students (Bigum, 2003; Blackmore, Hardcastle, Bamblett, & Owens, 2003; Cuban, 2002; Dede, 1997).

When this factor is coupled with issues related to the technical unreliability of equipment and infrastructure, inappropriate or often inaccessible professional development, continual curriculum change and revision, and increased levels of expectation placed on teachers from parents and review agencies across a wider range of accountabilities, teachers could fairly be excused for questioning the value of using such technologies with their students. Indeed, it would be reasonable to state that the apparent reluctance of many teachers to embrace these new educational technologies is highly understandable. Given the lack of a clear educational rationale for their inclusion in curriculum in the first place, and vague, at best, evidence of the educational benefits and advantages for their students, teachers need support in determining the value of computers in their programmes (Winter, 2004).

1.2 Relevance of the Research

The focus of this thesis arose from concern relating to the lack of a clear educational rationale for the inclusion of computers in New Zealand schools, a paucity of research into just how children work and respond in a 'digital environment', and uncertainty as to the nature of learning benefits for students, if any, from computer use. This perspective is supported by Robertson (2003), who claims that the narrative associated with computer implementation in schools has associated with it "no values other than economic" and that the processes involved in implementation have contained "no discussion of what education is for" (Robertson, 2003, p. 328). Postman (1993) had earlier targetted this issue by stating that computer use in education lacks a "mythology of learning and requires a theory about its purpose and meaning" (Postman, 1993, p. 75). He claims that without such a theoretical framework, it will continue to flounder and fail to deliver on the promises originally promoted for its inclusion in the educational environment.

This research therefore sought to identify the manner in which students work and learn in a primarily digital environment. That is, a situation where for the students in this class, virtually all curriculum-related activity was undertaken using computers. In this example, the move to a digital learning environment was associated with what were perceived by the teacher to be appropriate changes to curriculum design and teaching methodologies – areas which research has identified as being critical in optimising the potential benefit for students from access to computer resources (Capper, 2001; Cuban, 2002; Falloon, 1999; McCombs, 2000; Thornburg, 1999; Trinidad, MacNish, Aldridge, Fraser, & Wood, 2002; Yelland, 2001). Research and literature into the functioning of students in digital or e-classroom environments is virtually non-existent, due to their comparatively recent advent to the educational scene. Unlike most previous research in the field which has tended to focus on the use of limited numbers of computers within a conventionally designed curriculum, this research sought to examine the manner in which the three critical elements of teacher role and pedagogy, curriculum design, and high levels of computer resource, interacted in the establishment of a distinctive digital learning environment.

In addition, this research examined the perspectives promoted by authors such as Simonson and Maushak (1996), Oliver and Harvey (2002), McNabb, Houkes, and Rouk (1999), and McCombs (2000), who contend that the evaluative criteria applied to the impact of computers in the classroom, needs to be extended to include more than cognitive or achievement-related outcomes. They claim that broader educational benefits from computer use need to be considered in the development of a more inclusive evaluative framework. Such a framework should take into account affective, motivational, and social elements, in addition to any achievement-related benefits (McCombs, 2000; McNabb et al., 1999; Oliver & Harvey, 2002; Simonson & Maushak, 1996). This research attempted to take seriously such a framework by focussing on investigating whether the broad educational goals established for this e-classroom were being delivered on, and the role of the technology in this process.

This study utilised an exceptional data collection tool known as Camtasia (Techsmith, 2002). This software enabled the researcher to gain rich data relating to students' practices and interactions as they undertook their learning tasks using the computers in the e-classroom. The specific operation of this software will be detailed later, but feedback from the producer of the program indicated that it is the first time the product had been utilised for such research purposes (Techsmith, 2002). The use of Camtasia is an innovative one, and added considerably to the significance of this research.

1.3 Research Duration and Target Group

This research was undertaken over a period of 16 months, and involved a year 5 and 6 classroom in a local primary school. The chosen class was somewhat unique, in that it was the only 'e-classroom' within the Northland

District schools' region. The concept of an 'e-classroom' will be explored in greater depth later, but briefly it is a classroom where there is a high ratio of computers to students – in this instance one computer to approximately two students – and where most curriculum activities are facilitated by the use of computer hardware and software.

1.4 Research Aim and Questions

The overall aim of this thesis focused on answering the following question:

> **What is the nature of student work practices in an e-classroom environment, and what are the factors which influence this?**

In order to answer this question and to assist in structuring the thesis, this aim was further defined into three main research questions.

These were:

1. Upon what educational vision was the e-classroom environment at Parahaki School established, and what was the nature of the implementation processes associated with this?
2. How does the e-classroom environment impact upon the cognitive, affective and social development of its students?
3. In what areas might changes or improvements be made to optimise the learning potential of this e-classroom?

By determining answers to these questions, it was possible to:

- identify the relationship that existed between the establishment processes for the e-classroom, and how this influenced the philosophical and operational framework for the teaching and learning within it;

- identify how teaching practices and organisational structures established within this framework, impacted upon the achievement of student social, affective, and cognitive goals;
- determine for this classroom, the validity of the argument for using computers in this way; and
- identify areas of possible change or improvement for this e-classroom, and develop guidelines for other schools considering similar initiatives.

Whilst acknowledging that this research was situated in a specific context, it is anticipated that the findings will inform general classroom practitioners who may be seeking to enhance their practice in utilising computer resources with their students.

1.5 Thesis Structure

This first chapter introduces and outlines the research, and establishes a rationale for its purpose. It introduces briefly the context in which the research was undertaken, defines the research questions being investigated, and provides an overview of subsequent chapters.

Chapter 2 reviews literature surrounding arguments relating to the place of, and rationale for, ICT, and more specifically computers, in New Zealand school curriculum. It also briefly overviews the history surrounding this development. This will be positioned within the wider global context, by an examination of key perspectives related to assessing the impact of, and benefits from computer use in schools, and how this has influenced both teacher perception and practice. An overview of literature relating to social, affective, and cognitive outcomes from curriculum-based computer use with students, will also be presented in this chapter.

Chapter 3 provides a description of the research methodology and methods. It justifies the use of an interpretivist framework and case study methodology, and details specifics of the research tools and methods used in the data collection process. It also explains the structure of Chapters 4–6, by describing the rationale for adopting an integrated approach to presenting and analysing data from the study.

Chapter 4 presents and analyses data in relation to research question one. It profiles the school, and examines the philosophy behind the e-classroom – how this was formed and established by the principal, and interpreted by the classroom teacher. It also identifies the impact, from the teacher's perspective, of how having access to extensive computer resources led to an evolution of her practice, from a less teacher to a more student-directed model of learning.

Chapter 5 presents and analyses data related to research question two – the facilitation of student social, affective and cognitive elements. It presents an analysis of student practices as they undertook learning tasks within this environment, with particular emphasis on how it facilitated the social, affective and cognitive strategies they applied to tasks. It also examines the impact upon outcomes derived from student task engagement. Details of the nature of the discourse which occurred between group members during decision-making processes, and how this ultimately affected the attainment of learning goals, will be presented and analysed.

Chapter 6 responds to the research aim, by drawing together implications from the previous two chapters in a discussion of data related to research questions 1 and 2. It also responds to research question three, by identifying areas of change needed to improve the performance *of this e-classroom*. It discusses the nature of the relationship that must be developed between the computers, the students, the teacher, and the curriculum, in order that any potential learning advantages from having access to high a number of computers, can be realised.

Chapter 7 draws conclusions from the study, and identifies a range of principles for other schools contemplating similar initiatives. It describes the strengths and limitations of the research, and identifies areas for possible further investigation. The chapter closes with a concluding statement relating to the role of computers in schools, and the importance of teachers in facilitating their use.

CHAPTER 2

A Review of Literature

2.1 Defining Information and Communications Technology in the New Zealand Curriculum Framework

The use and application of Information and Communications technology (ICT) in schools is not a new phenomenon. Brown (1995) notes that since the dawn of human existence, people have developed technologies to meet human needs and fulfil opportunities. Within the context of ICT, these relate to the development of artifacts, systems or environments to exchange information and communicate for educational, political, and social purposes (Brown, 1995). He identifies the continual evolution of technologies ranging from cave drawings through stone tablets and papyrus scrolls, to the printing press and more recently, the huge array of electronic technologies which pervade our daily lives (Brown, 1995). He further argues that the contemporary view of the nature of ICTs as being limited to "electronic gadgets or machines" (Brown, 1995, p. 7), limits our understanding of the diversity and historical basis of this area. It restricts our ability to identify their significance and utilise them fully across a broad base of applications, in that "we tend to overlook that information and communications technologies are not always visible products or artefacts. The technology can also be an environment or system of acquiring, storing, retrieving, manipulating and interchanging information" (Brown, 1995, p. 7).

Whilst acknowledging this more inclusive view of ICT as being more than contemporary electronically-based devices and systems, it is the latter – specifically in terms of computers, which has drawn much attention in recent years. This attention particularly relates to the potential benefits computers hold for teaching and learning. Before examining some of these claims and identifying where they are emanating from, a brief examination of some theoretical aspects relating to the nature of Information, Technology, and Communication is provided.

2.1.1 The Nature of Information, Communication, and Technology

In understanding the nature of information, Brown (1995) draws upon the foundational work of Paisley and Chen (1982) in identifying both the structure and function of information. He claims that structurally, information can be defined as a "system of encoding symbols into a message that can be stored, retrieved, manipulated and interchanged, usually through various media" (Brown, 1995, p. 9). This structure can take many forms, ranging from tables of numbers to strings of symbols. Functionally, information is viewed as "any structure of information that alters a person's existing cognitive organisation" (Brown, 1995, p. 9). That is, information is what people process in the development of new knowledge. Stenmark (2001) also emphasises a clear distinction between the acquisition of information and the development of knowledge, in that information only becomes knowledge when "new facts inform us and alter existing knowledge by increasing (or shifting) the individual's knowledge state, thereby opening new possibilities to act" (Stenmark, 2001, p. 5).

Communication can also be defined at both structural and functional levels (McQuail & Windahl, 1993). Structurally, communication is viewed as involving "a source, a message, a transmitter, some barriers, a destination, a receiver and normally some feedback" (Brown, 1995, p. 9). It relates to the components and processes involved in getting information to a specific audience. At a functional level, communication is viewed as a process by which information is exchanged to facilitate the construction of new understandings (Blurton, 1999). That is, functionally, communication can be seen as having an impact at both an individual and societal level, by altering understandings, views, or actions (Blurton, 1999).

Compton and Harwood (2003) identify technological activity as being "a purposeful human activity undertaken to meet a need or realise an opportunity as influenced by, and impacting on, the socio-cultural and physical location in which it is undertaken" (Compton & Harwood, 2003, p. 3).

They refer to the process by which this occurs as "technological practice" (Compton & Harwood, 2003, p. 3), and involves the development of a course of action which is unique to each technological problem or opportunity in the development of artefacts, systems and environments. They state that the interplay of aspects such as the perspectives of key stakeholders, the capabilities of people involved in the development, the availability of knowledge and skills from other domains, and societal and environmental considerations, all influence the nature of technological practice, which is unique to each situation (Compton & Harwood, 2003). This 'social shaping' of technology is discussed at length by MacKenzie and Wajcman (1992) in relation to diverse developmental pathways for many modern technological innovations.

When these three definitions are combined, it is possible to develop a definition of this area which is inclusive, and acknowledges the breadth and diversity of ICTs as being artefacts, systems and environments. Information and Communications Technology therefore refers to "the diverse set of technological tools and resources used to communicate, and to create, disseminate, store and manage information. Communication and information are at the very heart of the educational process" (Blurton, 1999, p. 1).

When applying such a definition to educational contexts however, it could be fairly argued that virtually all that happens within a classroom of any sort, is an example of ICT. In fact, the very art of teaching itself could be viewed as ICT, by virtue of the fact that a good teacher is the designer of an information and communication environment, for the sole purpose of educating his or her students. Such a view conceptualises the classroom as an 'information and communication problem', with the role of teacher being to identify and develop solutions to learning problems, by utilising specific programmes and strategies to meet the learning needs of students.

2.2 Dimensions of Learning *with* Information and Communications Technology (ICT)

Brown (1995), in his review of the role of information and communications technology in the New Zealand Curriculum, makes reference to three main *dimensions* he sees ICTs as contributing to the learning process. He identifies these as learning *with* ICT, learning *in* ICT, and learning *about* ICT.

2.2.1 Learning *with* ICT

The first of these, learning *with* ICT, refers to the use of electronically-based technologies to support teaching and learning processes across curriculum areas. This is more commonly referred to as the *integration* of ICT (Ministry of Education, 1998, 2002), and involves teachers in identifying specific learning problems, needs or opportunities, that could be supported, met or enhanced, by the use of electronic technologies. This, in most instances refers to the classroom computer.

Historically, Taylor (1980) identified three principal modes for computer use in schools, which are categorised under the dimension of learning *with* ICT. The first of these he termed the *tutor* mode, whereby the computer is used to instruct the learner. That is, it acts as a surrogate or substitute for the teacher in providing direct instruction to the student. Such use places the computer, rather than the student at the centre of the learning process, with the interaction of the student being generally passive in responding to onscreen prompts and cues. Software of this type is categorised as computer-assisted instruction or CAI (Collins & Adams, 1977). It is characterised through programs emphasising drill and practice of basic knowledge and skills, tutorials, simulations, instructional games, and more recently, interactive fiction and problem solving applications.

Such software is based on the behaviourist theories of behavioural psychologists such as B.F Skinner (1976). It promotes the computer as being able to provide individualised instruction to students, delivering specific and measured steps towards the mastery of content knowledge or skills, reinforcing students for their performance along the way. The effectiveness of using computers in this mode is still under debate (Lockard, Abrams, & Many, 1994). While research suggests that for some students there can be learning benefits, these are highly dependent upon the design of the software, and the context in which it is used (Parr, 1995).

The second mode under the dimension of learning *with* ICT, refers to the use of the computer as a *tutee*. That is, the computer is 'taught' by the student via the development of software or other functions, sometimes to fulfil a requirement to display information, or the outcomes of a learning process. An example of software which can be used in this manner is Seymour Papert's Logo (Papert, 1980). The theoretical underpinnings for computer use in this way have also contributed to the development of more contemporary multimedia authoring software such as Hyperstudio (Knowledge Adventure, 2002). Theories behind the use of such software for educational purposes have been explored by cognitive theorists such as Spiro, Feltovich, Jacobson and Coulson (1992). They advocate its use for the development of metacognitive thinking skills, and as a means of developing and reinforcing transferable problem solving skills across a range of ill-structured knowledge domains (Spiro et al., 1992).

Although this theory is largely untested, a number of writers in this area (for example, Brown, 1995; Jonassen, 1996, 2000; Jonassen & Reeves, 1996; Steketee, Herrington, & Oliver, 2002) indicate that computers hold considerable potential to assist students to "construct their own meaning of knowledge, rather than absorb ideas preconceived by others" (Jonassen & Reeves, 1996, p. 695).

One of the primary issues related to the validation of computer use for this purpose, is the difficulty in assessing or 'measuring' just *how* and *what* is happening, when students are engaged in such learning activities. Many accounts of the benefits from using computers in this way appear to be based on teacher self-reports or anecdotes, with little conclusive research having been undertaken (Falloon, 1999).

The third mode under the dimension of learning *with* ICT, refers to the computer's ability to assist in making learning tasks "faster and more efficient than would otherwise have been possible" (Brown, 1995, p. 11). This mode is referred to as the *tool* mode, where applications such as wordprocessors, desktop publishers, spreadsheets, and databases, are used to assist in the development of knowledge across learning areas. The use of computers in this way has dominated the educational technology landscape in New Zealand and overseas for over a decade (Capper, Fitzgerald, Weldon, & Wilson, 2000; Simpson & Conlon, 2003), despite research into its effectiveness being somewhat inconclusive (Sivin-Kachala & Bialo, 1994). The best results from using technology in this way appear to be delivered when the computer is used as a tool in "combination with a learner-centred philosophy, and collaborative and cooperative teaching strategies" (Brown, 1995, p. 11).

2.2.2 Learning *in* ICT

The second dimension related to the role of ICT in the New Zealand Curriculum is identified as Learning *in* ICT. This focus is catered for by the inclusion of ICT as a technological area in the New Zealand Technology Curriculum (Ministry of Education, 1995). Learning *in* ICT focuses on the technological practice of solving information-related problems, and the variety of skills, strategies and knowledge that contribute to this process. Brown (1995) identifies these problems as being both of a structural and functional nature. The structural aspect is concerned with the identification and development of solutions to problems relating to the arrangement, organisation, and communication of information to specified audiences, or to meet identified objectives. The functional aspect refers to developing understanding of the manner in which such messages are mediated by the receivers, and the identification of factors which "either inhibit or enhance the processing of information into new knowledge" (Brown, 1995, p. 11).

It should be noted at this point that this process may not necessarily utilise computers. However increasingly this is the case, as the range of analytical tools and means of representing data and information for communication purposes using the computer, is increasing at a rapid rate.

2.2.3 Learning *about* ICT

The final dimension that Brown (1995) identifies is Learning *about* ICT. In this dimension the focus is on student development of an understanding of the relationship between ICT, people as individuals, and collectively as a society. As an illustration of this, MacKenzie and Wajcman (1992) and Knights and Murray (1994) alert us to the non-neutrality of technological artefacts and processes. MacKenzie and Wajcman (1992) suggest an important part of developing understanding in this area is to encourage the active critique of technological innovations, and not to make inherent assumptions about their appropriateness for particular tasks or purposes, or the views of reality they represent.

The relevance of this is demonstrated by Agalianos and Cope (1994) who, in an analysis of educational software, highlighted a huge differential in the portrayal of males to females in leadership roles, arts and technology, science, and sport and military. Predictably, the direct opposite was the case for depiction in domestic and caregiver roles. The critical element within this dimension is the encouragement of students to become critical thinkers in relation to their acceptance and use of ICTs. They should not be afraid to ask questions about who the 'winners and losers' are from their application, and to evaluate hidden biases and assumptions that are inherent within them.

In summarising this section, three dimensions exist which define the place of ICT in the New Zealand school context: Learning *with* ICT, Learning *about* ICT, and Learning *in* ICT. However, for the purposes of this research, primary emphasis will be given to the first of these, Learning *with* ICT. Specifically, it will examine the manner in which computers are used within an electronic or 'e classroom' setting in supporting teaching and learning goals across all curriculum areas, as opposed to explaining any further the notion of ICT as a technological area within Technology Education.

2.3 The Rationales for Including Computers in the New Zealand School Curriculum

This section discusses the variety of rationales that have been promoted in both international and local literature, as being relevant to the arguments surrounding the incorporation of computers into school curriculum. They are: vocational, economic, commercial, marketing, cost-effectiveness, social, transformational, and pedagogical.

These rationales are particularly relevant in backgrounding this research, as it could be argued that it is a lack of clarity in teachers' minds as to exactly *why* they should incorporate computers into their programmes, and unsurity of exactly *what* the learning benefits are for their students, that has caused the rather disparate implementation practices of the past decade (Bowen-Clewley, Capper, & Harris, 1998). This section will focus on the New Zealand context post-1990, but will also make reference to international literature.

2.3.1 The Sallis Report and the Education Reforms of the Early 1990s

The Sallis report (Sallis, Ferguson, Ham, Milne, McMahon, Parker, & Ramsay, 1990) could be regarded as the first attempt by centralised government in New Zealand to plot a coordinated pathway for schools in the use of computers. It articulated the importance of a coordinated and strategic approach to implementation, in which the government had a lead role in both the provision of hardware and software, and in meeting the professional development and training needs of teachers (Sallis et al., 1990). The report adopted a somewhat 'technical' approach to the implementation issue. It identified a range of discrete and measurable conditions or criteria which it stated needed to be met, in order for successful implementation to occur.

These included aspects such as in-service and pre-service professional development for teachers, ongoing support from school communities and boards, equitable access to adequate levels of hardware and software, and a sufficient level of "tagged funding" (Sallis et al., 1990, p. 10) to allow schools to make their own decisions in these areas.

> The status quo – community fund raising – remains the primary means of funding any school's attempts to move into the new, information rich, educational era... all but one of the submissions which addressed the funding issue suggested that it was the government's responsibility to provide tagged funding for schools for this purpose...
> (Sallis et al., 1990, p. 10)

This report subscribed to the argument that competence in the use and operation of technology was linked to New Zealand's ability to 'foot it' in the increasingly competitive international community. It warned that if government chose to adopt a 'hands off' approach to its implementation, then "New Zealand will remain by international standards technologically illiterate and innumerate" (Sallis et al., 1990, p. 6).

It is important to note that the Sallis report (1990) was commissioned by the Department of Education, at a transitional time in New Zealand's educational history. Centralised school administration through a network of regional education boards, was moving towards a self-governing, self-determining model promoted under the 'Tomorrow's Schools' reforms of the late 1980s. Under this model, the operation of schools was the responsibility of individual Boards of Trustees, who, with the principal, were charged with the task of ensuring school programmes, policies and goals, were developed to meet local educational objectives within national curriculum guidelines. These guidelines, at that stage, were still under development.

As in other instances (Blackmore, Johnson, & Warren, 2000), the implementation of such substantial and fundamental reforms changed the very nature of school accountabilities. The timing of the release of the Sallis report (1990) created a situation in many schools where computers were placed at the bottom of a long list of priorities. The ideological shift from centralised educational administration to local Boards of Trustees, meant that each individual school was responsible for plotting its own direction relating to the purchase and use of computers in their programmes. This led to a highly fragmented and often ill-informed implementation process, which saw many schools 'reinventing the wheel' and replicating bad purchase and infrastructural development decisions.

On the one hand, many schools welcomed the new freedoms afforded by these managerial reforms. However on the other, they lacked the necessary knowledge, direction and rationale, for incorporating something as complex and costly as computers, into their programmes. In short, they lacked answers to their questions as to why, how, and where they should be looking at using such technologies to support teaching, learning, and administrative tasks.

> ...school communities are unclear about the purpose of information technologies in schools. School administrators, subjected to a barrage of conflicting information from computer firms, are confused as to the real issues and 'what to buy'. Teachers, parents, and Boards of Trustees need access to guidance and advice on the purchase of suitable computer resources for schools. This involves informing decision makers about applications of software and hardware which are appropriate in terms of learning outcomes. Teachers, parents and Boards of Trustees need assistance in formulating a policy and strategic plan to ensure that purchase of software, maintenance, and upgrading of hardware is part of the school's budget.
> (Sallis et al., 1990, p .7)

This view is also supported by Chamberlain and Kennedy (1991) in a review of computer-related practices in New Zealand schools. This was undertaken as part of the Computers in Education study, commissioned in conjunction with the International Association for the Evaluation of Educational Achievement. Their findings concluded that one of the major impediments to the implementation of computers in schools, was "the lack of 'neutral' advice and guidance relating to the purchase of hardware and software, which has caused schools to repeat expensive mistakes, due to the (mis-) guidance of tricky software and hardware peddlers" (Chamberlain & Kennedy, 1991, p. 95).

They advocated the need to establish an "independent, centralised non-profit making – preferably a government – organisation, to provide advice and information on educational software and hardware available to schools" (Chamberlain & Kennedy, 1991, p. 95). They further commented that it was unfortunate that groups such as the Computer Courseware Development Unit (CCDU) which existed under the previous Department of Education structure and was generally in a position to offer such advice, had been disbanded as part of the education reforms of Tomorrow's Schools (Chamberlain & Kennedy, 1991). They warned that without access to such advice, and clear direction as to how and why they should be undertaking computer implementation, schools were ill-equipped to find answers to these issues themselves (Chamberlain & Kennedy, 1992).

Despite these early warning signs, successive governments of the early – mid 1990's continued to adopt a largely 'hands off' approach to assisting and guiding schools with their ICT initiatives. It was largely left up to individual schools to find their own way through the rapidly-changing technological landscape of the mid-1990's, and to fund purchases of hardware and software from their ever-diminishing operational grant, parent fundraising schemes, and corporate sponsorship programmes. One might speculate that such a decision was ideologically-based, in terms of the philosophy underpinning the reforms of the early 1990's. However, it could equally be argued that by adopting this approach, the government was avoiding the requirement to fund schools adequately, thereby pushing implementation at a national level. Whichever perspective is taken, it could reasonably be claimed that computer use in New Zealand schools has never really recovered from this.

2.3.2 The Questionable Robustness of the Rationales for Information and Communications Technology in New Zealand Schools

Another perspective on this issue is promoted by Brown (1997) who speculates that the government, via its Ministry of Education, was itself unsure of exactly why and how ICT should be incorporated as part of teaching and learning programmes. He claims that some of the rationales they promoted for its inclusion lacked sound educational purpose, and were conflicting and fundamentally flawed. These rationales, which he identified as vocational, economic, commercial, marketing, cost-effectiveness, social, transformational and pedagogical (Brown, 1997), are also reflected in a later report by Capper (2001). He stated that many schools opted into ICT for wrong or ill-defined reasons, often "through the need to demonstrate tangibly that they are up to date" (Capper, 2001, p. 4). Many of these rationales overlap and could be viewed as conflicting. The identified rationales will now be discussed, and relationships between them outlined.

The vocational arguments relating to the use of ICT in New Zealand schools relates to "the enhancement of prospects of students in gaining employment in an increasingly competitive labour market" (Brown, 1997, p. 46). Such an argument makes a direct link between the school-based acquisition of technical and operational skills relating to the technologies, and the requirements of the workplace (Roschelle, Pea, Hoadley, Gordin, & Means, 2001). This argument also features prominently in the Ministry of Education's National ICT Strategy – The Learning Technologies Planning Guide for Schools (1998).

> Many New Zealand schools are currently expanding their use of computers as tools for learning in a range of essential learning areas. Incorporation of learning technologies into the school curriculum, and the development of students' ICT skills, enhances student readiness for their introduction into the workforce.
> (Ministry of Education, 1998, p. 1-3)

The economic rationale is aligned with vocational, and relates to the need to ensure New Zealand has a highly skilled and technologically literate workforce. This is viewed as being essential to ensure that the economic performance of the country is maintained and enhanced. This rationale features prominently in literature related to ICT use in schools, and its relationship with the so-called "knowledge economy" (Cheung & Lewis, 1998; Institute for Professional Development and Educational Research, 2002; MCEETYA, 2000; Ministry of Economic Development, 2003; Ministry of Research, Science & Technology, 2002; Singapore Ministry of Education, 1997; U.S Department of Education, 2001). The literature identifies as a critical role of any education system the development of "smart citizens" (Brown, 1997, p. 46), who possess high levels of ICT capability and are readily able to adapt to the changing demands of a global marketplace.

The commercial rationale for the inclusion of ICT in schools, centres on the perceived self-interest of vendors and suppliers of hardware and software, to maintain and extend their sales of ICT equipment to schools. Such a rationale, as identified previously in discussion of the Sallis Report (1990), undoubtedly influenced greatly the decisions made by schools in this area during the formative years of the mid 1990s. In the absence of any alternative or independent advice, schools made decisions based on the advice of vendors and suppliers, who generally held a vested interest in selling particular systems and products. Such decisions, for many schools, have since proven to be costly, with the installation of equipment and infrastructure which has proven to be unreliable, or has failed to meet anticipated performance requirements (Capper, 2001).

The fourth rationale has been termed the 'marketing rationale', and has been identified as one of the most powerful influences on the manner in which ICT has been incorporated into the New Zealand school system (Capper, 2001). This argument is closely related to the outcomes of the 'Tomorrow's Schools' educational reforms of the late 1980's, where the funding formula and manner in which it was determined, was changed radically from a 'broad band' model, to one by which schools were paid a set amount per student enrolled. This change also coincided with the removal of school enrolment 'zones' – a system whereby each school was allocated a defined catchment area from which it could draw its students. The removal of this system effectively set up open competition for students between schools.

An outcome of this decision saw schools trying to attract as many students (and therefore funds) as possible. Many Boards of Trustees and principals viewed the provision of large quantities of ICT equipment, especially computers, as a way of demonstrating to prospective parents that their school was up to date, and reflecting contemporary educational thinking. As Brown (1997) states, "educational technology becomes a powerful marketing icon for schools to entice parents who are concerned that their children do not have access to computers, and thereby, are somehow 'missing out'" (p. 46).

Capper (2001) also comments on this, but adds that in many cases the schools are unable to link this decision with sound educational goals.

> Most school approaches to ICT are dominated by the desire to purchase and deploy the technology itself. This appears to be driven by a mix of competitive pressures between schools and a desire to ensure that current students do not 'miss out' (on what they might be missing out is often unstated). The pressure to adopt is therefore driven by the technology itself, rather than by any assessment of educational needs.
> (Capper, 2001, p. 6)

This technology-driven approach is also discussed by Selwood (2002) who claims that in making decisions related to the provisioning of ICT resources, "schools need to move away from hardware and infrastructure requirements to the quality and style of the associated human resources" (p. 119). He states that unlike businesses, schools tend to make such decisions less on the basis of goal orientation, but more with a concern for "equitable distribution of expenditure over all departments" (Selwood, 2002, p. 120). He comments that while such a strategy may ensure that equipment is equitably provisioned, this may not necessarily "align the goals of IT with those of the school as a whole" (Selwood, 2002, p. 125).

The role of school leaders in establishing a shared vision in relation to the role of ICT in supporting broad educational goals within the school, Selwood (2002) sees as critical. However, as he comments, "principals are generally not perceived as credible advisors on effective (ICT) leadership" (Selwood, 2002, p. 124) while others in leadership positions "felt not knowing the skills presented a hurdle for them" (p. 123). Selwood and Fisher (2003) claim there is a need to develop in schools teams of the "right people" (p. 242) who are able to share the responsibility for ICT implementation. These include colleagues who possess "excellent communication skills, have sound management and leadership capabilities, and a thorough grounding in the theory and practice of education generally, and ICT in education in particular" (Selwood & Fisher, 2003, p. 247).

The cost-effectiveness rationale also does little to support the development of ICT in schools. This argument is based on the premise that computers potentially have the ability to decrease the cost of the delivery of education, by doing away with the need for teachers and classrooms, in addition to breaking down barriers of distance and isolation. Not unexpectedly, such a view does not find favour with teachers, many of whom were, and still are, facing redeployment due to declines in primary and secondary school rolls. During the last quarter of 2003, this rationale came to the fore in relation to local Education Development Initiatives (EDIs) as proposed by government (Ministry of Education, 2003). Under this scheme, schools with declining rolls within a defined geographical area are to be amalgamated or centralised onto one site, with students being transported daily to attend classes.

Although not detailed explicitly in information distributed to schools relating to this initiative, the Minister of Education has mentioned the potential for ICTs to act as a conduit in delivering education to more remote students affected by this policy (Ministry of Education, 2003). There are also presently projects associated with the revised Ministry of Education ICT Strategy for Schools (Ministry of Education, 2002), where computers are being used in a range of self-directed study support centres throughout New Zealand. The technology is being used to facilitate interactive communication with other study centres and with a central website, to assist in the formation of student learning communities. This is taking place to a large extent without significant teacher supervision or input, and the project is looking to be extended into secondary schools in 2004. Similar initiatives are also being explored by the New Zealand Correspondence School, in working with remote or displaced students using e-learning technologies for course delivery (Wenmoth, 2002).

The social rationale relates to the perceived 'gap' which exists between what goes on presently in schools, and the type of knowledge, skills, and attitudes it is considered students are going to need to enable them to function productively in an information-rich society of the future. Brown claims that "the size of this gap necessitates an urgency to produce students who are ready for, and have the skills to survive in, the communication age" (Brown, 1997, p. 46).

Such a view is also shared by Page (1999), Roschelle et al. (2001), and Kress (1998), who claim that both external and internal demands are being brought to bear on schools to prepare their students to "meet the technological challenges of the future" (Page, 1999, p. 15). Page (1999) cites pressure on schools to develop liaisons with ICT-focused businesses and commercial enterprises to help bridge the gap between what goes on in schools and the so-called 'real world', as evidence of this.

The transformational rationale is closely linked with cost-effectiveness through the potential that some writers have identified for ICT to act as a catalyst to significant and systemic reform of curriculum and schooling (Brown, 1997; Capper, 2001; Iverson, 2001; Strommen, 1992; Wetzel, 2002). Their arguments centre on the capacity for technology to decentralise education, allowing it to take place irrespective of time and place, and without the constraints imposed by the organisational structures of the conventional school system. Capper (2001) in particular, discusses this in some length in his Ministry of Education commissioned analysis of the use of Information and Communications Technology in New Zealand Schools. He claims that one of the primary reasons that ICT is not "delivering on the hoped for gains" (Capper, 2001, p. 26) is that it has been conceptualised by teachers as "simply a tool" (Capper, 2001, p. 21), expected to function within existing educational organisations, structures, and pedagogies. He claims that the reluctance of schools and teachers to adapt and modify existing practices, has greatly moderated the transformational potential of the technology (Capper, 2001).

Closely related to the previous is what Brown (1997) defines as the pedagogical rationale. This rationale focuses on the potential of ICT "in offering unprecedented potential to enhance learning... by providing new opportunities for social and cognitive development, within and beyond the classroom" (Brown, 1997, p. 46). This view is also reflected in the Ministry of Education's ICT Strategy for Schools (1998) and its revision document, Digital Horizons (2002).

> While ICT has been in use within New Zealand schools over the past decade, the opportunities it presents for use in the classroom have been continually growing. The full potential of these learning technologies is yet to be realised in many schools.
> There is compelling evidence that, with appropriate teaching and learning techniques, learning technologies can improve student learning.
> (Ministry of Education, 1998, pp. 1–3)

The Ministry document, however, does not state what this 'compelling evidence' is, or how the technology was applied to achieve such results. Additionally, in the preamble to the ICT strategy revision document, Digital Horizons (2002), the Minister of Education makes reference to present work with ICT in our classrooms. He claims that:

> I am constantly amazed at the range and standard of work that children are producing as a result (of working with ICT). I know we are posting better results than many systems internationally in providing a learning environment that equips young people with knowledge and skills for an online world...
> (Ministry of Education, 2002, p. 2)

This document appears to be highly deterministic in its assessment of the impact of ICT on learning, almost laying the blame for a lack of evidence supporting this on educational researchers.

> Research into the uses of ICT in education lags behind what is actually happening in schools. Nevertheless, evidence is currently emerging from studies in the UK and elsewhere that indicates improved learning outcomes for learners in schools where ICT is used as a tool for cognitive development in curriculum areas...
> (Ministry of Education, 2002, p. 7)

Once again this document lacks any reference to exactly what these 'emerging studies' were, or how 'improved learning outcomes' were defined. It also does not contain any other information which would allow an assessment to be made as to the validity and relevance of the findings, in relation to supporting ICT use in schools.

In summary, an analysis of the rationales for the inclusion of ICT in schools indicates the lack of a solid research base in terms of ICT's role in enhancing learning outcomes for students (Capper, 2001; Cuban, 2002; Harrison, Comber, Fisher, Haw, Lewin, Lunzer, McFarlane, Mavers, Scrimshaw, Somekh, & Watling, 2002; Hawke & Capper, 1999; Robertson, 2003; Wood, 2003). They also indicate a level of conflict and confusion relating to the justification for computer-inclusion in schools generally.

According to Parr and Ward (2004), the promotion of empirical claims relating to the performance of technologies in being able to initiate such fundamental changes and transformational effects on schools, and their role in enhancing the economic and social performance of the country, is making assumptions about the capabilities of technology which are unable to be substantiated. While such performances may be the case in isolated instances, it is far from the universal principle as promoted by these rationales. She illustrates this by reference to the Ministry of Education's Digital Opportunities projects, in claiming that misguided assumptions made about the potential of computers to facilitate school-system and curriculum-level change in host schools, contributed to the failure of many projects to deliver the anticipated gains (Parr & Ward, 2004). Such a perspective is shared by authors such as Brown (1997) and Stratford and Brown (2002), who claim that the political-economic imperative associated with computer implementation in New Zealand schools is counter-productive. They argue that it diverts attention away from the core business of schools – that is, finding ways of using the technology to support and enhance the immediate learning needs of their students (Stratford & Brown, 2002).

When examined critically, most of the above rationales appear to be founded on vague rhetoric associated with the importance of student computer or information 'literacy'. This is linked to the development of a skill base to allow New Zealand to 'foot it' internationally in terms of economic performance, or to enable students to function effectively in the so-called 'digital world' of the future. While these are noble aims, little evidence has been provided to support such claims.

Other arguments relating to the need to have computers in schools as some kind of a marketing tool, devalues the role of the technology to little more than a 'window dressing' device, and a very expensive one at that. Unfortunately, principals continue to seem very keen to highlight to prospective parents and school visitors the level of technology available to students, as they seek to attract 'clients' and promote their school as being modern and up-to-date. It seems ironic that the pedagogical rationale, the one that at least theoretically should be at the forefront of the reasoning or justification for computers' inclusion in schools, appears also to have limited support in research. This perspective is reinforced by the lack of direct reference to any research of this nature in official documents which are supposed to be guiding this process. The next section details this issue in greater depth.

2.4 ICT Development and National Policy Initiatives

Stratford and Brown (2002), claim that the technologically-driven approach adopted in both the National ICT Strategy (Ministry of Education, 1998) and Digital Horizons (2002), ignores the political and social context of the classroom, and "makes it easier to categorise new technologies somewhat uncritically as good, neutral or evil" (Stratford & Brown, 2002, p. 3). Such a perspective, they claim, can lead to assessments being made about the usefulness of technology in terms of the technology alone (Stratford & Brown, 2002).

They illustrate this by reference to the frequently heralded assertion that "computers help children learn" (Stratford & Brown, 2002, p. 4) which features prominently in the Ministry's strategy documents, and Education Review Office (1999, 2000, 2001) reports on the implementation of computers in schools. Such a view, according to Postman (1993), is fundamentally flawed, in that it assumes that the technology itself is neutral and contains no inherent biases of any kind. To the contrary, Postman (1993) claims that any artifact which is brought to bear on a social situation, by its very presence, acts as an autonomous force on its users. He further states that this is particularly relevant in the case of information technologies, where "the uses made of the technology are largely determined by the structure of the technology itself" (Postman, 1993, p. 7). The medium often acts as the message due to inherent "ideological biases" (Postman, 1993, p. 16).

He illustrates this by reference to his early work which described information technologies as "metaphors through which we conceptualise reality in one way or other" (Postman, 1979, p. 39).

> ...the printing press, the computer, and television are not simply machines which convey information. They will classify the world for us, sequence it, frame it, enlarge it, reduce it, or argue a case for what it is like.

> Through these media metaphors we do not see the world as it is. We see it as our coding systems are. Such is the power of the form of information.
> (Postman, 1979, p. 39)

2.4.1 'Technocentricism' and Policy Development

When this perspective is used to examine the discourse surrounding the development of ICT in New Zealand schools, it would be fair to claim that strategy and review documents produced by the Ministry of Education and other centralised agencies, represent a technologically 'deterministic' view of the value of ICT to school programmes. That is, they represent a view that the mere inclusion of ICT in schools is by necessity a good thing, and that this inclusion will inevitably lead to enhancement of curriculum delivery, improved student learning outcomes, and school administrative efficiencies. However as Hawke and Capper (1999) state, "despite the large amount of investment in information technology in schools, it becomes increasingly clear that it is not achieving the hoped for gains" (p. 5).

The technologically 'deterministic' perspective is further supported when a closer examination of official reports is made. For example, the Learning Centre Trust report – Information and Communications Technology in New Zealand Schools (2003), sought to examine "some of the key developments and issues with ICT in New Zealand schools" (Learning Centre Trust, 2003, p. 4). In this survey, six aspects of school ICT implementation were examined.

These were:

1. School ICT infrastructure, including the use of networks, software in use by schools, and ICT related equipment and its teaching applications.
2. Internet access and usage.
3. ICT planning and funding in schools.
4. Professional development for teachers and principals.
5. Principals' use of LeadSpace (the Ministry of Education's portal for principals) and their attitudes towards ICT in schools.
6. ICT in schools and the wider community.
   (Learning Centre Trust, 2003, p. 4)

What is particularly relevant in this report is not so much the outcomes from the research, but what the research examined, and how the data were collected, analysed, and recorded. The research design emphasised a highly deterministic and 'technocentric' approach. Data were collected about a number of factors including the amount of ICT available in schools, how this was distributed throughout the schools, who used it, and how often. By adopting such an approach, this research conveniently 'side-stepped' the issue of assessing whether or not the considerable investment in ICT was paying any learning dividend for students. Instead, the findings implied that by virtue of the hugely increased amounts of technology available in schools over the survey period, that this was indeed the case. Any comments related to perceived improvements in educational outcomes for students were only loosely based on anecdotal data and self-reported feedback from principals and teachers, and were not supported in any other way. For example:

> Similar numbers (between 58% and 63%) of primary and secondary/composite principals, in commenting on ICT use in their schools, agree that it is improving both the efficiency and quality of curriculum delivery....
>
> ...overall, schools most often assessed the impact of ICT in their schools through feedback provided by teachers...
>
> ...primary schools also frequently measured the value of ICT through the school's ICT Strategic Plan, whereas secondary/composite schools used student feedback...
> (Learning Centre Trust, 2003, p. 14)

Stratford and Brown (2002), claim that a technologically-driven, 'technocentric' approach permeates throughout the Ministry of Education's projects which constitute its ICT strategy. They point to one of the flagships of the strategy, the Digital Opportunities projects (Ministry of Education, 2001) as clear examples of this. These projects Stratford and Brown (2002) claim operate on a "deficit model, whereby computers are supplied to four different situations, with the expectation of educational reward" (Stratford & Brown, 2002, p. 5). They specifically target one of the Digital Opportunities projects, whereby a number of laptop computers were provided to secondary school teachers and students who were working in courses associated with

Mathematics, Science and Technology. According to the Ministry of Education (2001) the purpose of this project was:

> ...to encourage and assist students to excel in senior Science, Mathematics and Technology. It tests whether providing an incentive, such as a laptop, helps with retention between the 6th and 7th form, and whether it is of assistance as a learning tool.
> (Ministry of Education, 2001)

The injection of quantities of ICT into the schools involved in the Digital Opportunities project described above, Stratford and Brown term as "technodumping" (2002, p. 5). They claim that such approaches to implementation are based on the flawed assumption that the provision of technology will assist in somehow bridging an educational deficit which presently exists – in this case, issues related to the retention rate of senior students in particular subject areas (Parr & Ward, 2004; Stratford & Brown, 2002). The recently released final evaluation report from this project indicates very limited success in achieving this goal (Bolstad, 2004).

2.4.2 Teacher Response to Technocentricism

Capper (2001) further critiques the validity of 'technodumping' as being a credible strategy for ICT policy design and implementation at a school level. He claims that without fundamental changes to school organisational structures and teacher pedagogical approaches, the advent of significant levels of technology can lead to situations of teacher resentment and entrenchment. While he does state that in some cases the presence of the technology in a school has initiated some limited change to organisational structures, generally these changes have been against the intention and will of the teachers and the school as a whole (Capper, 2001).

Capper (2001) states that computers can be conceptualised both as a tool "which extends our mental abilities – that is the way in which we think and learn" (Capper, 2001, p. 13), and as a device which is capable of altering the nature of the social relationships which exist within a school. Capper (2001) refers to concepts of "contradiction and disturbance" (p. 20) in explaining how ICT impacts upon existing practice in schools. He defines disturbance as "anything unexpected which interrupts the normal and expected flow of activity" (Capper, 2001, p. 20). Contradiction is defined as "processes embedded in the activities of the system which are, by their nature, contradictory, and therefore undermine the system's efforts to achieve its goals" (Capper, 2001, p. 20).

Capper (2001) further states that disturbances, if persistent enough, become embedded into the social organisation of the school, and can translate into longer-term contradictions which set up an 'inner tension' within the organisation. This tension can manifest itself at all levels of the school and particularly in the classroom, where "computers and the way they were deployed for use, is in contradiction with the ways in which teacher directed classes are conducted" (Capper, 2001, p. 21).

Capper (2001) illustrates this by reference to his research into the use of computers in New Zealand schools. He describes differing teacher responses to contradiction as a result of student self-initiated exploration of software, leading to unanticipated and unplanned student learning.

> In one case study site, we observed a lesson where students were following task sheets to learn some of the basic principles of computer programming. The task involved them writing a progressively more complex program that would lead the computer to produce fractals on the screen. The teacher was telling the students (working in pairs) what to do for the next step, and then reviewing the results with them before moving on to the next step. In other words, the lesson was highly structured and teacher directed. But some student pairs quickly understood what was being done, and they did not wait for the teacher, but quickly moved ahead to write instructions that produced dramatic and exciting fractals that were far ahead of the teacher's intent. Neighbouring students noticed what was happening and progressively began to learn from the input of their peers, rather than that of their teacher...
> (Capper, 2001, p. 22)

In this example, the manner in which the students used the technology to move well ahead of the learning goals as planned by the teacher, set up a tension which resulted in a perceived loss of teacher 'control' of the lesson. However, what is relevant in this illustration is how the teacher responded to the situation.

> In this case, the teacher became aware of what was happening and quickly adjusted. He was able to take advantage of the energetic learning that was going on, and avoided the mistake of trying to reimpose his own planned process on the class. The teacher was adept at adapting to the actual situation...
> (Capper, 2001, p. 22)

If this teacher was then able reflect on this incident and embed such a response into future practice, then he would have learnt an important strategy which would better enable him to capitalise on the potential of ICTs to enhance his future programme. It could therefore be viewed as facilitating a significant transformation in his teaching practice. Such strategies were also noted by Compton and Harwood (2004) during their research into effective teacher practice in Technology Education.

However, such a response was not typical of many teachers in Capper's (2001) study. Capper stated that the "first and most important thing that people do when confronted with a disturbance to their work, is to correct the situation and recover 'normality'" (Capper, 2001, p. 21). This was the case for most teachers in his study, who actively tried to "control the technology and fit it into existing practice. In so doing, they turned a disturbance into a long-term contradiction" (Capper, 2001, p .21).

This result was also found by researchers at the MIT Media lab in an experiment set up with teachers of Physics and Chemistry. The researchers designed a piece of software as a tool-mediated change strategy to support Physics and Chemistry teaching. However, it was designed in a way so that it could not be successfully used within a framework based upon teachers' existing pedagogical practices. When the software was beta tested with a group of experienced teachers, all teachers commented positively on the usefulness of the program and the nature of the content, but defined all the features of the software which required departure from their existing practices as 'bugs'. They then proceeded to devote most of their time to trying to develop 'work arounds' for these 'bugs', which they did successfully. In the process of doing this, they effectively sidelined the features of the software which represented about 80% of the development costs (Laserna & Barowy, 1997).

These examples illustrate the potential of ICT innovations, if introduced unexpectedly and without adequate preparation, to set up situations of disturbance and contradiction. These processes undermine the capability of the technology both to support and enhance teaching and learning processes, and to act as a means to transform organisational practices and structures.
It is often the response of the individual teacher to those tensions, which can dictate the level of success, or otherwise, of the innovation.

2.5 Rethinking Directions for Computer Use in Schools

Despite such flawed implementation practices, it would be difficult to argue against the fact that electronic information and communications technologies are going to play an increasing role in the lives of students leaving school in the foreseeable future.

As Page (1999) explains:

> It is clear that schools need to prepare students for a world where computer-related activities pervade their daily lives. As is the case now, much of the information that we will access will be in electronic formats, so it is clear that students will need to learn how to access and use that information effectively and independently.
> (Page, 1999, p. 17)

So just where does this leave schools? Whilst acknowledging the significance of issues related to poor planning and implementation processes, a way needs to be found to best utilise the range of computers and other ICTs which are rapidly emerging and becoming readily available, in virtually any classroom in the country.

According to Krueger (2000), this process needs to start with an examination of the present emphasis of many schools on the teaching of technical-level skills. That is, there needs to be an acknowledgement that these are "not the goal, but rather it is to find ways to use computers and telecommunications to improve learning" (Krueger, 2000, p. 46).

Such an emphasis, according to Skerman, Billany, Just, and Stove (2000) requires a rethink of the technological debate. They claim that the key to this is the extent to which schools are able to "use educational technologies to support a range of higher order cognitive, metacognitive, affective and social skills, while retaining the best of current practice" (Skerman et al., 2000, p. 13). Clearly a teaching and learning framework must be developed which enables teachers to capitalise on any potential new ICTs offer for their programmes. Furthermore, this framework needs to be based on sound pedagogy, and an indepth theoretical understanding of the nature of teaching and learning. By identifying the features of this framework within the e-classroom which is the context of this research, it is expected more information will be gained relating to how students work in such environments, and the nature of teacher role. This information is vital in realising the full potential of digital technologies in schools.

2.6 Evaluating the Impact of Computers in the Classroom

An examination of the literature reveals considerable debate relating to the basis for the inclusion of computers in classrooms (McQueen, 2004; Trotter, 1998). Indeed, as Cuban (2002) points out in reference to the American experience "...as for enhanced efficiency in learning and teaching, there have been no advances (measured by higher academic achievement of urban, suburban or rural students) over the last decade, that can be confidently attributed to broader access to computers..." (Cuban, 2002, p. 178).

He qualifies this somewhat by stating that American teachers as a general rule are "infrequent and limited users of new technology for classroom instruction" (Cuban, 2002, p. 178), and that "e-learning in public schools has turned out to be word-processing and Internet searching" (Cuban, 2002, p. 178). Such a perspective is also shared by Collins and Dewees (2001) in their analysis of the use of computers in American rural education. Cuban (2002) attributes some of this to a reluctance of the American education system to adopt alternative frameworks for teaching and learning which may better support computer innovation, and a "historical legacy which carries so much weight that, unless changed, will retard the widespread use of technology and hinder substantial changes to classroom practices" (Cuban, 2002, p. 180).

Cuban (2002) discusses the powerful influence of the economically-driven reform movement on computer implementation in the United States. He documents how, after the initial surge of enthusiasm for computer-supported school reform from the 'techno-enthusiasts' of the late 1980s and early 1990s, "a new generation of school reformers promoting rigorous academic standards, accountability, and higher test scores, grew in prominence" (Cuban, 2002, p. 181). These reformers appeared to lose sight of "the historic civil idealism and broad social purposes public schools serve in a democracy" (Cuban, 2002, p. 190), instead preferring to link their "technologically inclined, standards-based curriculum, test scores, and accountability to increasing economic productivity and the Gross National Product" (Cuban, 2002, p. 191). Their technologically-driven ideology centred around the perception that serious school problems were able to be solved with "smarter managers, more machines, cleverer software, adequate staff support, and increased professional development" (Cuban, 2002, p. 191).

2.6.1 Limitations of Applying 'Traditional' Measures to Evaluating the Impact of Computers in Schools

This view Cuban (2002) argues is fundamentally flawed on two counts. Firstly, he claims that linking access to more and faster information via increased levels of hardware and software does not mean more knowledgeable and capable students. He states that what is lacking in this equation (and in American education generally) is an ability to apply a "critical awareness, reasoning and judgment, that will allow the turning of information into knowledge, or in time, the forging of that knowledge into wisdom" (Cuban, 2002, p. 189). Issues such as this were also identified earlier by authors such as Clarke (1995), who warned against making assumptions about technology's capability to develop 'wise citizens'. He claimed that technology was capable of delivering information, but the transformation of this information into knowledge and eventually wisdom, was a rigourous intellectual process that any appeared reluctant to engage in (Clarke, 1995).

Secondly, Cuban (2002) claims that the problems of American schooling are more fundamental than those which can be solved by the application of technology. He suggests that many of the problems presently afflicting American education have their roots deeply set in funding, social, health, and poverty issues, which cannot be solved by "wiring schools and creating hardware and software infrastructures that give students and teachers access to technology" (Cuban, 2002, p. 188).

Cuban (2002) has not been alone in questioning the direction for computer implementation in schools, and the manner in which the impacts of this implementation have been evaluated. Authors such as Heinecke, Blasi, Milman, and Washington (1999), McNabb et al. (1999), McCombs (2000), Culp, Honey, and Spielvogel (2003), Xiufeng, Macmillan, and Timmons (1998), and Falloon, (2003), claim that the narrow manner in which the impact of computers on student learning has traditionally been defined, is restricting the validation of its use for other purposes. They also state that this has caused a narrowing in the evaluative criteria against which technology's impact is assessed.

Heinecke et al. (1999) are particularly critical of this, stating that the use of technology as a means to 'install' in students basic skills and content, such as that which is able to be easily measured using standardised test procedures, "reduces the equation to only a student, a computer, and a test" (Heinecke et al., 1999, p. 3). Blackmore et al. (2000), add to this debate by claiming that the move towards standardisation of student outcomes as defined by "limited academic measures" (Blackmore et al., 2000, p. 7) has produced a "shift away from the more innovative and progressive pedagogies and structures" (Blackmore, et al., 2000, p. 7) they view as being supportive of computer innovation. While Blackmore et al. (2000) primarily refers to the Australian experience, data will be presented later in this thesis which indicates that such a perception was also held by some principals in New Zealand, particularly relating to the standardising influence of the Education Review Office school review process of the 1990s.

As discussed previously in relation to Cuban's work (2002), Heinecke et al., (1999) claim that the manner in which technology is used and evaluated is inextricably linked to notions relating to the goals for education held by teachers, and others responsible for technology's implementation. As identified earlier by Capper (2001) and Page (1999), Heinecke et al.'s (1999) discussion focuses on the importance of developing in our students, skills of critical analysis, higher-order reflective thinking, problem solving, and metacognitive capability. They see these as being vital in enabling students to function in a dynamic and rapidly evolving society of the future. Heinecke et al. (1999), identify the potential of computers to support programmes based on such objectives, but claim that in order for this to happen, the criteria against which the effectiveness of such programmes is made, needs to be revisited.

> If, on the other hand, one views the goals of education as the production of students who can engage in higher-order, problem-based inquiry, new potential for entirely different uses of technology emerge... we can evaluate these outcomes, but it is more complicated than the standardised test route. Standardised tests are an efficient means for measuring certain types of learning outcomes, but we must again ask ourselves, are these the outcomes we value for the new millennium? To a certain extent we are living out the decisions reflected in previous evaluation methods which constrain the purpose and effectiveness of technology in education. (Heinecke et al., 1999, p. 3)

Additionally, they state that uncertainty about the reasons for inclusion of computers in schools compounds this issue further, in that there "appears to be little consensus about their purpose" (Heinecke et al., 1999, p. 3).

Supporting this, Culp et al. (2003) in a discussion of their work with locally-based projects, claim that one of the major challenges facing computer deployment is the need to disseminate information about the benefits of computer use to a wider audience. However, one of the major obstacles to achieving this is "finding scalable and substantive ways to support local school communities in thinking differently about evaluative questions and about evidence" (Culp et al., 2003, p. 79).

Xiufeng et al. (1998), in their seven month study of computer integration across subjects in a secondary school also identified similar issues relating to how the impact of their intervention was evaluated. They quickly identified the need to develop alternative frameworks based on a more holistic view of learning, than that able to assessed using traditional measures of achievement.

> It is evident that new approaches to evaluating the effects of computers in the curriculum are necessary. Based on the perspectives reviewed previously, we decided to follow a more holistic approach to studying the impact of computers on student learning...
> (Xiufeng et al., 1998, p. 189)

2.6.2 The Need for a Multifaceted Approach to Evaluating the Impact of Computers in Schools

If we accept the views expressed by authors such as Capper (2001), Heinecke et al. (1999), McNabb et al. (1999), Culp et al. (2003), Xiufeng (1998), Falloon (2003), and McCombs (2000), it appears that developing an alternative framework for evaluating the effectiveness or impact of computers in schools, should be considered. Any such framework must recognise that schools are complex social systems, and that the processes of teaching and learning are embedded within a larger social organisation. School environments demand a multifaceted approach to evaluation – one which is "theory-based, employs multiple-method designs, and emphasises shared rather than adversarial interests between evaluators and programme participants" (Heinecke et al., 1999, p. 5).

Whilst supporting such an approach, Roschelle et al. (2001) acknowledge inherent difficulties in identifying the specific impact technology makes on any teaching and learning situation, by stating that it is only one of many variables that may be in operation at any point in the teaching and learning process. They identify the need to move towards more formative means of evaluation based upon a wider definition of what constitutes a 'learning outcome', and which reflects the capabilities of computers in developing "complex concepts and higher-order thinking skills" (Roschelle, 2001, p. 92).

The move towards broader evaluative criteria for computer use is also supported by McNabb et al. (1999). They argue that one of the main issues inhibiting the recognition of a wider perspective has been the limited formative nature of data available, through the past reliance on standardised test procedures (McNabb et al., 1999). They claim that such procedures are unable to reflect the outcomes of what is essentially a socially complex and interactive process. This process involves the development of a mix of "administrative procedures, curricula, classroom organisation, teachers' pedagogical approaches, time and space designations, school –community partnerships, and logistical and social factors" (McNabb et al., 1999, p. 2). This 'blend' of factors forms a distinctive operating environment which is unique for each school – even to a classroom level – and that as such, any attempts to apply standardised evaluative processes 'across the board' would yield results which would be virtually meaningless (McNabb et al., 1999). The move towards more formative evaluation measures, they argue, would "...supply information on how technology affects student attitudes towards learning. It can show the impact of technology on promoting collaboration amongst diverse learners. It can track technology literacy skills development, and indicate the impact of technology access" (McNabb et al., 1999, p. 4).

The challenge is to develop a means of assessing student progress over time, and to identify both qualitatively and quantitatively those performances and enhancements which would not have been possible without access to technology such as computers. To help facilitate this process, McCombs (2000) suggests that there needs to be a more student-centred approach, in which the impact of computers upon the teaching and learning process is assessed from a perspective which conceptualises learning as an integrative and holistic process. Such an approach is also consistent with work undertaken by cognitive researchers such as Diamond and Hopson (1999), Jensen (1998), and Sylwester (1995).

2.6.3 Towards a Broader Perspective on Evaluating the Impact of Computers in Schools

The challenge in broadening perspectives on the effectiveness of computers in schools, lies in developing alternative frameworks which acknowledge the range of skills and capabilities that are best able to be developed through their use. The present emphasis on using computers within curriculum to develop low-level 'rote' capabilities, does not allow students to develop critical skills essential for self-regulating and controlling dimensions of their learning – areas which McCombs (2000) views technology as being most able to add value.

Authors such as McCombs (2000), Thornburg (1999), Hawke and Capper (1999), and Blackmore et al. (2003), identify the need for fundamental and systemic reform of the schooling system. They view this as being essential in developing the sort of environment capable of realising the potential of computers, and conducive to developing life-long learners. Papert (2002) also laments that the externally imposed structure schooling mandates, effectively denies students opportunities to develop learning independence and self-managing processes. He states that many of the issues schools are presently facing, are the result of children being more able to access knowledge via electronic means outside of the traditional education system, and that they see "school is out of touch with the needs of the modern world" (Papert, 2002, p. 1).

McCombs (2000) and Roschelle et al. (2001), suggest that in order to create learning environments which both reflect the true needs of students entering the 21st Century, and offer the greatest potential for harnessing the capability of new learning technologies, schools need to refocus on the individual, and the development of attitudes and skills to support life-long learning. McCombs (2000) states that the curriculum needs to de-emphasise the mastery of specific content knowledge, in favour of preparing students to "become knowledge producers, knowledge users, and socially responsible citizens" (p. 2). Thornburg (1999) claims that such skills should form the very core of our education system as we enter the 21st century, and that teaching and learning processes need to change dramatically to reflect this new goal.

> ...in the world of the past where access was limited, information was treated as a scarce resource, and educators had the task of imparting this information for the benefit of learners. We used to live in a world where content was king. That world no longer exists. Content is abundant, and is, therefore, a poor basis on which to base an educational system. What is scarce today is context and meaning.
> (Thornburg, 1999, p. 2).

Sandholtz, Ringstaff, and Dwyer (1997) identify the "raucous clash over educational standards" (p. 35) as being a contributing factor to the reluctance of schools to adopt alternative structures and methods supportive of new technologies. McCombs (2000) claims that these movements have at their core the mastery of specifically defined content knowledge and skills, and that any appraisal of the benefit from technology use is made within such a framework. She argues that this view ignores some fundamental benefits technology is able to provide to the learning environment as a whole, and to the processes involved in student learning.

> From a person or learner-centred view, the current focus on content must be balanced with a focus on individual learners and their learning needs in an increasingly complex and fast-changing world. This balance is essential if we are to adequately prepare students for healthy and productive futures.
> (McCombs, 2000, p. 2)

To achieve such goals, McCombs (2000) states that there needs to be a balance developed between maintaining high standards of achievement, but with an increased focus on attention to personal and motivational factors able to be supported with technology. The foundation to this is a reconceptualisation of the nature of the relationship between the teacher and the learner, and a recognition that students should be able to contribute to the development of their own learning programmes. Such a reconceptualisation McCombs (2000) sees as critical to the establishment of an effective technology-supported learning environment, and needs to be based on learner-centred rather than curriculum-centred principles.

The imperative in this respect is to move towards the use of technology to achieve a broader array of outcomes for students. According to McCombs (2000) these should include:

- investigating the potential of technology to assist in promoting cognitive and metacognitive capabilities, through the development of strategic thinking and reasoning skills, analytical skills, and by providing meaningful contexts for learning;
- a recognition of the innate ability of technology to trigger learner intrinsic motivation through stimulation of creativity, higher order thinking, and natural curiosity; and
- the capacity of technology to support the learning of diverse groups of students, and to work across intellectual, emotional and social domains.

What is particularly relevant in this analysis, is the broad manner in which technology's contribution to the overall learning of students has been defined. The notion that technology is able to contribute to student development across cognitive, motivational, and social domains is particularly relevant for this research. As identified in Chapter 1, this study examines how the context of the e-classroom environment impacts upon the facilitation of skills and attributes in these three areas.

The broadening of the framework used to determine the value technology can add to schools, is inextricably linked to the need for fundamental changes to the structure and nature of schooling in its present form. Such changes include the need for greater levels of student input into the development of curriculum including the negotiation of learning goals, more flexible organisational structures, and significant changes to assessment methods (Roschelle et al., 2001; Sandholtz, Ringstaff, & Dwyer, 1997).

This is supported by contemporary research undertaken in New Zealand by Compton and Harwood (2003) in the area of Technology Education. This research indicated significant advantages for student learning when negotiated approaches to the development of learning outcomes was utilised. Significant improvements were witnessed to student outcomes and motivational levels, when unanticipated or unintended learning as a result of divergent student interaction with the task, was validated by the formation of revised and negotiated learning goals. This revision then formed the modified focus for their continuation with the task (Compton & Harwood, 2003). The critical element in their findings related to the teacher's ability and willingness to both acknowledge and monitor these revised goals, and provide the students with the necessary resources and organisational structure to carry them out (Compton & Harwood, 2003).

Whilst acknowledging this framework was trialed in the area of Technology Education, a similar structure could be utilised as teachers seek to identify ways in which the divergent activities possible within a computer-based learning environment, could be managed and assessed.

2.7 Computers and the Development of Cognitive Elements

The previous discussion outlined broadly the arguments for extending the evaluative criteria against which the impact of technology in a learning context is assessed. These arguments related to the need to take a more holistic view of how technology could be used to support cognitive as well as social and affective outcomes. Emphasis on using technology for such outcomes was seen as a means of better-equipping students with the type of skills viewed as essential for the information-rich world of the 21st century (Roschelle et al., 2001; Yelland, 2001). This section examines literature related to using technology to achieve the first of these, that is, enhancing cognitive capabilities. The latter sections draws significantly from the seminal work of Jonassen (1994, 1996, 2000) and Jonassen and Reeves (1996) in an analysis of the use of computers as cognitive or mind tools. Their work has been used as it represents the most complete accounts available of computer use in this way, in an area with a very limited array of available literature.

2.7.1 Computers and the Acquisition of Basic Knowledge

Research by Oliver and Harvey (2002), claims that education is a complex social process which "makes it difficult to know where to look for impact, or to recognise it when it happens" (Oliver & Harvey, 2002, p. 1). In stating this, some studies do show that computers, if used appropriately and in specifically targetted areas, can enhance student learning of basic knowledge components, skills and processes (ACOT, 1996, 1998; British Educational Communications and Technology Agency, 2001; Cox, Abbott, Web, Blakely, Beauchamp, & Rhodes, 2003; Kulik, Kulik, & Bangert-Drowns, 1985; Mann, Shakeshaft, Becker, & Kottkamp, 1999; Reeves, 1998; Russell & Plati, 2002; Salpeter, 1998; Schacter 1999; Stoney & Oliver, 2002; Weglinsky, 1998).

In the Mann et al. (1999) investigation, the state government of West Virginia commissioned a longitudinal study to research what impact the provision of computer hardware and software could have on the acquisition of basic knowledge and skills. These were incorporated in the state educational goals and objectives. The study, entitled the Basic Skills/ Computer Education (BS/CE) programme, was undertaken with grade four and five students in 18 schools over a period of three years from 1996–1998. It was supported with sufficient numbers of computers to allow for student access on a regular basis. The stock of computers in each of the schools was gradually increased during the course of the study, to ensure there was a "critical mass of hardware, software and training, which was tightly focused on a grade-by-grade basis, to follow through the schedule of basic skills acquisition" (Mann, et al., 1999, p. 13). The computers could be organised on a basis that suited each of the 18 schools – either in computer labs, or as stand-alone mini-pods in classrooms. Self-report data from the students involved in the study indicated that on average they used the computers for around an hour and a half every 2–3 days, with most of this use being for skill-development exercises in Mathematics and Language.

The results of the study indicated significant advantages for students using the BS/CE programme to develop basic numeracy and literacy skills (Mann, et al., 1999). The researchers analysed nearly 400 student results using two years of gathered data from statewide Stanford 9 Achievement tests. It was claimed that using this approach gave a fair indication of comparison, as this test was normed against a nationally-represented group of students at comparative grade levels in a cross-section of American schools (Mann, et al., 1999). The data were analysed against a framework which included an examination of software and computer availability and use, the development of teacher and student attitudes towards computers, and the nature of teacher training and involvement in computer implementation decisions. After performing a regression analysis on the results of the Stanford 9 Achievement tests using the analytical framework, it was found that students who were participants in the study gained an average 11% advantage over those in the national survey (Mann, et al., 1999).

In discussing these results however, the authors acknowledge that:

> ...statistically, as practically, it takes multiple dimensions to make a difference. The model demonstrates that it is software specific to the purposes of basic skills achievement, availability of computers, teacher training and involvement in implementation decisions, positive teacher and student attitudes towards computers, and time spent using the software, that led to the gains.
> (Mann et al., 1999, p. 30)

They also acknowledge that during the course of the study, West Virginia schools were undergoing major renovations. Additionally, teachers were experiencing significant improvements to working conditions and salary which, they speculate, could have influenced their performance. However, self-report data from teachers on this issue, did not support this speculation (Mann et al., 1999).

In another similar study by Wenglinsky (1998), the relationship between the use of computers, and student achievement in Mathematics was examined. For this study, over 13,000 fourth and eighth graders were surveyed using the 1996 American National Assessment of Educational Progress (NAEP). Wenglinsky (1998) analysed the results of the survey in the area of Mathematics, to see if there was any correlation between the achievement levels of the students, and four technology-related variables. These variables were:

- frequency of computer use for Mathematics in the school;
- access to computers and frequency of computer use in the home;
- levels of Mathematics teachers' professional development in computer use; and
- the kinds of instructional uses of computers by Mathematics teachers and their students.

Additionally, Weglinsky (1998) collected data related to the manner in which access and use of computers in schools, influenced the view that students held in relation to going to school. He analysed these under the heading of 'social environment', and recorded and reported on levels of student tardiness and absenteeism, teacher absenteeism and morale, and the level of student regard for school property.

The results of the study identified critical links between the role of the teacher, the level of access students had to computers both in schools and at home, and the manner in which computers were used in support of learning goals (Wenglinsky, 1998). For example, eighth grade students who had higher access to and use of computers at school, also tended to have higher access and use at home. When this was associated with teachers who had undertaken professional development focusing on the use of computers to develop higher-order thinking and problem solving skills – that is, were knowledgeable in using computers for this purpose, then significant improvements in the academic attainment levels of students in Mathematics was evident (Wenglinsky, 1998). This pattern was also translated to students' and teachers' views of the social environment. Indeed, it appeared to be a self-perpetuating cycle, whereby academic successes derived from home and indirectly from school use of computers, led to improved attitudes to school, less absenteeism, and higher levels of student and staff morale.

Conversely, the study revealed that for the fourth grade students, the benefits from school access and use of computers was far less defined (Wenglinsky, 1998). In this instance, teacher professional development appeared to focus on using computer-based learning games in Mathematics, "meaning teachers who have had professional development on using computers in this way, are more likely to use them in this way (with their class)" (Wenglinsky, 1998, p. 26). Although the learning benefits for students from using computers in this manner were still slightly positive, this was attributed to the teachers who had experienced this sort of professional development, using computers more for such purposes. Furthermore, teachers who had not received professional development in using computers in Mathematics, tended to use their computer more for 'drill and practice' exercises, that is, tasks requiring "low level skills which were negatively related to academic achievement" (Wenglinsky, 1998, p. 29). The same overall pattern prevailed for fourth grade students when it came to their opinions of the social environment.

It is possible to conclude that computers can have an impact on academic achievement, but that this is inextricably linked to the nature and level of teacher professional development, and student access to computers, both at school and at home (Weglinsky, 1998). These factors, in turn, greatly impact upon the manner in which computers are used in the classroom, and the benefit that is able to be derived from that use. In the Wenglinsky (1998) study, it is apparent that those teachers who received professional development in using the computer to enhance higher-order thinking and analytical skills, and who taught students who had good levels of access to computers both at school and at home, were in the best position to use computers to enhance academic performance. However, the study also alerted that extremely high levels of computer use may actually be counterproductive, "as students may revert to using computers in unproductive ways, such as playing non-educational games" (Wenglinsky, 1998, p. 32). The critical aspect in this equation appears to be the identification of specific and targeted purposes for computer use, which focus on the development of higher order thinking and problem solving capabilities (Yelland, 2001).

The implications of these findings for this research are significant. It is apparent that for any learning advantage to be gained from computer use, there needs to be developed a unique balance between curriculum design, teaching strategies and pedagogy, and purposeful computer application. The nature of this 'blend' does not appear to be consistent in all cases, but is very much aligned to the type of knowledge or capabilities teachers expect students to gain from computer use, and how this is interfaced with teacher beliefs on what and how students learn.

As indicated by the research questions in Chapter 1, it is the identification of the nature and effectiveness of the 'blend' between these three elements, and how this might be enhanced to optimise student learning, that is central to the purpose of this thesis.

2.7.2 Computers and Cognitive Functioning

As discussed earlier in reference to Collins and Adams (1977) work, traditional use of computers in schools has focused largely on their capabilities in developing specific knowledge and skills. This was usually achieved through the application of a range of software, which targeted perceived deficits in students' understandings. Such uses have typically involved the application of 'drill and practice' software, and represented a *learning from* model of computer use. In this model, "the computer is programmed to teach the student, to direct the activities of the learner toward the acquisition of pre-specified knowledge or skills" (Jonassen, 2000, p. 4). The rationale behind computer use in this way was based on the premise of automaticity, that is, that the development of lower-order skills are required as a prerequisite for higher-order functioning. It was considered that until such skills become 'automatic', students would be unable to undertake tasks demanding capabilities such as higher-level problem solving or reflective analysis (Merrill, Hammons, Vincent, Reynolds, Christensen, & Tolman, 1996).

Whilst drill and practice software in its various forms is able to assist in meeting the remedial needs of some students, research into its effectiveness when used in this way indicates only limited success (Jonassen, 2000). The reason for this is that such programs are based on "one of the oldest and most meaningless forms of learning, rote learning" (Jonassen, 2000, p. 5). This approach to the design of learning tasks inhibits student ability to transfer skills and knowledge out of the rote context, to meaningful problems embedded in 'real world' situations (Jonassen, 2000).

Additionally, the design of such software does not allow students to develop creative solutions to problems which may not have been anticipated by the software designers, and are therefore not incorporated into the program. This is indeed one of the major criticisms of all categories of Computer Assisted Instruction (CAI) software. Students are not encouraged to develop reflective and analytical thinking skills in the construction of understandings, or in developing strategies to solve problems. Rather, their task is to try to identify a predetermined 'map' generated by the software designers, which will allow them to progress to a prescribed objective. Such low-level use does not capitalise on the potential of the computer to act as a powerful cognitive tool for learning (Lajoie, 2000).

Unlike CAI software, the use of computers as cognitive tools is based on the notion of a 'learning partnership' being developed between the computer and the student. The computer is used to support and extend the cognitive capabilities of the student, by "amplifying learner's thinking by transcending the limitations of the mind" (Jonassen, 2000, p. 10). This, Jonassen (2000) refers to as learning *with* computers. In this instance, cognitive tools can be defined as "...computer-based tools and learning environments that have been adapted or developed to function as intellectual partners with the learner, in order to engage and facilitate critical thinking and higher-order learning" (Jonassen, 2000, p. 9).

Jonassen (2000) identifies some examples of computer software which he states as being able to act in this capacity. The list includes applications used for semantic or concept-mapping, developing databases and spreadsheets, computer modelling, multimedia and hypermedia publishing, developing visualisations and microworlds, and expert system software.

The use of computers as cognitive tools (or mindtools) is designed to enhance user thought processes (Derry, 1990). That is, they do not necessarily make the task of the user easier by eliminating the need for high levels of information processing, but allow the user to "make more effective use of their mental efforts" (Jonassen, 2000, p. 10). Application in this way is not seen as using the computer in a manner Perkins (1993) describes as a 'finger tip tool', but rather it requires learners to have a deeper and more complete understanding of the content and subject material under study, and encourages them to think critically in their analysis and interpretation of information, as they construct understandings from it.

Computer mindtools assist in the development of critical thinking capacity by requiring, through their range of functions, engagement in critical thought by the learner. That is, in order for a learner to engage with a computer-based mindtool, they must have first of all engaged critically with the information and key concepts associated with what the mindtool is going to be used to construct and represent. The mindtool is not the end in itself – it is a vehicle through which the construction of learner knowledge is supported and extended. An example of this is provided by Jonassen (2000) in relation to the use of semantic or concept mapping software.

> ...learners cannot construct semantic nets or expert systems knowledge bases without analysing and therefore thinking critically about the content they are studying. The tools scaffold meaningful thinking; they engage learners and support them once they are engaged. Mindtools actively engage learners in the creation of knowledge that reflects their comprehension and conception of the information, rather than replicating the teacher's presentation of information.
> (Jonassen, 2000, p. 10)

Validation for the use of computers as mindtools is derived from constructivist-based learning theory, which posits that as learners we construct our own realities, through interpreting our experiences as we interact with, and exist in the world. How we build these understandings is a function of our existing knowledge and previous experiences, how we have interpreted and organised these into knowledge structures known as schemata (mental constructs), and the beliefs and values we use to interpret the events as we experience them in the world.

This is also supported within sociocultural theory, where the development of socially-constructed meaning occurs through a natural process of social negotiation (Vygotsky, 1962). Such a process is important to the development of common understandings of phenomena, objects and events, which is an essential element for a functioning society. Within such a framework, mindtools can assist in the knowledge construction process by allowing learners to "organise, represent, manipulate, and reflect on what they know, not reproduce what someone else tells them" (Jonassen, 2000, p. 10). Such a process can be further enhanced when learners work together using mindtools in collaborative groups, in the negotiation and development of shared meaning, understandings and representations.

The earlier work of Norman (1993), who theorised that computers could be used to support the development of reflective thinking, tends to support this. Norman (1993) claimed that the computer's ability to assist in the process of composing new understandings by allowing learners to add, modify and compare knowledge representations, encourages learners to "reflect on what they have done, what needs to be done, and what else they need to do and know" (Jonassen, 2000, p. 13). The fact that this process can be undertaken with relative ease using computer-based mindtools supports the facilitation of this process. This factor is important to the present study because the use of computers in this way dominated curriculum design and student activity in this e-classroom.

The notion of the development of a 'cognitive partnership' between learners and computer-based mindtools has been promoted as another argument for using computers in this way. According to Jonassen and Reeves (1996), computers have the capacity to "share the cognitive burden of carrying out learning tasks" (p. 697), by virtue that they are able to undertake operations such as basic computation and 'memorisation', far better than the learner. By doing this, they free up the learner to concentrate on what is most meaningful in terms of learning – developing ideas, constructing understandings, and thinking creatively. Therefore, by using computers as a 'learning partner', students are able to optimise their performance by 'off-loading' to the computer those basic tasks which it does best, leaving them to concentrate on high order activities.

2.7.3 Computers and the Development of Critical, Creative and Complex Thinking

One of the principal arguments for using computers as mindtools, is the enhanced potential for developing complex thinking processes. Jonassen

(2000) identifies the process of complex thinking as being an interactive system involving the exercise of three essential elements – content or basic thinking, critical thinking, and creative thinking. This framework is based on the Integrated Thinking Model (Iowa Department of Education, 1989), which identifies the essential processes of designing, decision-making and problem solving, as 'vehicles' by which the three elements are operationalised in any given situation.

Content or basic thinking is identified as that knowledge which represents "the skills, attitudes and dispositions required to learn accepted information – basic academic content, general knowledge and common sense – and to recall this information after it has been learnt" (Iowa Department of Education, 1989, p. 7). It forms the knowledge base from which critical, creative and complex thinking draw, and is generally the outcome from traditional learning experiences.

Critical thinking involves the dynamic reorganisation by the learner of knowledge in meaningful and useful ways. According to Jonassen (2000), it involves:

- the exercise of skills of evaluation, analysis, and connection, in making judgments about something in terms of self-generated or publicly available criteria or standards;
- being able to deconstruct whole entities into meaningful parts and understand the interrelationships between those parts; and
- determining or developing relationships between the entities under analysis.

Critical thinking attempts to assess the validity of information and phenomena using such processes as classification, pattern recognition, sequencing, logical thinking, deductive and inductive inference, and prioritisation. It is a pivotal component of complex thinking processes.

Creative thinking skills interact dynamically with critical thinking in the construction of new understandings. However, unlike critical thinking, creative thinking does not use objective criteria to evaluate information, but rather "goes beyond accepted knowledge to generate new knowledge" (Jonassen, 2000, p. 28). Creative thinking is more subjective in the use of personal skills and experiences in the evaluation of information, and involves the exercise of synthesis, imagination and elaboration. Within this element, skills such as the ability to think analogically, hypothesising, process planning, summarisation, ideas generation, prediction, speculation, intuition, visualisation, and modification and refinement of ideas, all interact in creating new understandings which are original and dynamic (Jonassen, 2000). Creative thinking also has an interactive relationship with critical thinking, in that the outcomes from creative thought processes may be at times subject to critical analysis, in order to assess their validity.

All three elements contribute to a process which Jonassen (2000) terms complex thinking. As stated earlier, complex thinking is the process by which basic, critical, and creative thinking are 'operationalised' into "action-oriented processes" (Jonassen, 2000, p. 30). Strategies include the use of skills such as problem solving, designing, and decision-making in the development of solutions to problems or situations, the creation of products or artifacts of any sort, or the systematic and rational identification of preferred options from a range of alternatives. Each of these strategies is further defined by sets of sub-skills, which identify the type of processes which would be evident within each of these strategies.

For problem solving, they include the identification, researching and formulation of problems, finding alternative solutions to problems, and solution selection and development. For designing, Jonassen (2000) lists these as imagining and formulating goals, product invention, and product assessment, evaluation and refinement. The sub-skills of decision making are identified as the ability to recognise an issue, generate alternative solutions to the issue – assessing the consequences of each before making a choice, and then evaluating the appropriateness of the choice in terms of the available information, intuition, and other sources of verification (Jonassen, 2000). These sets of sub-skills are seen as iterative and complimentary, and all contribute to the development of a 'blend' of the three thinking elements, which can then be developed into strategies and applied to the given situation.

2.7.4 Issues and Implications Related to using Computers to Enhance Cognitive Elements

The use of computers as cognitive mindtools does, however, hold several implications for teachers and for the nature of many present educational practices. One of the unfortunate features of many contemporary education systems world-wide is their acceptance, and in many cases, promotion and celebration of mediocrity (Jonassen 2000).

He cites the American system as one example of this, where he claims that there is "...a diminution amongst American students in the ability and willingness to think. Declining standards are but symptoms of an intellectual disease in our society. Learning, thinking and knowledge, and efforts to develop them – are valued less and less" (Jonassen, 2000, p. 272).

Salomon and Globerson (1987) had previously put forward three primary reasons for the phenomena of declining standards. The first of these centred on the apparently limited array of strategies that learners were able to bring to any learning task. They claimed that the emphasis of curriculum on the attainment and memorisation of often meaningless facts, meant that learners did not have strategies outside of the application of these, through which to solve learning problems (Salomon & Globerson, 1987). The second reason they identified was the apparent desire by students to find easy, quick-fix solutions to problems, rather than being prepared to spend time thinking about and analysing them (Salomon & Globerson, 1987). Jonassen (2000) refers to this as "engaging in effortful reasoning" (p. 272). He describes the issue as a 'misengagement' with the problem, which results in students "misapplying their misconceptions, rather than decomposing the problem, analysing assumptions, elaborating on information, and using other critical thinking skills in the generation of original solutions" (Jonassen, 2000, p. 273).

The third factor Salomon and Globerson (1987) identified was the lack of motivation of students, and the declining level of expectation (and the acceptance of this) by teachers, parents, and society generally. They point to a developing reluctance within society for individuals to accept responsibility for personal actions, or to actively assume responsibility for personal choices or options. This manifests itself in schools in the form of "learned helplessness, poor perceived self-efficacy, and improper attribution of success or failure" (Jonassen, 2000, p. 272). In the classroom, it is displayed through students who are not prepared to exert any mental effort in solving a learning problem, choosing instead to continually ask the teacher or others for help (Saloman & Globerson, 1987).

In order to optimise the potential benefit from using computers as mindtools in the classroom, Jonassen (2000) states that both teachers and learners need to have as their goal, the development of practices and dispositions that will enable "mindful learning" (p. 273). In defining this, Salomon and Globerson (1987) describe mindful learning as the "volitional, metacognitively guided employment of non-automatic, usually effort demanding processes" (p. 625). Through the application of 'mindful learning', it is considered that meaningful learning – that is, learning which is "applicable to similar situations, and transferable to dissimilar situations" (Jonassen, 2000, p. 273), will be possible.

The transition to a learning environment in which mindful learning is supported, requires radical change to most typical classrooms. Roschelle et al. (2001) point to the passive nature of most present learning environments, in which typically students are seen to be the recipients of teacher wisdom, and where curriculum is dominated by high levels of teacher planning and direction. Jonassen (2000) argues that teachers instead need to be the designers of environments which encourage learner self-regulation, where learners contribute to development of learning goals, and have an increased level of input into the content and delivery of curriculum (Jonassen, 1996). The process of managing the transition to such an environment Jonassen (2000) claims is not an easy one, as students have been enculturated for most of their learning careers by high levels of teacher direction and interference in their learning. That is, they have not been given the opportunity to develop self-regulatory capacity, and teachers may be initially frustrated by their lack of ability, perseverance, and experience. Once again, this is highly relevant to this research study, where students in this e-classroom were provided with significant opportunities to have input to the planning and execution of learning experiences, and in making decisions related to the use of the computers.

The evaluation of levels of student collaboration, self-regulation, and critical, complex, and creative thinking employed during the use of mindtools, Jonassen (2000) views as being particularly problematic. However, this is something that must be considered, as the development of such processes are "the raisons d'etre of Mindtools" (Jonassen, 2000, p. 284). He discusses the need to evaluate the effectiveness of these over a prolonged period of time, within a range of different contexts, and using a variety of assessment methods. The challenge lies in making such processes explicit, and developing methods by which any student progression through their use is able to be evaluated.

2.8 Computers and Student Affective and Motivational Elements

For a number of years, educational researchers have been interested in the relationship between student attitude, motivation and learning. As far back as 70 years ago, Allport (1935) made reference to the importance of the concept of attitude to contemporary American psychology, and since that time, educators have been examining how to enhance learner attitude because of its possible impact on learning (Simonson & Maushak, 1996). More recently, research has focused on the capacity of modern electronic technologies such as computers to enhance student attitudes towards learning tasks, and to increase motivational levels (Bialo & Sivin-Kachala, 1996; Bolstad, 2004; Kulik, 1994; McQueen, 2004; Panitz, 1999; Parr & Ward, 2004; Pittard, Bannister, & Dunn, 2004; Small, 1997; Somekh, Lewin, Mavers, Fisher, Harrison, Haw, & Lunzer, 2002; Stark, Simpson, Gray, & Payne, 2000; Terrell & Rendulic, 1996; Wenglinsky, 1998).

2.8.1 Computers and Classroom Environments

While some authors have been reluctant to link computer use directly to enhanced achievement (Blackmore et al., 2003; Brown, 2004; Capper, 2001; Cuban, 2002; Harris, 1997; Pittard et al., 2004; Selwyn, 2004) others have promoted the notion that computers can act in a powerful way by enhancing the learning environment for some students (ACOT, 1996, 1998; Cleverley, 2004; Iverson, 2001; Newhouse, 1999; Trinidad et al., 2002). These authors claim that computer use indirectly promotes student attitudes and motivation, and thereby, they speculate, also improves student performance. At this point it is pertinent to comment briefly on some general research relating to the importance of the learning environment on student performance, and then the role computers can play in this.

According to Nair and Fisher (2001), classroom environment ranks as "one of the nine factors that contribute to the variance in students' cognitive and affective outcomes" (p. 1). In a general study examining the relationship between learning environments and student attitudes to science, they determined how aspects such as the perceived levels of personalisation of programmes, student cohesiveness, task orientation, cooperation, and programme innovation, were impacted upon as a result of learning environment transition from secondary to tertiary levels. Generally, their findings indicated that as students moved to the tertiary level, their attitudes to their learning environment became less favourable, and they "became more dissatisfied with their attitudes towards their science courses" (Nair & Fisher, 2001, p. 14). In this instance, they also identified a level of congruence between student and teacher perceptions of the impact of transition on the learning environment, but commented that such congruence may not always be the case (Nair & Fisher, 2000).

This incongruence is illustrated in a just-released study by Bolstad (2004), into the impact of the inclusion of notebook computers for all students in senior secondary science and mathematics classes in the Hutt Valley region of New Zealand. Amongst other things, her three year investigation examined how the inclusion of these technologies impacted upon the learning environment for students. A significant outcome in this respect was the difference in perception that teachers held of the innovation, when compared to that held by the students. The study found that generally students considered the advent of notebooks to be a positive enhancement of the learning environment, potentially at least enabling greater freedoms and access to information, and more options for presenting their work.

However, many teachers in the study held the opposite views. They viewed the notebooks as an unwanted intrusion, and felt that they disrupted the working environment of their classrooms by providing an unnecessary distraction from what they viewed as their generally well-functioning programmes (Bolstad, 2004). As in the earlier discussion of the work of Capper (2001), this led to teacher retrenchment of practice to what was judged to be the situation before the innovation was introduced, and a rejection of many of the potentials presented by the notebooks and identified by the students. This appeared in turn to have a negative impact upon the learning environment, as students became frustrated with their teachers' lack of interest and preparedness to explore the potential of the notebooks, and eventually themselves lost interest in the initiative (Bolstad, 2004). This reflected in statistical data relating to the project, which indicated a "drop of 28% in the number of students bringing their notebooks to school on a daily basis, from the beginning of 2002 to May 2003" (Bolstad, 2004, p. 72).

Whilst some of the responsibility for the apparent failure of this programme can be attributed to the teachers, as Bolstad (2004) identified, much of this can also be attributed to the manner in which the project was implemented. This project adopted a 'technology-push' model of implementation, and held all the attributes of what Stratford and Brown earlier termed "technodumping" (2002, p. 5).

In stating this however, there appears to be evidence that when implemented appropriately, computers can enhance classroom learning environments (Roschelle, et al., 2001). In a recent study by Blackmore et al. (2003) into the use of computers to enhance the learning environment of disadvantaged students, it was determined that one of the most powerful effects from the integration of computers was how they acted upon and changed the established structures of the classroom. They reported higher levels of student engagement, less teacher dependence and more inter-student collaboration, increased 'customisation' of learning experiences to meet diverse learner needs, and substantially changed student-teacher relationships, as a result of computer integration (Blackmore et al., 2003). However, as in other similar studies, they found a "weaker untested association between cognitive learning outcomes and computer use" (Blackmore et al., 2003, p. iv).

2.8.2 Computers and Attitude Formation

Attitude has been defined by Simonson and Maushak (1996) as "learned predispositions held by individuals that make them likely to act in certain ways. Attitudes are not observable, but they do serve to produce observable actions in people" (Simonson & Maushak, 1996, p. 987).

Simonson and Maushak (1996) identify four principal components they claim contribute to attitude development – they are affective response, cognitions, behaviours, and behavioural intentions. 'Affective response' is defined as "a person's evaluation of, liking of, or emotional response to some situation, object or person" (Simonson & Maushak, 1996, p. 986). For the purposes of this research, it refers to the nature of students' responses to using computers for curriculum related tasks – their likes and dislikes, preferences, and how these impact upon their learning processes and performance.

The cognitive component of attitude formation relates to the level of understanding or factual knowledge a learner holds about a situation, object, or topic. Simonson and Maushak (1996) state that this component is particularly powerful in the formation of attitude. They claim the level of ‘comfort’ experienced by a learner in relation to, for example, the operation of computers, will have a significant impact upon how they approach tasks involving the use of computers, and therefore, their overall performance with them.

The behavioural component of attitude formation “involves the person’s overt behaviour directed towards a situation, object or person” (Simonson & Maushak, 1996, p. 986). In the instance related to computer use as described previously, an individual’s behavioural response to the prospect of having to use a computer for a specific task, would be a product of how often they have used the computer in the past, and the nature of experiences they had whilst using it. That is, “...persons who routinely use computers, especially if they choose to use them freely, would be more likely to have positive attitudes towards computers, and be less anxious, than would others who have had fewer experiences with computers” (Simonson & Maushak, 1996, p. 986). The behavioural component of attitude formation and how this impacts upon student motivational levels was particularly relevant to this study. In the environment in which this research took place, students had ongoing access to high levels of computer technology, and were expected to use this to complete almost all curriculum-related work.

The final component to attitude formation Simonson and Maushak (1996) have identified as ‘behavioural intention’. This is differentiated from the behavioural component in that it relates to an individual’s intention or plan to act or respond in a particular manner, irrespective of whether or not that intention is carried out. With reference to this study, learner behavioural intention could act as an initial positive or negative input into student attitude formation, when being required to use the computer or specified software application. This could be further compounded when behavioural intention is linked to an initial learner assessment of the nature of the learning task.

The four components identified here comprise an interrelated framework which contributes to attitude construction, but this process is a complex one, and one in which the social environment has significant impact. For example, within the context of the classroom, the presence and use of computers is just one of many variables that may, at any one time, impact upon learner attitude formation. According to social constructivist views and consistent with the Nair and Fisher (2001) study, learning is essentially a social process, and one in which the relationship established between teacher and learner is critical to learner attitude formation. In addition, learner perception of the relevance and interest-level of the curriculum being presented, how much involvement they have had in the development of this, and the nature of relationships formed with other learners in the class, all impact upon the formation of learner attitude (Nair & Fisher, 2001).

2.8.3 Computers, Student Motivation, and Achievement

The relevance of examining student attitude to computer use is based on the premise that the inclusion of computers in learning tasks can lead to improved levels of student motivation, and therefore improved levels of student achievement (Pittard et al., 2004; Simonson & Maushak, 1996). A general relationship between attitude and achievement has been well-documented in research (Lamb, 1987; Levy, 1973; Perry & Kopperman, 1973; Rickards, 1998; Simonson & Bullard, 1978; Telli, Rakici, & Cakiroglu, 2003; Wood, Aldridge, Fraser, & Fisher, 2003). However, such research has been reluctant to draw any more than a loose relationship – that is, there have been few studies that have claimed to have identified a clear 'cause and effect' linkage between the two.

As discussed earlier, there are too many variables impacting upon the learning situation which serve to cloud the identification of:

> ...the relationship between how a person feels and how he or she behaves. Attitudes are thought to "predispose" persons to act in particular ways. Positive attitudes towards a topic are felt to orient the person in a positive manner toward the idea, but not to predict actions directly.
> (Simonson & Maushak, 1996, p. 987)

Whilst it is important therefore to be cautious in making judgments about the role computers can play in developing student attitudes and motivation for learning tasks, and any subsequent impact on achievement, studies by Lepper and Hodell (1989), ACOT (1996, 1998), Warschauer (1996), Abelkop (2002), Wishart (2000), Finger, Baker, Nagel, and Rarere (2002a & b), Newhouse (1999), and Cleverley (2004), paint a more optimistic picture. For example, in the Apple Classrooms of Tomorrow studies (ACOT, 1996; ACOT, 1998) it was claimed that the presence of computers in sufficient numbers to enable continuous access for curriculum tasks, had significant impacts on student motivation and attitudes. This manifested itself through decreases in student absenteeism, improved student retention rates, and up to 75% higher college entry levels for students participating in the ACOT programme. Similarly, in Lepper and Hodell's (1989) study on the factors that contribute to the development of intrinsic motivation in the classroom, they likewise saw computers as being a critical factor in the development of positive attitudes to learning, and the development of self-concept (Lepper & Hodell, 1989).

Additionally, studies reported by Abelkop (2002) into the impact of computer-rich programmes on student motivation and attitude, such as those developed by the North Central Regional Educational Laboratory, revealed similar findings, particularly amongst low-achieving and developmentally-delayed students. Abelkop's study reported significant improvements in the levels of student task application, and "increased self-esteem, a greater sense of self-efficacy, and improved social status amongst peers" (Abelkop, 2002, p. 16).

Whilst any direct 'cause and effect' link between computer use and achievement levels is at best ill-defined, it appears that there is growing evidence supporting the notion that computers can improve student attitudes to learning, increase on-task application, and enhance motivational aspects (Pittard et al., 2004). As Simonson and Maushak state, "it seems logical that students are more likely to remember information, seek new ideas, and continue studying, when they react favourably to an instructional situation or medium, or like a certain content area" (Simonson & Maushak, 1996, p. 987). A question this study seeks to answer, however, is whether any motivational and attitudinal influence from computer use is enduring, and if so, does it have any 'flow on' effect to the quality of student work and the attainment of learning outcomes?

2.9 Computers and the Facilitation of Social, Cooperative and Collaborative Skills

For many years, educational researchers have been promoting the benefits of cooperative and collaborative activity between students in general and special education (Holt, 1993; Johnson & Johnson, 1989; Johnson & Johnson, 1994; Kagan, 1992; Kagan, 1998; Male, 1998; Pomplun, 1996; Putman, 1998; Rutherford, Mathur, & Quinn, 1998; Yelland, 1995). More recently, attention has turned to the utility of such approaches to facilitate the use of computers in the classroom (Cleverley, 2004; Williams, 2000).

2.9.1 From Individualised to Cooperative Structures

Early uses of computers in education focused on the perceived ability of technology to individualise student learning, by developing and tailoring instruction to meet the needs of the individual learner. Such approaches focused on the potential of computers in being able to individualise instruction, by "meeting the diverse learning needs of people of differing ability, from different backgrounds, at different levels of readiness, motivation and interest, and with different learning styles" (Hooper, 1992, p. 21). According to Johnson and Johnson (1996), such an approach holds intuitive appeal. However, it is limited in its usefulness both from a learner's perspective, and in terms of the capacity of software designers to develop software which is flexible enough to meet hugely diverse learning needs and styles, and at a cost which is economically viable.

Johnson and Johnson (1996) further claim that the individualisation of instruction in this manner is often undesirable from the learner's perspective, in that it often serves to isolate students and may cause "frustration, boredom, anxiety, and a perception that learning is impersonal" (Johnson & Johnson, 1996, p. 1018). They also point to issues associated with the costs of providing sufficient levels of hardware and software for students to undertake individualised activity. Further, they comment that working in isolation denies students access to the encouragement and cognitive support of peers in the development of shared mental constructs (Johnson & Johnson, 1996).

Johnson and Johnson define cooperative learning as "the instructional use of small groups so that students work together to maximise their own and each others learning" (Johnson & Johnson, 1996, p. 1018). The potential benefits for students when engaged in cooperative activity with computers, can be related to the benefits of cooperative learning generally. Hooper (1992) reminds us that there needs to be a clear differentiation drawn between cooperative learning and other group learning methods, where although students are required to work together, activity may not be deemed to be cooperative as such.

In order to maximise the benefits from cooperative learning, Johnson and Johnson (1996) claim that there must be high levels of "positive social interdependence" (p. 1018) between members of the group. That is, members must perceive that the attainment of learning goals can only be achieved if all others in the group also reach their goals. The effectiveness of such interaction Hooper (1992) states, is largely dependent upon the nature of student interactions, which are influenced by factors such as task structure, rewards, group dynamics and interpersonal skills. He claims that two principal indicators need to be present in such situations – equality and mutuality (Hooper, 1992).

Equality refers to a situation within a cooperative group whereby all members of the group, and their ideas and contributions, are seen as being equal. Such a situation is vital to ensure that a free-flow of ideas and information between and amongst group members, is established and maintained. Mutuality relates to the "degree of engagement between group members" (Hooper, 1992, p. 23). High levels of mutuality is needed to develop a supportive learning environment, in which students are able to freely experiment with and challenge ideas in developing insights and understandings. In order to optimise the potential benefits from cooperative learning, groups should be aiming to increase their levels of cooperative behaviour, through the exercise of mutuality and equality (Hooper, 1992).

The extent to which positive interdependence is able to be developed within any group situation, is related to the nature of the task structure and the presence of a cooperative incentive and cooperative motive (Slavin, 1983). Virtually all cooperative group learning situations have at their centre a cooperative task structure – that is, a requirement that all members work together to achieve a common goal (Hooper, 1992). However, the approaches to achieving this may vary from group to group. Some groups may opt for a level of task specialisation in achieving an outcome, while others may decide on a more collaborative process which involves the parallel participation of all group members. According to Hooper (1992), the collaborative approach offers the greatest potential for developing both mutuality and equality, in that while task specialisation may yield high levels of equality and offer increased efficiencies, it may not be supportive of developing mutuality. This arises by virtue that individual group members, to a large degree, will be functioning independently in developing their contribution to the overall learning task, thereby reducing mutuality.

Mutuality can also be influenced by what Slavin (1983) terms the 'incentive structure' associated with the task. According to Slavin (1983), incentive structures can be either competitive, individual, or cooperative. Intra-group competitive structures are seen as being the least effective in promoting learning using cooperative strategies, in that they create competition between members of the group whereby achievement of one member comes at the expense of others. Individualistic incentive structures exist where the members of the group are individually assessed or graded, even when the task has been completed collectively. In this situation, there is little incentive for individuals to support or assist each other during task completion, and the level of mutuality, although superior to the competitive structure, is still far from optimal (Hooper, 1992). Cooperative incentive structures exist where the members of the group are interdependent with each other, and rewards are allocated on the basis of the overall performance of the group. When utilising such structures for cooperative learning in the classroom, Hooper (1992) claims students have a vested interest in the performance of other group members, and are therefore increasingly likely to support and scaffold each other, thereby increasing levels of mutuality.

The final aspect associated with the effectiveness of cooperative learning, relates to the level of group motivation. This refers to "the tendency of individual group members to behave cooperatively within a group environment" (Hooper, 1992, p. 25). Whilst motivational levels within the group can be attributed to task and incentive structures, in many instances there are a number of other factors which can contribute to this. For example, Latane, Williams, and Harkins (1979) in their discussion of a phenomenon termed 'social loafing', have identified that an individual's perception as to the extent that their contribution to the group effort is recognised, is instrumental in determining their level of task application. Kerr (1983) and Kerr and Bruun (1983), link motivational levels to an individual's perception as to the degree of effort that other group members are applying to the task. That is, levels of individual motivation and effort decline when others in the group are not seen to be 'pulling their weight'.

2.9.2 Computers and Cooperative Learning

The literature tends to suggest that the use of cooperative learning strategies, given appropriate task, incentive, and motivational structures, offers potential as an organisational framework for optimising the use of computers in the classroom.

According to Johnson and Johnson (1996):

> ...technology-assisted cooperative learning tends to be a cost-effective way of teaching students how to use technology, increase academic achievement, give learners control over their learning, create positive attitudes towards technology-based instruction and cooperative learning, promote cognitive development, and increase social skills. Computers themselves promote cooperative interactions amongst learners...
> (Johnson & Johnson, 1996, p. 1031)

Such a view is also supported by a meta-analysis undertaken by Rysavy and Sales (1991) which examined the research findings of 13 investigations into the use of computers in cooperative learning contexts. In all but one of the studies, improvements were noted in areas relating to the quality of social interchange. More specifically, the patterns of study identified higher levels of collaboration and scaffolded interaction between group members, in addition to a lessening in the reliance upon teacher intervention and feedback. Achievement improvements were also noted in 6 out of 10 of the studies, when compared with other non-teacher directed classroom activities of a similar nature (Rysavy & Sales, 1991).

Johnson and Johnson (1996) found similar results in comparative studies undertaken with students ranging from eighth grade to first year college. In exercises based on solving problems related to computerised navigation and map-reading, they discovered that students whose incentive structures were based on cooperative principles, displayed higher levels of persistence in solving problems. They were also more successful in operating the software and negotiating understandings relating to the nature of the task, instructions, and procedures (Johnson & Johnson, 1996). Hooper, Temiyakarn, and Williams, in a 1993 study, found similar results, in determining that the effectiveness of computer-based cooperative learning could be further enhanced by paying attention to the composition and structuring of groups. They found superior results when individual levels of accountability were maintained, and when teachers took the time to teach specific cooperative and collaborative skills which focused students on ways to improve group processing and interactions (Hooper et al., 1993).

Additional benefits from the use of computers in cooperative learning structures relate to the more appropriate design of contemporary software in supporting the facilitation of social and collaborative skills. As previously discussed, early educational software design emphasised a role for the computer as a tutor – that is, as a surrogate or teacher-substitute, capable of facilitating the bridging of specific learner knowledge or skill deficits. However, more recent innovations in this area have led to a change towards more open and learner-centered program designs, often based on multimedia, hypertext or hypermedia coding. As introduced earlier by reference to Mindtools (Jonassen, 1996, 2000), such designs enable students to collaborate in the development and authoring of projects and knowledge representations. The computer is used as a device to help process and represent the cooperatively-generated understandings of the group. According to Johnson and Johnson (1996), such software when used in conjunction with cooperative group organisation, offers unprecedented potential to enhance notions of learner-control and set up situations of 'cognitive conflict' amongst group members. Cognitive conflict they view as being critical to enhancing cognitive development (Johnson & Johnson, 1996).

It is apparent from the literature that the use of cooperative groupings and collaborative learning strategies as a means of organising student work with computers, holds many potential advantages. These range from facilitating more ready access to relatively scarce computer resources, to, in some instances, improvements in achievement, attitude to work tasks, cognitive capabilities, and a range of social skills. However as Johnson and Johnson (1996) have stated, challenges exist for researchers to be able to identify the exact nature of the benefits using technology in this manner holds for students.

There also needs to be greater exploration of the role of the teacher in these environments, and clarification of the type of skills and capacities that should be taught to students (and how these are evaluated), to allow them to maximise any potential benefits from access to such experiences (Yelland, 2001). Undertaking this exploration is central to the aim of this thesis.

2.10 Chapter Summary

This literature review provides a strong argument for the need for research into the impact and implications of computers in education settings. It documented the rather haphazard and uncoordinated nature of the implementation of computers in New Zealand schools since 1990. It has presented literature that demonstrates the absence of a firm educational rationale based on sound educational principles, instead highlighting a range of confusing and often conflicting purposes which have been promoted by government and other centralised authorities for computer-inclusion in our schools. This lack of a clear purpose, and the timing of the implementation phase at a critical transitional stage in New Zealand's educational history, where schools were being bombarded with radical curriculum and managerial reforms, served to undermine any attempts by schools to integrate computers into their programmes.

Centralised policies also contributed to the confusion, by representing a 'technocentric' view of implementation, where considerable amounts of hardware and software were purchased by many schools, with an expectation of significant improvements in student learning, and a transformation of teacher practice. In reality, the review suggests that neither has occurred in most instances (for example, Brown, 1997; Capper, 2001; Daley, Watkins, Williams, Courtney, Davis, & Dymock, 2001; Selwyn, 2004; Stratford & Brown, 2002). This misguided approach appears to have had little significant positive impact on the use of computers in our classrooms. In fact, the 'technodumping' model which underpinned a number of these policies has, in many instances, led to levels of teacher 'disturbance' and 'contradiction' (Capper, 2001). The sudden and abrupt addition of computers to classrooms often caused a retrenchment in practice, as teachers sought to regain a sense of normality and equilibrium in the face of what they viewed as an unwanted intrusion.

Whilst acknowledging arguments from authors such as Page (1999) who state that schools ignore the potential of computers at their peril, in the absence of a clear and research-supported educational purpose based on verifiable gains for students, the review considered a range of literature which argued the need to reconceptualise how we evaluated the impact of technology, specifically computers, in our schools. The middle section discussed the limitations of applying traditional measures such as achievement gains in making any assessments, instead arguing that this scope needs to be broadened to include wider social, affective and cognitive objectives. Such a re-scoping found considerable support in literature from authors such as McCombs (2000), Xiufeng (1998), Heinecke, (1999) and Culp et al., (2003). They claimed that the narrow focus on using standardised procedures and test scores to appraise any impact from computer use by students is not only misguided and difficult to substantiate, but also denies inquiry into possibly more diverse advantages from technology use, based on a more holistic view of learning.

The later sections of the review examined the evidence for expanding the definition of how the role of computers is evaluated in supporting students in our classrooms (for example, McNabb et al., 1999). It suggested that if a clear purpose for the use of computers in schools is to be identified, then we must go back and examine the basic principles underpinning education in our society, and how these must reflect a more holistic view of the purpose of schooling. Literature was presented which outlined theories relating to the role computers could play in enhancing student attitude to learning, and in facilitating the development of a range of cognitive capacities such as higher order thinking, problem solving, and creative and complex thinking (for example, Jonassen, 1994, 1996, 2000; Jonassen & Reeves, 1996; Simonson & Maushak, 1996). Arguments were also outlined which made a case for using computers in cooperative grouping arrangements, to facilitate a range of social and interpersonal skills such as collaboration and negotiation (Hooper, 1992; Johnson & Johnson, 1996; Yelland, 1995). Although many of these arguments were theoretical in nature, they provided a solid foundation upon which to build a framework for this research, and indicated specific areas of inquiry around which data could be collected. In particular - broadening the focus to include social and affective implications, as well as cognitive

The following chapter outlines the methodological framework, and methods of data collection and analysis which were applied to this study.

CHAPTER 3

Methodology and Research Methods

3.1 Assumptions and the Research Methodology

As discussed in Chapter 1, the primary aim of this thesis was to examine the nature of student work practices in a digitally-dominated environment, and to explore the factors which impacted upon student performance and interactions within this specific context. It is important to emphasise that the study's intent was not the generation of universal 'laws' or 'rules' which could necessarily be applied 'across the board' in all or any situations of a similar nature. While the researcher entered the research context with a clear framework for investigation based on examining the cognitive, affective, and social elements of student work practices within this environment, the study was not focused on the testing of any hypothesis or theory in relation to the efficacy of using computers in this manner for improving student learning. Indeed, the advent of the e-classroom concept is such a recent phenomenon that the development of a theoretical base, validated by research and reflective of effective classroom practice is, at best, in its earliest stages of development, as discussed in detail in the previous chapter.

This study therefore utilised an interpretive methodology, as it sought to learn from and through a close and intense investigation of this case, how the digital environment in its entirety impacted upon, and influenced, the learning of this group of students. That is, it was involved in "uncovering the manifest interaction of significant factors characteristic of this community, in order to capture various nuances, patterns, and more latent elements that other research approaches might overlook" (Berg, 2004, p. 251).

The initial purpose of this explorative study was to reveal and describe the realities for the students and the teacher in this room, in order to gain a greater understanding of the complexities of teaching and learning within this environment. In the second instance, it aimed to provide some level of guidance and recommendations for changes to practices within this environment in order to optimise its learning potential, whilst also acting to inform other schools wishing to undertake similar initiatives. However, it should be emphasised that these recommendations are very tentative in nature, and if used, should *inform* rather than *direct* any changes, or the development of similar initiatives. The limitations of a single study, combined with a dearth of research into environments of a similar nature, make universal generalisability from the findings highly problematic (Berg, 2004). These issues will be discussed more fully later in this chapter.

3.1.1 Chapter Structure

This chapter introduces the methodological framework and research methods which underpin this study. Section 3.2 backgrounds the interpretive research paradigm, and how this influences methodology, the selection of data collection tools and methods, and the presentation of findings. Section 3.3 then discusses the relevance of an intrinsic case study methodology to this inquiry, and describes its appropriateness in terms of providing a suitable working framework to enable the collection of data. This section includes a description of the data gathering tools and methods used in the study, how they were applied in the research context, and a discussion of ethical considerations. The chapter concludes with section 3.4 which provides an introductory description of the research participants, details of the research context, and an explanation of the digital or e-classroom concept.

3.2 Methodological Framework – Interpretive Research

The purpose of interpretive research has been identified by Berg (2004) as "the seek(ing) of answers to questions by examining social settings, and the individuals who inhabit these settings" (p. 7). Interpretive research concerns itself with the manner in which humans organise and "arrange themselves and their settings, and how inhabitants of these settings make sense of their surroundings through symbols, rituals, social structures, social roles, and so forth" (Berg, 2004, p. 7).

Interpretive research has been utilised to greater or lesser degrees in social science research for around seventy years (Erickson, 1986). It has its roots in the work of the 'Chicago School' from the 1920's and 1930's, and since that time has established an important role in developing understandings in various areas of human inquiry (Denzin & Lincoln, 2000). The epistemological underpinning of interpretive research views knowledge as a social construction, and thereby stresses the existence and validity of "multiple meaning structures and holistic analysis" (Burns, 1997, p. 11). In so doing it allows the researcher to "share in the understandings and perceptions of others, and to explore how people structure and give meaning to their daily lives" (Berg, 2004, p. 7). This epistemological foundation is based on the ontological notion that reality is itself socially-constructed, that is, we "create meaningful interpretations of the physical and behavioural objects that surround us in our environments" (Erickson, 1986, p. 126). With regard to the classroom setting, interpretive research allows for the development of "thick descriptions" (Stake, 2000, p. 439) which serve to provide an "understanding of the ways in which teachers and students, in their actions together, constitute environments for one another" (Erickson, 1986, p. 128).

Interpretive research is particularly suited to the educational setting, as it allows the researcher to gain unique insights into the ways in which the multiplicity of phenomenon which comprise daily classroom activity, interact with, and are created by, teachers and students (Berg, 2004).
Thus it:

> allows researchers to share in the understandings and perceptions of others, and to explore how people structure and give meaning to their daily lives. Researchers are able to examine how people learn about and make sense of themselves and others.
> (Berg, 2004, p. 7).

The purpose of 'revealing realities' therefore rendered the interpretive paradigm as being appropriate for this study, as it enabled the researcher to gain an "insider's view of the field" (Burns, 1997, p. 14). It allowed for the discovery and documentation of "qualities of educational interaction too often missed by scientific, more positivist inquiries" (Burns, 1997, p. 14). In addition, it enabled the identification of factors within this particular classroom which impacted upon student interactions, and then allowed this to be fed back to the classroom teacher through information which could be used to inform decisions about improving the environment. According to Burns (1997), this is one of the most significant advantages of research adopting qualitative methods within interpretive methodologies.

> Since qualitative reports are not presented as statistical summations, but rather in a more descriptive, narrative style, this type of research might be of more benefit to the practitioner. Ordinary teachers, who may not have knowledge of sophisticated measurement techniques, can turn to qualitative reports in order to examine forms of knowledge that might otherwise be unavailable, thereby gaining new insight concerning educational endeavours.
> (Burns, 1997, p. 14).

Erickson (1986) claims that one of the richnesses of interpretive research when applied to the classroom setting, is its strength in being able to uncover the nature of social organisation and culture which exists between students and teachers, and serves to construct learning environments unique to each context. With regard to this study, such an aspect is of significant importance. The distinctive character of this learning environment in terms of the levels of computer resource, the nature of the students in the class, and the philosophical positioning of the teacher, established high levels of uniqueness which, according to Erickson (1986), constitute what he terms a "local microculture" (p. 128).

> Interpretive research presumes that microcultures differ from one classroom to the next, no matter what degree of similarity in general demographic features obtains between the two rooms, which may be literally next door or across the hall from one another.
> (Erickson, 1986, p. 128).

These groupings, according to Erickson (1986), share "distinctive meanings-in-action." (p. 128). That is, they share a common set of "local understandings and traditions" (Erickson, 1986, p. 128) which serve to provide the grouping with a defined and often unique sense of identity, making them a "typical unit of analysis for study by fieldwork researchers" (Erickson, 1986, p. 128). It is the recognition and acknowledgment of the uniqueness of each classroom environment within interpretive research, which made it particularly suited for use as the underpinning methodological framework for this study.

Critics of interpretive research point to perceived limitations of this method, particularly with regards to the validity and reliability of findings (Anderson, 1995). Issues of internal validity relate to the extent to which the findings accurately interpret and reflect "the truthfulness of responses, accuracy of records, and authenticity of historical artifacts" (Anderson, 1995, p. 13). This criticism centres on what is viewed as the subjective nature of interpretive research, in that the potential exists in analysis for "human subjectivity when selecting evidence to support or refute, or when choosing a particular explanation for the evidence found" (Burns, 1997, p. 378). In addressing internal validity issues within interpretivist research, rigorous processes of triangulation are used (Anderson, 1995; Berg, 2004; Burns, 1997; Cohen & Manion, 1994; Denzin, 1978; Stake, 2000). Triangulation has been described by Denzin (1978) as the use of multiple data collection technologies, multiple theories, multiple researchers, multiple methodologies, or combinations of these, within research activities. The use of triangulation techniques allows for the convergence of multiple data sources as a means of confirming measures and the validity of research findings (Berg, 2004). According to Berg (2004), triangulation addresses the issue that "methods impose certain perspectives on reality" (p. 4), by providing multiple perspectives focusing on revealing "slightly different facets of the same symbolic reality" (Berg, 2004, p. 5). This study employed such triangulation techniques, the specifics of which will be presented later in this chapter.

The levels of external validity or reliability of findings is another criticism often leveled at interpretive research, as due to their situated nature, they are perceived to be ideographic in character and "provide very little evidence for scientific generalisation" (Burns, 1997, p. 380). However, as Erickson (1986) points out, the principal concern of the interpretive researcher is not that of establishing universal laws. He comments that "the primary concern of interpretive research is particularisability, rather than generalisability, and this can be done, interpretive researchers maintain, by attending to the details of the concrete case at hand" (Erickson, 1986, p. 130).

Erickson (1986) goes on to comment on the importance of interpretive research in the formation of theories related to discovering more about the nature of teaching and learning. He states that although each classroom exhibits what he terms "universal properties of teaching" (Erickson, 1986, p. 130), each needs to be perceived as its own unique system or model. That is, although there are generic aspects to teaching and learning which may apply across cultures and are relevant irrespective of place and time, there too are unique elements which serve to define these processes more precisely and uniquely on a class-by-class basis (Erickson, 1986). The purpose of interpretive research therefore becomes the description of these elements within each classroom setting, in order to inform possible translation of models into other contexts. But as Erickson (1986) identifies, "the discovery of fully specified models of organisation of teaching and learning must precede the testing of generalisation of those models to other classrooms" (Erickson, 1986, p. 130).

The previous point is particularly relevant to this study, as this research was carried out in a unique learning environment, with few examples of similar or related research being available against which to compare findings in an effort to develop generalisations. To a large extent, this study is an example of what Erickson (1986) refers to above as "a specified model" (p. 130) in that its primary objective is to inform the generation of initial theoretical perspectives and/or hypotheses related to teaching and learning in digitally-dominated environments. Further discussion of this will now be presented with reference to the use of case study research methodology.

3.3 Case Study Methodology

Erickson (1986) defines a case study as:

> the intensive investigation of a single object of social inquiry such as a classroom... and that it holds major advantages in that it allows the immersion of oneself in the dynamics of a single social entity and enables the uncovering of events or processes that one might miss with more superficial methods.
> Erickson (1986, p. 238).

Burns (1997) comments that case studies have a number of purposes or functions within educational research. Due to their intense and subjective nature, he states that they are particularly suited to acting as preliminaries to major investigations by providing a "source of hypothesis for future research" (Burns, 1997, p. 365), or in assisting in developing deeper understandings "of the class of events from which the case has been drawn" (p. 366). In addition, he claims that case studies may be used to refute of confirm a universal generalisation, or contribute to the construction of theories which "may assist in refocusing the direction of future investigations in the area" (Burns, 1997, p. 366). Case studies can also serve to provide more comprehensive perspectives of the nature of phenomena which "constitute the lifecycle of a defined unit" (Burns, 1997, p. 366).

Stake (2000) identifies three broad categorisations of case studies. These he terms intrinsic case studies, instrumental case studies, and collective case studies. Intrinsic case studies are undertaken primarily in instances where a researcher's purpose is to gain an indepth explanation and understanding of events and interactions within unique and defined contexts, whether these contexts are seen as being typical or atypical. Stake (2000) claims that the important element in this respect is that the researcher holds what he terms "an intrinsic interest in the case, and little interest in the advance of science" (p. 439). Intrinsic designs aim the inquiry towards an understanding of what is important and unique about the case in its own right and within its own world – and this may not be "the same as the worlds of other researchers and theorists" (Stake, 2000, p. 439). Intrinsic designs develop what is perceived to be the case's own issues, contexts, and interpretations – that is, its unique *"thick description"* (Stake, 2000, p. 439).

Stake (2000) comments that the primary motivation for intrinsic case study research relates to the researcher's desire to gain a better understanding of the specifics of the case at hand, "because, in all its particularity and *ordinariness,* the case in itself is of interest" (Stake, 2000, p. 437). This "particularisation" (Erickson, 1986, p. 130) characteristic of intrinsic case studies, enables the researcher to engage fully and intensely with the research context, allowing for the "presentation, interpretation and investigation of detailed information on a single unit developing idiographic interpretations" (Burns, 1997, p. 383).

The second categorisation Stake (2000) terms as instrumental case studies. These differ from intrinsic studies in that the main motivation for undertaking them is "to provide insight into an issue or redraw a generalisation" (Stake, 2000, p. 437). The case itself is seen to be only of secondary interest, in that it "plays a supportive role, and it facilitates understanding of something else" (Stake, 2000, p. 437). The line between intrinsic and instrumental case studies however, is somewhat blurred. Although both forms identify with a discrete context and detail its activities with high levels of scrutiny, in the case of an instrumental study this is motivated by external rather than intrinsic interests (Stake, 2000). That is, "the choice of case is made to advance understanding of that other interest" (Stake, 2000, p. 437).

The final categorisation Stake (2000) terms as a collective case study. In this form of investigation, the researcher may jointly study a number of cases in order to "investigate a phenomenon, population, or general condition" (Stake, 2000, p. 437). By adopting this strategy which utilises multiple instances which may or may not be selected according to the presence of common characteristics, Stake (2000) claims that the researcher is seeking to gain a "better understanding, perhaps a better theorising, about a still larger collection of cases" (p. 437). Collective case studies often lead or contribute to the generation of theories or generalities, which can be used to make predications about performances within other instances of a similar type (Stake, 2000).

An intrinsic case study methodology positioned within the interpretive paradigm was selected for this inquiry, as it allowed the researcher to gain an indepth understanding of the manner in which the e-classroom environment facilitated the holistic development of a specific group of students, within a "defined and bounded system" (Burns, 1997, p. 364). Of primary importance in this selection was that case study methodology enabled the achievement of the specific goals of this research. Primarily, these were to ***describe*** and ***interpret*** the performances of the teacher and students within this particular environment, using the research questions as a categorising and analytical framework. The resultant data were then analysed to ***inform*** changes to this environment in order to optimise future learning opportunities for these students. The outcomes may also contribute to an expansion of the general body of understanding relating to the relationship between curriculum design, teaching approaches, and student work habits and patterns within digitally-dominated environments. However, as previously discussed, the newness of the e-classroom concept meant that the body of available literature relating to the efficacy of such a model of computer use was very limited.

This study therefore, did not endeavour to develop broad generalisations relating to computer use in this manner, but rather sought to ***inform*** the field by presenting a range of findings which can stimulate debate, and encourage a closer and more critical examination of factors which should be taken into account when implementing such facilities. These factors are presented in detail in Chapter 7 of this thesis.

Several school-based case studies consistent with intrinsic design principles have been successfully undertaken with relatively limited sample groups. These include Blose's (2003) seven month study of environments in two intermediate-level mathematics classrooms; Ireland's (2000) single-class interpretive study in the use of collaborative peer organisational structures for mathematics teaching; and Pearson's (2002) year-long case study of two primary teachers engaging in implementation of the 'Primary Investigations' science program. Similar approaches have also been adopted outside of educational settings. For example, Atkinson's (1996) interpretive study of the strategic planning processes utilised by seven local government officials when engaging a Group Support System, and Irving's (2001) case study examining restraint use with three patients in an acute teaching hospital in Australia.

In acknowledging the relatively small number of students involved in this study, given the primary purpose of the study as presented above and the use of an intrinsic case study framework, the issue of generalisabilty should not be seen as a critical outcome of this research. Such an approach finds considerable support in literature relating to case study design (Burns, 1997, 2000; Erickson, 1996, 1998; Gilham, 2000; Stake, 2000).

As Erickson (1998) states:

> The fundamental issue is determining the extent of generalisation, not as one's assertions apply to settings beyond the one that was studied (ie: to external generalisation), but as the findings concerning patterns in the setting are supported by evidence from within the setting (ie: to internal generalisation which involves generalisation within the case rather than beyond it).
> (Erickson, 1998, p. 1162).

Burns (1997, 2000) agrees with this assertion by claiming that each case is its own unique entity, and that "generalisation should not be emphasised in all research" (1997, p. 439).

One of the criticisms often leveled at case studies is that "researchers often observe in educational settings for very brief periods of time, such as once for a few hours, and then make sweeping generalizations about teachers, schools and students from these brief 'slices of time'" (Savenye & Robinson, 1996, p. 1177).

Within this study, this criticism was addressed in two ways. Firstly, and as discussed above, the primary purpose of this research was particularisation and not generalisability, and secondly, by spending a longer period of time within the research setting, the researcher was able to capture the natural and holistic characteristics of real-life events within the classroom over a significant period of time (Burns, 2000). The researcher was present in the classroom on a full-time basis for 16 months, enabling the collection of significant amounts of data representing the complete array of student activities within the classroom. Through the ongoing use of the data collection tools over a prolonged period, the researcher was able to undertake continuous analysis of outcomes as they presented themselves. These in turn were fed back into the study, through refinement of the research focuses and organisational frameworks which were applied to the data. This formative process was critical in guiding the research within the parameters of the original research focus and questions, whilst allowing for sufficient "adaptiveness and flexibility" (Burns, 1997, p. 375) which is seen as essential to good case study design (Burns, 1997; Denzin, 2001; Erickson, 1986, 1998; Gilham, 2000; Stake, 2000).

3.3.1 Internal Validity

The issue of internal validity needs to be addressed in case study methodology, in order to ensure the data gathered accurately represents the multiplicity of perspectives present in the social organisation and structure of the case (Burns, 2000). Cohen and Manion (1994), in their discussion of the various forms of triangulation, identify between-method triangulation as being one of the most effective methods for ensuring internal validity. This is defined as "the use of more than one method in pursuit of a given objective"

(Cohen & Manion, 1994, p. 234), and serves as a strategy for checking on the validity of findings by "embracing the notion of convergence between independent measures of the same objective" (Cohen & Manion, 1994, p. 238). Additionally, they identify respondent or participant triangulation as being particularly useful in validating the authenticity and accuracy of research results (Cohen & Manion, 1994). Participant triangulation relates to the practice of gaining feedback from those involved in the research as to the accuracy of findings, by a process of checking and verification. At a practical level, this could involve the generation of tentative findings and the sharing of these with the research participants, taking into account their comments on accuracy and authenticity, in the development of final accounts.

Within the context of this research, between-method triangulation and participant triangulation have been used in the data collection process. As detailed below, both individual and pair interviews, comprehensive researcher field notes, and a unique video capture tool known as 'Camtasia', were used in collecting data from this study. This data were cross checked and categorised using the coding system detailed briefly in the next section. In addition, researcher field notes were cross-checked for accuracy with research participants as soon as practicable after recording (participant triangulation). In the instances of video capture, on several occasions students were played back the relevant segments of video and asked to comment and elaborate on their contents, specifically in terms of reasons for actions and strategies which were witnessed, and how they contributed to the overall outcome. This process proved invaluable in clarifying initial perceptions of the videos, as interpreted by the researcher.

3.3.2 Data Analysis

As suggested by Savenye and Robinson (1996), data in intrinsic case studies should be analysed continually throughout – "from conceptualization through the entire data collection phase, into the interpretation and writing phases" (p. 1185). By doing this, ongoing findings are able to be fed back into the study, and used to inform new directions for data gathering and "make new observations, conduct new interviews, and look more deeply for patterns in a recursive process" (Savenye & Robinson, 1996, p. 1186). Within this study, data were coded using category labels derived from the research questions, in order to identify critical elements within the implementation process and in patterns of student activity, which indicated how the environment was existing in terms of the nature of the social, affective, and cognitive interactions occurring within it. This process involved the researcher in scanning all data sources and keeping an indexed log of patterns and consistencies across them, in order to "build a picture and tell the story that describes what is happening" (Savenye & Robinson, 1996. p. 1186). The coding system was continually revised during the course of the study, and developed greater specificity through the addition of sub-categories which further defined events and phenomena as they were revealed.

3.3.3 Researcher Role

Within case study research, researcher roles have been identified typically as falling on a continuum between non-participant and participant (Burns, 1997; Cohen & Manion, 1994; Stake, 2000). Participant research is typified by the active engagement of the researcher in the activities and discourse of the context under study, to an extent that in many instances, they become "one of the group" (Cohen & Manion, 1994, p. 107). The adoption of a participant-researcher role provides unprecedented opportunities to gain insights into realities as perceived from the perspective of an 'insider'. It also offers unique opportunities to gain 'natural' data that might not have otherwise been attainable (Burns, 1997). Cohen and Manion (1994) claim a participant researcher role allows the researcher to develop more informal and intimate relationships with those they are researching. This serves to increase the level of acceptance of the researcher into the research context, and enables them to observe behaviour as it occurs, and in its natural setting (Cohen & Manion, 1994).

While participant research undoubtedly has many advantages, there exists some criticisms of the approach. This criticism relates to the potential for high levels of subjectivity and bias, as the researcher becomes 'too close' to those being researched, and they can become selective in their collection, interpretation, and analysis of data (Burns, 1997). In stating this, it must be acknowledged that the potential for subjectivity exists in all research, as, for example, Burns points out, "what is forgotten is that bias can enter into the conduct of all research from the conduct of experiments, to the design of survey questionnaires" (Burns, 1997, p. 380). The important aspect to consider in this respect is how such bias can be minimised through adoption of measures such as triangulation, as described previously with reference to internal validity.

In non-participant research, the researcher conducts the investigation from a perspective detached as much as practicable from the research context. That is, the researcher actively seeks to maintain as objective a stance as possible by "standing aloof" (Cohen & Manion, 1994, p. 107) from those involved in the research, and observing occurrences and events from 'without'. Whilst some authors suggest that non-participatory research may enhance the objectivity of research (Stake, 2000), others contend that, in reality, a situation of objectivity is difficult, if not impossible, to achieve (Cohen & Manion, 1994). In illustrating this, Cohen and Manion (1994) state that the mere presence of the researcher within the research environment impacts upon or 'contaminates' the environment, so that complete objectivity is not possible. Others claim that adopting a non-participant stance in research is not desirable at any rate, as the results from non-participant observation can be restrictive, with only a partial understanding of the situation being developed (Tippery, 2003). As Cohen and Manion (1994) identify, the reality of any case study research is that the role of the researcher can vary along "a crude and arbitrary continuum" (p. 109) ranging from participant researcher at one end to non-participant at the other.

Within this study, the researcher adopted primarily a non-participant observational role in relation to the primary participant group (ie: the students). However, due to the length of time over which the research was undertaken and the nature of the students in the class, it was not possible to rigorously maintain this stance throughout. As Cohen and Manion (1994) point out, the essence of a good case study is the ability of the researcher to obtain data which as accurately as possible account for the realities of those being researched. In this case, in order to obtain as 'natural' data as possible, the researcher needed to be seen as an integral part of the research setting. Therefore, the researcher role varied from non-participant, to one akin with being seen by the students as a 'teacher-like' figure in the classroom. It was considered that such a role was appropriate, as it was not possible to maintain a totally non-participant role within the environment for the duration of the study. In addition, as the classroom teacher pointed out, the students were unlikely to provide natural accounts if they felt they were unable to develop a trusting relationship with the researcher.

This movement along the participant to non-participant continuum as described by Cohen and Manion (1994), was determined by the requirements at any point in time, and took account of the need to maintain a balance between the attainment of the research objectives, and the preservation of a trusting relationship with the students. Working alongside and providing a degree of scaffolding as the students undertook their learning tasks greatly enhanced this research. It allowed the researcher to gain a closer insight into student work processes, and develop a more complete understanding of the nature of possible teaching strategies that could be used in supporting these processes.

3.4 Methods

As previously discussed, the internal validity of this research was strengthened though the use of between-method triangulation, and participant verification. These methods will now be introduced and discussed.

3.4.1 Interviews

Cannell and Kahn define the interview as "a conversation with a purpose" (1957, p. 149). Cohen and Manion (1994) categorise interviews as one of the most effective and frequently used methods in qualitative research. They identify principal interview strategies which can be used in the data collection process – structured and unstructured interviews, focused or semi-structured interviews, and non-directive interviews. In the structured interview, the content and procedures associated with the interview are determined in advance, and there is relatively little leeway for the interviewer to vary from this (Cohen & Manion, 1994). In contrast to this, the unstructured interview allows the researcher greater flexibility and freedom in determining the course of the interview. Although such an approach still requires careful planning in advance to ensure that interview objectives are met, the sequence and wording of the questions can take account of feedback received from the interviewee (Cohen & Manion, 1994).

Non-directive interviews, according to Moser and Kalton (1977), are interviews in which the strategies used allow the interviewee the maximum freedom to express their perspective, with minimal direction or control being exhibited by the interviewer. Such approaches are used when the interviewer seeks data which are as subjective and spontaneous as possible, or when they are seeking to uncover complex attitudes or opinions on the subject under investigation. Unlike the unstructured interview, questions for non-directive interviews are seldom developed in advance, with the schedule being developed during the course of the interview, often in response to the interviewee's comments.

The need to ensure greater levels of interviewer control has led to the development of the final strategy, the focused or semi-structured interview. In this technique, the interviewer has undertaken prior research into the views or perspectives held by the interviewee, in relation to the interview subject. This is then used by the researcher as a basis to generate questions or interview guidelines, which are used to provide a structure for the interview. Although this structure is not 'set in concrete', it is useful in providing a focus for the interview, when there is a need to probe into specific aspects associated with the interviewee's views or opinions in relation to the interview subject (Cohen & Manion, 1994).

Interview strategies used at any one time can comprise a 'blend' of structured and unstructured, non-directive, and focused or semi-structured techniques, according to the needs of the interviewer and the nature of responses from the interview subjects. As Cohen and Manion (1994) identify, it is up to the researcher to determine the best approaches and methods to employ at any point in time, to ensure the attainment of research objectives.

This study utilised semi-structured interviews in gaining data for later analysis. Interviews were held with the students both individually and later in pairs, using pre-determined interview schedules (Appendices 1 and 2). The first of these interviews was held in the second month of the research, with the principal objective being to determine the students' perceptions of the e-classroom environment, and to ascertain any fundamental differences which they saw between their work in that environment and in the more 'traditional' classroom. At the time of the first interview, approximately half of the students had been in the class for just under two months, while the remainder were in their second year, having spent their year five also in the e-classroom. This interview adopted a semi-structured framework, with a set of pre-determined 'starter' questions being used with the students (Appendix 1). Sufficient flexibility was allowed to accommodate discussion on relevant issues related to the research objectives, as they came to hand.

The second interview was a paired interview, which was undertaken in the 11th month of the study. This also adopted a semi-structured format, utilising a pre-determined interview schedule (Appendix 2). It concentrated on students' observations and strategies related to social processes, and how they saw these impacting upon both their performances with the computers, and the attainment of learning goals. A pair strategy was selected for the second round of interviews due to its potential to initiate conversations which would yield a wide range of responses, and encourage debate about key ideas, in revealing a greater depth and breadth of opinion on the subject under investigation (Watts & Ebbut, 1987).

In addition, interviews were also held with the classroom teacher, the principal of the school, and the systems administrator (Appendices 3, 4 and 5, respectively). These interviews used a semi-structured format with a pre-determined set of questions being used initially, but with more general discussion and analysis of responses being incorporated as the interviews progressed. The interviews were primarily undertaken to determine the philosophy behind the concept of the e-classroom, and how views about the resource contributed to the development of students within the e-class (Room 1), and to the overall objectives of the school. The teacher interview also examined the teacher's philosophy in relation to teaching and learning, how she viewed her role in this process, and how she made decisions relating to the nature and design of the curriculum that she implemented in her classroom. All interviews were recorded using a dictaphone notetaker, and then saved as digitised computer files to facilitate more convenient later analysis.

3.4.2 Researcher Field Notes

The second method used for data collection was the keeping of detailed researcher field notes. Anderson (1995) defines these as a "record of everything the researcher hears, sees, experiences and thinks" (p. 152). He further sub-categorises these into two types – descriptive and reflective (Anderson, 1995). Descriptive field notes derive from the researcher's desire to "capture a slice of life" (Anderson, 1995, p. 152) in developing word-pictures of the activities that constitute the 'natural life' of those being researched. They typically contain information about the subjects, a reconstruction of the dialogue between the subjects, a description of the research setting, accounts of events, and details of observer strategies and behaviours.

Also contained in the field notes are comments from the researcher which reflect their interpretation of the events and happenings as they observe and interpret them. These can relate to reflections on specific methods and approaches used in the research process, ethical dilemmas or conflicts encountered, and 'jog' notes which prompt the researcher to seek further clarification of observations or suggest new directions for investigation. According to Anderson (1995), field notes are an integral component of case study research and serve as an ideal tool for collecting authentic data, as and when it happens.

Within the context of this study, extensive field notes were collected chronologically in a series of researcher log books. These notes were both reflective and descriptive, and sought to create an overall narrative focused on the strategies, processes, and outcomes for both the students and the teacher, as they interacted with each other and with the computer technology. These notes were analysed throughout the study and revealed additional information, which was then used to refocus the observations and data collection strategies, to achieve greater elaboration of these new areas of investigation.

3.4.3 Video Capture Software

The third method of data collection related to the use of a unique video capture tool named 'Camtasia' (Techsmith, 2002). This software-based collection tool was originally designed for use in the computer training industry, and allows the recording of onscreen activity, and related audio discourse, via the creation of digital videos. The Camtasia software effectively records all the mouse movements, menu item selections, use of built-in software tools, on-screen entries (etc.) which are made by the user, in addition to all the audio dialogue associated with making these decisions. This is then processed into a movie format, which can be saved onto a rewritable compact disk for later analysis.

The Camtasia software was installed on two specific research computers which were then incorporated into the e-classroom's thin-client network. The two research computers were set up in exactly the same manner as the others on the network, so that the software and desktop layout was consistent, and basic operational procedures were the same. This was important to ensure as 'seamless' as possible integration of the research machines into the school's network. It was essential that students could freely move throughout the room, access their files, and use whichever machine they wished in undertaking their learning tasks. The Camtasia software installed on the two research computers was activated and deactivated by a specific keystroke, and worked 'in the background' as the students used other applications and went about their learning activities. There was no visible sign at desktop or application level that the software was operating, apart from the change in colour from red to green of a small icon located in the bottom right of the lower icon tray.

The students and parents were informed of the presence of this software on the research machines and that it was to be used in the data collection process, at the beginning of the research. However, the students were not subsequently reminded of this. After consultation with the teacher, it was decided that this strategy was needed to ensure that the students did not artificially 'stage' performances while the software was active, thereby creating inaccurate representations of their normal learning processes and strategies. In all, almost 90 hours of screen capture was taken using Camtasia, with students engaged in the full range of learning experiences from multimedia authoring and using the web for research, through to the development of concept maps and more conventional writing and spreadsheet-based tasks. This data was stored digitally on a large computer hard drive using categorisations based on the research questions outlined in Chapter 1. These related to the nature of interactions and activities recorded in the videos, with respect to the extent to which they illustrated the impact of the environment on cognitive, affective and social aspects of student work practices. In actuality, these categorisations acted as a guide only, as most recordings to some extent illustrated an integration of all three, rather than being discrete examples of one or another.

Camtasia allowed the capture of data which, to the greatest extent possible, depicted the natural interactions of the students as they completed their learning tasks using the computers. It also enabled the recording of teacher interventions and the subsequent influence that these had on student practice. Although all 90 hours of video capture was analysed, not all has been used in the examples provided in Chapters 4 and 5 of this study.

3.4.4 Participant Feedback

The three data collection methods described previously, namely interviews, researcher field notes, and Camtasia video technology, enabled method-level triangulation. However, internal validity for the findings was also enhanced by the use of participant triangulation. This process involves the researcher "rechecking with the research participants as to the authenticity of the observations made" (Burns, 1997, p. 382). In this instance, participant triangulation was a regular process, in which the researcher field notes were checked for accuracy with the classroom teacher, as they were written up and analysed. Interpretations of responses to interview questions were cross-checked with the students and all other participants, to ensure that an accurate account of their meaning was recorded. This process proved to be highly valuable. On several occasions, both the teacher and students were able to add significant detail to the accounts, particularly relating to the reasons or rationales for approaches and strategies which were used, and decisions that were made. Additionally, the teacher was able to provide valuable additional information on the students, which supplemented the data obtained from both the observations and the student interviews.

3.4.5 Research Ethics

This research was carried out in accordance with the ethics guidelines as indicated by Curtin University's Human Research Ethics Committee (2002), with approval for the research being granted through the acceptance of the researcher's Application for Candidacy.

The research was undertaken using appropriate ethical principles, as based on Anderson's (1995) guidelines:

1. That informed consent has been obtained and appropriately documented, and participants are given the right to withdraw from the research at any time;
2. That the risks to participants are outweighed by the anticipated benefits of the research;
3. That the risks to participants are minimised by research procedures that do not unnecessarily expose subjects to risks;
4. That the rights and welfare of the participants are adequately protected; and
5. That the research will be periodically reviewed.
(Anderson, 1995, p. 20)

The relevant principles as identified above were implemented during this study in the following ways.

Firstly, before the commencement of the research, a letter was sent home to all students' parents or caregivers. This letter introduced them to the research, provided an indication of the objectives of the research, detailed the research methods and tools to be used, and invited them to indicate if they had any objections or concerns about their child being involved in the study (Appendix 6). A return slip was attached to the bottom of the form, and parents were given the opportunity to fill this in and return it to the school, if they wished to withdraw their child from the study. It was suggested by the principal that such an approach was the one most likely to be successful, as the use of a return-to-school approval form for school programmes in the past had largely been unsuccessful, due to the poor level of returns received. For this research, no negative responses were received, and the study was able to proceed with the full complement of students.

Secondly, and as mentioned previously, this study utilised a computer-based video data collection tool which operated 'in the background' as students worked in groups on the two research computers. Although students and parents were informed of its presence at the beginning of the research, students were not reminded of its operation on a case-by-case basis. This decision was made after extensive discussion with the principal and the teacher. They commented that given the unique nature of the students and the importance of obtaining data which were as accurate as possible, the benefits for the research from not disclosing its operation apart from the 'global' notification at the beginning of the study, outweighed any possible risk to students. In addition, when analysing the data gathered using this tool, the researcher maintained as confidential, and did not report on, any specific instances which could in any way incriminate the students or any other research participants. Whilst data of this nature were collected and analysed in the same manner as other data, it has not been used in the specific examples presented in this study, nor will it be used in any papers or presentations which may result from it.

Thirdly, during the data presentation, analysis, and discussion of findings detailed later in this thesis, the anonymity of the research participants and the school involved has been maintained by the use of pseudonyms. As field notes were developed and an initial analysis was completed, the results were shared and discussed with the classroom teacher and the principal of the school. At all times, they were kept well informed of the progress of the research and of any issues that arose. They were also invited to make comment on the preliminary findings, and on several occasions they made significant contributions which helped to refocus the research, or elaborate and clarify tentative findings.

Fourthly, the research focus, data collection methods, and findings were reviewed at regular intervals throughout the study through meetings with the teacher and principal. These meetings took place once a term, and provided an opportunity for the researcher to reflect on the focus and findings of the research, and the effectiveness of the research tools in providing suitable data. These meetings also enabled more formalised critical input to be gained from key research participants, which served to refine the use of the data gathering tools, and provided additional insights and focuses for the research.

3.5 Research Participants and Setting

3.5.1 Class Profile

This research was undertaken with a group of 33 year 5 and 6 students at a New Zealand primary school, located in the Northland educational region. The school was classified as decile 1A using the Ministry of Education's ranking system[1], and as such, was placed at the lowest level in terms of socio-economic rating, and therefore in its predicted potential to access community resources and support.

The class was of mixed ethnicity, with a total of 21 of the 33 students either being identified as Maori or of Pacific Island origin, and the remainder being classified as European. This balance was representative of the school population generally, with approximately 230 (69%) of the total school roll of 330 being of Maori or Pacific Island extraction. The gender balance of the class was skewed somewhat, with 19 of the 33 students being girls. The following table provides an ethnicity by gender profile.

Table 3.1: Gender by Ethnicity Profile – The e-Classroom

Gender	**Ethnicity**	
	Maori or Pacific Island	European
Boys	8	6
Girls	13	6

[1] The decile rating is the indicator used to measure the extent to which schools draw from low socio-economic communities. Each state and state-integrated school is ranked into deciles (10% groupings) on the basis of the indicator. The indicator is based on Census data for households with school-aged children in each school's catchment area, together with ethnicity data from the school's roll returns. Decile ratings determine the allocation of Targeted Funding for Educational Achievement (TFEA), the Special Education Grant (SEG), the Careers Information Grant (CIG), and Decile Discretionary Funding

The class was known as Room 1, and was one of four Year 5 and 6 composite classes at the school. The students exhibited a large range of abilities. Approximately 40% had a reading age 1–2 years in advance of their chronological age, whereas approximately 30% had reading ages of 1–2 years below. At the beginning of the year, the students undertook an Information Skills test as part of the New Zealand Council for Educational Research (NZCER) monitoring series. The test revealed a slightly below average stanine of 4.5 for the class across the range of information skills, including using books for reference, interpreting graphs and tables, using the library to obtain information, and accessing information from encyclopaedias and dictionaries. Although no other standardised tests in this series were undertaken with this class, an overview of the students' performance in Progressive Achievement Tests (NZCER, 2000) from the previous year, generally indicated average to slightly below average achievement across the board in areas including Mathematics, Oral and Written Language, and Study Skills.

3.5.2 Teacher Profile

The classroom teacher involved in the research had been teaching at this school for nine years, and held the position of senior teacher with responsibility for the organisation and programme operation in the senior school (years 4–6). For the purposes of his research, she will be known by the pseudonym of Sarah.

Sarah was an experienced teacher, having been in the profession for 18 years in total. In addition to her teaching responsibilities, she was also the regional coordinator for a cluster of schools participating in a Ministry of Education 'ICT Lead School' contract. This contract involved her in providing professional support and guidance to 10 other suburban and city schools in incorporating computers as an integral component of their programmes. This role meant that she spent, on average, one day a week away from her classroom, working with and facilitating teachers in the cluster schools, or holding workshops related to planning and developing programmes with computers. The coordination contract had been awarded to the school from a range of applications within the region. It was awarded on the basis that the school had displayed leadership and innovation in the use of computers, and that it had staff capable and knowledgeable enough in implementation processes and practices to be able to support the other schools.

Sarah's involvement with the use of computers in her classes had spanned many years, having initially commenced her exploration of the use of computers in learning in 1993, using early-model BBC microcomputers. She was widely acknowledged in the region for her expertise in this area. In addition, she had been called upon in many instances in the past to provide professional support for teachers on an informal basis, and to contribute to workshops and conferences, both regionally and nationally. Further elaboration on the role of Sarah in this research is provided in the next chapter.

3.5.3 Network Administrator Profile

Another participant in this research was the network administrator and, for the purposes of this research, she will be known by the pseudonym of Shirley. Shirley had overall responsibility for the maintenance and operation of the school's thin-client computer network. This network operated from three servers, which drove the school's complement of nearly 50 computers. Shirley played a significant role in this research but not as a participant, in that it was she who organised the setting up of the two research computers and their 'seamless' integration into the school network. She also had the final say on the type of software accessible to the classrooms through the network, although this process took into account teacher needs and preferences where practicable. Throughout the research and as much as possible, Shirley accommodated the objectives of the project into her network development decisions. As the project progressed, it was interesting to note the increasing levels of 'comfort' that she felt with innovations initiated during the research, such as the installation of Camtasia on the two research computers. According to Sarah, such innovations would previously have not been considered as options, due to the level of perceived threat to the integrity of the network (Sarah, interview, 2003).

3.5.4 Principal Profile

The school principal, who is known throughout this thesis by the pseudonym of Peter, began his career in education in 1966 and, after working his way through a number of small schools and minor principalships, assumed the role of principal of Parahaki School in 1992. At this point it is important to acknowledge that Peter was instrumental in developing the e-classroom concept at the school, the first in the Northland education region. Ever since he began his classroom teaching career, he had been philosophically driven by his belief in the teacher's capacity to "make a difference to the lives of kids" (Peter, interview, 2003). He viewed the advent of computers and other electronically-based technologies as providing an ideal opportunity to enhance this role, by bringing a level of communicative experience to the classroom which would have otherwise been unavailable. He viewed his role within the school as supporting teachers in the development of innovative ways of meeting the needs of their students, and identifying and nurturing the talents of individual staff members in supporting the objectives of the school. He identified these objectives as "nurturing the attitudes which foster and support life-long learning" and developing students who are "independent and able think critically in making informed and sensible decisions" (Peter, interview, 2003). He viewed access to high levels of technology as being an important tool in helping to facilitate the attainment of these goals.

3.5.5 The e-Classroom Physical Environment

As previously mentioned, Room 1 was a unique classroom in the sense that it was the only digitally-dominated or e-classroom in the Northland educational region. For the purposes of this research, the e-classroom environment is described as:

> ...a classroom in which students have continual access to high levels of computer resources with which to undertake learning tasks. In this instance, the 33 students in Room 1 have available to them 14 computers at any one time. This resource is supplemented by a range of other electronic information-gathering and information-processing technologies such as digital cameras, scanners, fax machines and conference telephones.
> (Researcher log book 1, 2003)

The e-classroom in this study differs from a more conventional classroom which may have access to only one or two computers, in that not only were greater numbers of computers available, but also the curriculum was planned and delivered with the intent of maximising use through their availability.

The layout of the e-classroom can be seen in the photographs in Figures 3.1 and 3.2. The development of purpose-designed furniture was a feature of this e-classroom, with the use of flexible, inward-facing and irregularly-shaped tables allowing greater arrangement options, and also creating social workgroups to facilitate collaboration and discussion. This was a conscious decision made by the teacher and the principal in keeping with the philosophy behind the development of the e-classroom. That is, it supported the development of cooperative and collaborative capacities, in addition to cognitive and academic skills.

All the computers in the room operated using a centrally-administered network, which meant that maximum space could be made available at student workstations for off-computer and on-computer activity. This was a planned decision that allowed standardisation and centralised maintenance of hardware and software. It also meant that students had sufficient space to group around a computer and interact and work collaboratively, if they so wished. The exception to this was the location of the two research computers, which were unable to be located amongst the pods as can be seen in the photograph in Figure 3.3. These machines were provided by the researcher for the duration of the study, and improved the computer/student ratio supporting smaller groups and individual work. During the course of the study, all students in the class used these machines several times, with Camtasia being used to collect data accurately representing their practices.

The research machines were set against a wall, but once again in a manner which allowed for maximum workspace and collaborative use by groups of students. Apart from this factor and their physical design, in all other ways the research computers were identical to the other computers in the room.

Figure 3.1: The Pod Arrangement and Unique Furniture Design in the e-Classroom

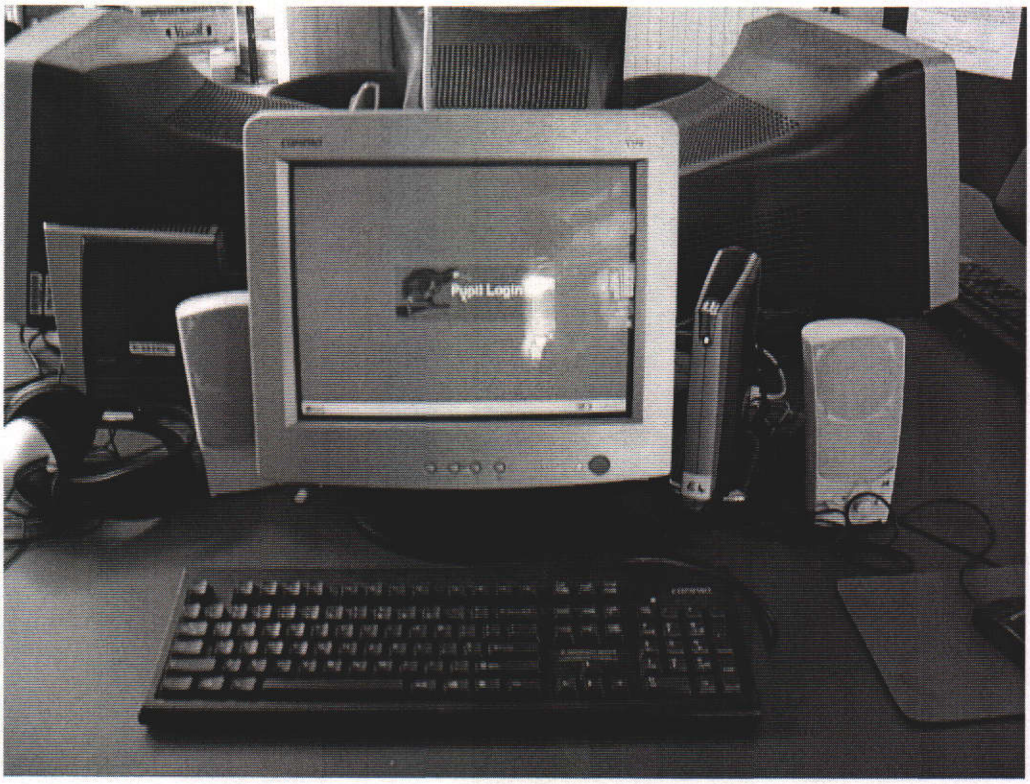


Figure 3.2: Standardised Computer Desktops

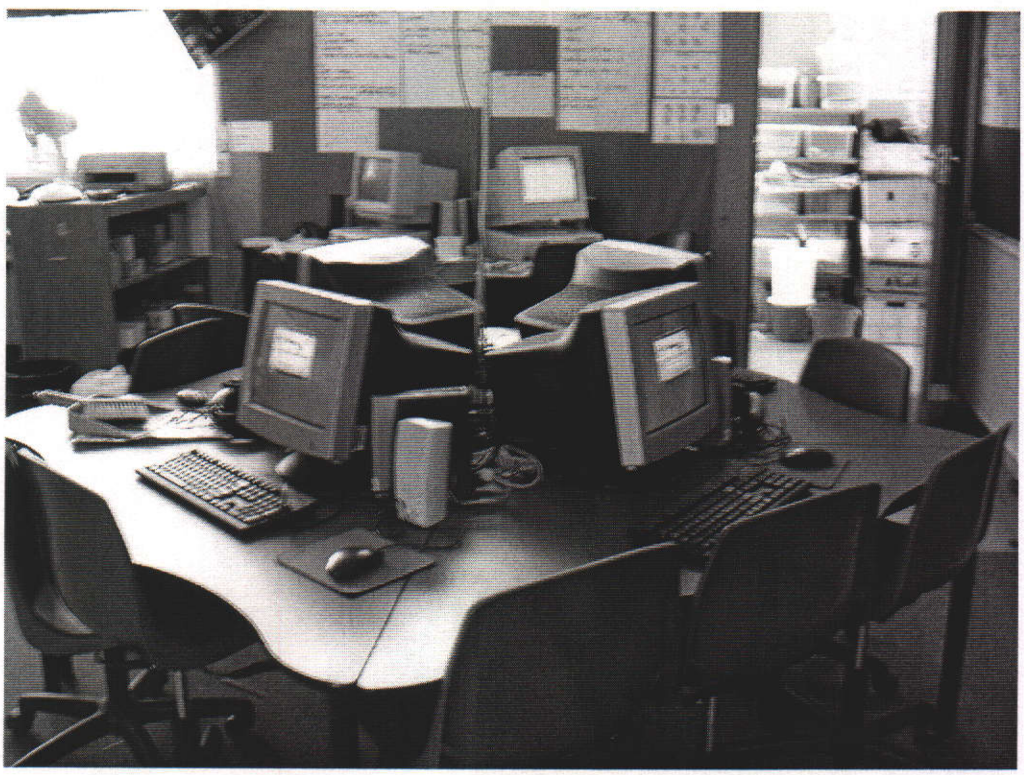


Figure 3.3: The Two Research Computers (in background)

The range of software available on all machines in the network was also identical. Table 3.2 summarises the packages installed, and provides a brief description of their function.

Table 3.2: Summary and Description of Available Applications in the e-Classroom

Application	Description
Windows 2000/Citrix	Server operating system
Inspiration	A utility that allows the recording and mapping of ideas and thoughts in graphical 'mind' or 'concept' map format. For more details, refer to: www.inspiration.com
Microsoft Works	Basic productivity wordprocessor, spreadsheet and database application. This constituted the main 'backbone' application used for many of the learning tasks. Refer to: http://www.microsoft.com/products/works/
Microsoft Powerpoint	Stylised multimedia authoring and presentation tool. This was used by the students in producing visual presentations from research, for creating multimedia slideshows related to topics being studied, and for recording their assessment portfolios. Although Powerpoint is an integral component of the Microsoft Office suite, the other applications from this suite were not available to the students. Refer to: http://office.microsoft.com/home/default.aspx
Microsoft Paint	This basic art utility is a component of Microsoft Windows, and allows the creation of drawings and illustrations using a range of art tools. Students used Paint to create artwork which was then either imported or copied and pasted into other work. Refer to: http://www.microsoft.com/windows2000/en/professional/help/default.asp?url=/windows2000/en/professional/help/app_paintbrush.htm
Microsoft Internet Explorer	This web browser became available to students in the last three months of the study, as prior to this external web access had not been possible from the classroom. Internet Explorer was used primarily for topic-based research and as a source of images and information related to topics being investigated. Refer to: http://www.microsoft.com/windows/ie/default.asp
Encarta CD reference encyclopaedia	Encarta was accessible to the classroom via the network terminal server, and served as a primary information source for topic studies, in much the same manner as that described for Internet Explorer, later in the study. Refer to: http://encarta.msn.com/encnet/features/reference.aspx
LCSI Logo	LCSI Logo was used by some students in the class for Mathematically-based problem solving activities. Logo is a programming language for children, developed at MIT by Seymour Papert. Refer to: http://el.media.mit.edu/logo-foundation/logo/

Table 3.2 (Cont.)

Microsoft Publisher	Publisher is an addition to the Microsoft Office suite of applications, and enables the development of desktop published posters, charts, cards etc. It was used occasionally by some students to present outcomes from topics, or for specific purposes such as advertising flyer production. Refer to: http://office.microsoft.com/home/office.aspx?assetid=FX01085794

The software installed on the computers as detailed in Table 3.2 was standardised in every respect, so that no matter which computer the students went to, they could access their work-in-progress files and were able to navigate their way around the desktop and file structure with ease. All student work was stored in individual class and student folders that were located on the central server (Frodo). Within each of these folders the students had created and organised subdirectories, using a range of classifications, in which they stored their individual files.

3.6 Chapter Summary

This chapter outlined the methodological framework for this research. It argued that the adoption of an interpretive approach using an intrinsic case study methodology facilitated the fulfillment of research goals, by allowing the researcher to engage intensively with the research context and utilise a range of qualitative data collection tools over an extended period of time. The adoption of this framework enabled the witnessing of the full array of activities that constituted the natural life of this classroom (Burns, 1997), and data to be collected that as accurately as possible represented the diversity of experiences which were encountered by the students and teacher.

Measures to address potential issues such as internal validity and the generalisability of research outcomes, were described and justified by comprehensive reference to literature and other similar studies which utilised an intrinsic case study approach, within relatively defined sample populations. As described, *particularisation* rather than generalisation (Erickson, 1986) was the primary objective for this study. Although it revealed a number of considerations which could benefit other schools considering implementing similar initiatives (see Chapter 7), its main focus was on optimising the performance of the e-classroom environment for the learning of this group of students. Any generalised interpretation of the recommendations described in Chapter 7 should be made with caution.

This chapter also introduced the research participants, and provided some insights into the research context. Elements relating to the organisation and physical setup of the e-classroom were explained, and a brief introduction to the rationale and purpose of the facility was presented. These aspects, and the manner in which they contributed to the programme operating in Room 1, are detailed more comprehensively in the following chapters.

It is important to note at this point that Chapters 4 and 5 each include the presentation and analysis of data related to research questions 1 and 2 respectively. These are:

1. Upon what educational vision was the e-classroom environment at Parahaki School established, and what was the nature of the implementation processes associated with this?
2. How does the e-classroom environment impact upon the cognitive, affective and social development of its students?

The reasons for adopting this structure in preference to one in which data were presented in one chapter, and then analysed and discussed in separate chapters, were:

- to enable a full understanding to be gained of the complexity of the establishment processes for the e-classroom (Chapter 4), in advance of exploring how this impacted upon the teaching and learning practices within it (Chapter 5); and
- to enable a full understanding to be gained of teaching and learning practices within the e-classroom (Chapter 5), in order to discuss these in relation to the overall aim of the research and the identification of areas for possible change or improvement (Chapter 6).

In other words, each of these chapters required that an understanding was gained of the key outcomes and ideas contained in the one before it, in order that subsequently presented material or concepts would be more readily contextualised and understood. Similar structures have been used successfully for comparable interpretive studies, particularly in education and social science disciplines (for example, Geelan, 1998; Gribble, 2002; Kearney, 2002; Millen, 2003; Morar, 2003; Nicholls, 2003; Nix, 2003; Selwood, 2000; Stoker, 2003; White, 1998).

CHAPTER 4

The e-Classroom: its Establishment, Vision, and Implementation at Parahaki School

This chapter presents and analyses data in relation to research question 1, namely:

> **Upon what educational vision was the e-classroom environment at Parahaki School established, and what was the nature of the implementation processes associated with this?**

Firstly, it profiles the school and its vision in relation to the extensive use of computers in its learning programmes, how this vision was viewed and represented by key players, and issues related to its implementation. Secondly, it presents and analyses data on the nature of the e-classroom concept, why it was initiated and developed, and how it was considered to contribute to the overall attainment of the vision. This data were of considerable relevance in clearly establishing the objectives set by the school for the development of the e-classroom. These objectives were defined in terms of meeting what the school saw as the unique learning needs of its students. Specifically, these related to the use of technology in the facilitation of cognitive, affective, and social skills and attributes that would enable students to become life long learners, and assist them to make positive contributions to their community.

As detailed in Chapter 3, to ensure the research participants and the school involved remain anonymous, all names have been changed in the following presentation and analysis. Data for this chapter have been drawn from researcher investigation of external information sources, participant interviews, and researcher observations and field notes, verified through participant triangulation.

4.1 School Profile

As previously introduced, the school involved in this research was a suburban contributing school, located in a medium-sized provincial city in the Northland region of New Zealand. The school had a roll of 330, and catered for students from year one through to year six, with most leaving the school at the end of year six to attend the local intermediate (years 7 & 8) or a regional area school (years 7–13). The school was located in a low socio-economic area, and as such attracted the lowest decile rating (1a) for any school in New Zealand (see previous footnote re the Ministry of Education's decile rating system for New Zealand schools). The demographics of the immediate surrounding area identified high levels of unemployment amongst the adult population (21.2%), with almost half (49.6%) of all children belonging to single parent families with incomes less that $24,000 per annum (Statistics New Zealand, 2001). The school population had a majority of Maori students (62%), with the remainder being of either European or Pacific Island extraction. The school had high numbers of students with social, emotional and behavioural problems, and had in place a number of initiatives to assist in meeting their basic needs in these areas.

Peter, the principal of the school, had a strong philosophical belief in the right of every child to educational opportunities, which led to the school adopting a 'nil-expulsion' policy. This policy meant that although students may be stood down for a period of time for serious misdemeanors, they would not be expelled from the school. In practice, what tended to happen during such occasions was that the stand down was viewed as a 'time out' from the school environment, with the student being provided with school work by the classroom teacher, to complete under caregiver supervision in the home. After the stand-down period, the student was free to continue with their work back in the classroom or in another environment within the school, usually under the monitoring of an individual behaviour management programme.

While such a philosophical stance was meritable in terms of allowing students who would otherwise have been lost to the system continued access to educational opportunities, it held several implications for the school in relation to the make-up of the school population. Firstly, as the school had a reputation for catering for the needs of difficult students, it 'attracted' difficult students from other schools in the region. That is, students who were on indefinite stand downs or were expelled from other schools in the city, were not turned away. In fact, at the time of this study it had got to the stage that it was starting to attract students who had been turned away from schools outside of the region, often students that no other school would accept (case notes, 2003; Peter, interview, 2003). Whilst this philosophy was founded on a genuine desire by the principal to assist these students, it had in many ways led to the school becoming a 'dumping ground' for students that no other school wanted. While the school attracted additional funding and teacher aide support, the relatively high numbers of these students placed great demands on the principal, teachers and support personnel. These demands related to having to deal with high levels of physical and verbal abuse, in addition to attempting to meet student educational, social, and emotional needs.

Whilst such an environment was undoubtedly very demanding for the staff of the school, the teachers and support personnel appeared highly motivated in developing innovative programmes to encourage their students to make the most of their time at school (case notes, 2003). These programmes emphasised *hauora,* or holistic development. *Hauora* acknowledges that for many students, prerequisite capabilities related to social skills and affective development need to be reinforced, in conjunction with, or before, enhancing academic achievement can be attained. The emphasis on the holistic nature of curriculum and programmes was identified by the Education Review Office as being one of the major strengths of the school in its 2002 Effectiveness Review... "all school personnel work supportively with children. The principal and teachers consider the children's social and behavioural needs, and actively review programmes and procedures to support the children's *hauora*/holistic development" (Education Review Office, 2002, p. 2).

The school had traditionally been viewed as being highly innovative in developing specific programmes to meet the diverse learning needs of its students. Such programmes not only related to behaviourally challenging students, but also to capable students who may be 'lost', or denied extended learning opportunities in the normal classroom. As part of the initiatives to meet the needs of capable students, the school played host to what was known as 'GKP' or the Gifted Kids' Programme. This programme identified children from throughout the city who would benefit from enrichment and extension unable to be provided by the traditional classroom curriculum. It was staffed separately to other classes within the school, and gained its funding from sponsorship obtained from a community trust. The programme involved up to 25 students from contributing schools participating in week-long extension and enrichment programmes. These programmes were often based within the community, or used other contexts such as community or future problem-solving scenario-based frameworks. At any one time, there were up to 10 students selected from Parahaki School to participate in the GKP programme.

Additional innovations which had been established at this school, and were specifically targeted to meet diverse student learning needs, related to the provision and use of Information and Communications Technology. The next section of this chapter will provide an overview of these initiatives, and the perspectives and roles of key players who were integral to their development.

4.2 Computer Development at Parahaki School

4.2.1 The Role of the Principal

The development of the use of computers at Parahaki School began with the arrival of the present principal, Peter, in 1992. Peter came to the school with a range of teaching experiences dating from his entry to Teachers' College in 1966. He had undertaken roles ranging from basic scale teacher, to principal of small schools, deputy principal of larger schools, and finally as principal of Parahaki School. From an analysis of data obtained during the formal interviews held with Peter, and through less formal discussions and observations, it was apparent that he held a strong philosophy relating to the importance of education for all students. This appeared to be motivated by a powerful belief that education was fundamental in enabling individuals to have choices, and a level of control over their own well-being and destiny. This view appeared to emanate from his own personal experiences as a child at school, and an attitude that 'the system' had traditionally failed to address the more holistic needs of students, by concentrating almost exclusively on the promotion of sporting or academic achievement.

> **Peter:** ...a lot of experiences in that time have coloured the way I do things, including my own experiences as a child at Hill St. school, my negative experiences at both primary and secondary school, where I was very much the incapable student... incapable academically, and certainly incapable on the sports field... to the extent that I took up long-distance running which has taught me a lot about myself... about courage... about being able to do stuff on your own... independently, without having to rely on others, and taking responsibility for doing so. A lot of these experiences have assisted me in getting to where I am today. If I don't like doing what I have been told to do I will challenge it, and if I can't challenge it, I will subvert it...
> (Peter, interview, 2003)

He related his early teaching experiences as being particularly formative in the development of his management philosophy, that in past positions he had often found himself 'out of step' with school administration, in advocating for the rights of students in matters relating to school policies and decisions.

> **Peter:** ...following a long period of teaching at Morning School, where I met atypical kids... started rocking the boat in terms of sticking up for kids... learnt a lot about (teacher) racism... a lot about severe special needs... and how the system was failing these kids...
> (Peter, interview, 2003)

This view permeated through to the set of principles upon which he made decisions relating to the operation of his school. He claimed that one of the most critical characteristics a school leader needed in this respect, was a set of deeper beliefs and convictions. He stated that these should relate to the importance of the principal's role, and that school leaders should be willing to act on these, even though they may be viewed as going 'against the tide' of thinking prevailing at the time. These convictions Peter believed were essential, and should be based on doing what was considered to be the best for the child, and encompass a broad definition of the role of school.

> **Peter:** ...there is a certain degree of satisfaction in being able to 'stick it to the system'... but the most rewarding part of my role at the moment is having my own convictions and being able to realise my convictions and my inherent beliefs about education, in being able to do the things I believe in, and being able to make a difference to kids...
> (Peter, interview, 2003)

Peter viewed the need to 'turn around' some of the poor attitudes children at Parahaki School held in relation to education, as being critical to his role. This particularly related to the negative perceptions students held of teachers and school as an institution. Many of these, he considered, arose from the home, and from the poor experiences parents had at school and the manner in which their schooling had alienated them from culturally-based values.

> **Peter:** A big thing is that a lot of our kids have (or have had) a negative attitude towards school, often enculturated in them by their parents, particularly Maori parents who have not had very good experiences (I guess) of their own schooling... school was a waste of time attitude... another attitude – that you don't have to do what the teachers tell you... that's a real challenge for us at the moment. I think that being able to persuade kids that school is a good place, that it is an environment conducive to learning... get the kids to want to come to school by developing programmes that are relevant and capitalising on their strengths... which may not (necessarily) be those represented by the seven curriculum documents...
> (Peter, interview, 2003)

The philosophical view held by Peter that ultimately it was up to the individual to take responsibility for their own actions, and that the school's role was to equip and encourage its students to be able to do this, had also influenced considerably his staff management style. In the same way that he encouraged the development of independence in students, he viewed the professional staff as 'experts' at their own practice. He saw his role as helping to establish an environment in which teachers were able to utilise and build upon their relative strengths, in keeping with the overall objectives of the school. The emphasis on teacher 'autonomy with responsibility' was very apparent, with the development of a culture in which staff were able to 'run with' ideas and innovations they saw as supporting the needs of their students, on the proviso that they were viable and withstood scrutiny.

> **Peter:** I have an innate belief that the teacher has the ultimate responsibility for the education that happens in the classroom. I believe my job is to provide the support and resourcing, time for reflection, to do the provoking, stimulate, and then back off as much as possible and leave it to the person... but keep a watchful eye on what is going on.
> (Peter, interview, 2003)

This attitude of respect for, and the fostering of professional independence, and a willingness to challenge existing structures and 'think outside of the square' in identifying better learning opportunities for students, was the basis upon which Peter initiated the computer development at Parahaki School. Although he was, by his own admission, a self-confessed 'non-starter' when it came to computer use in his own professional practice, from early in the 1990's he was able to identify the communicative potential of the technology (Peter, interview, 2003). He recognised the powerful manner in which it could help facilitate and bring to the classroom, motivational learning experiences which would have otherwise been difficult to achieve (Peter, interview, 2003). He described his first encounter with online bulletin boards as being particularly formative in this respect, in alerting him to the potential of computers to diminish cultural and geographical barriers imposed by traditional classroom environments, and provide powerful learning contexts.

> **Peter:** There are two parts to ICT... the 'C' part was actually missing at the beginning... there was nothing about communication... and right at the start I saw the power of bulletin boards. The kids were on using K–12 (I think it was) and the power of K–12 and the intensity of the focus that the kids had when they are on the bulletin boards was something that really staggered me... when the message was typing out on the screen in

> front of them… and seeing their faces light up… that was the first real hook that I had… the power (of computers) for communication…
> (Peter, interview, 2003)

The vision of computers as being a powerful communicative tool and able to elicit motivational and cognitive responses from students that he had not witnessed through any other medium, was the stimulus for Peter, in 1993, to begin the development of computer initiatives at Parahaki School. These initiatives began at a time when few other schools had shown any interest in using computers in learning, and, as previously described in the literature review, support and guidance from central authorities was non-existent, or at best, confused. The implementation began with the automation of the school library and the development of a coaxial network throughout the school. These initiatives were largely planned by Shirley, who had joined the staff in 1986 as a teacher aide/cleaner. She had undertaken a part-time certificate-level Polytechnic course on computer systems between 1987 and 1990, and assumed the role of Systems Administrator at the time the initiatives commenced in 1993.

At the same time, the school entered into a partnership with the local Computerland agency, and adopted a "business model" (Peter, interview, 2003) for their infrastructural design. The notion of "business model" (Peter, interview, 2003) primarily referred to the development of a thin-client network which used a terminal server and small, desktop 'dummy' computers - similar to that used in some business environments, in place of a more traditional 'fat client' network or stand-alone machines. The only schools in the city at this time that had access to a network of any kind were a few large secondary schools, and the technology being used even in those environments was not proving to be reliable or robust. The decision to move to a business model infrastructurally was not considered at the time to be soundly-based.

> **Peter:** …as most people thought that even having a network in a primary school was a waste of time and money… they couldn't get them to work in secondary schools, so what hope did a little primary school have…
> (Peter, interview, 2003).

It was clear from the interviews with Shirley and Peter, that the decision to adopt a thin-client environment utilising Windows-based computers, put them out-of-step with most of the educational-computing fraternity of the time, and attracted more than its fair share of criticism.

> **Shirley:** If it is right that children should be exposed to the technology (and we weren't at that time absolutely sure this was the case) and we were going to have to put all this stuff in, then we were going to do it based on the business model...
> we were going to do it rationally, and therefore we went to the business world for their expertise. That's why we set the system up in the way we did in the beginning. And because we got slammed early on and made to feel like we were traitors to education because we didn't go down the Apple way... we were told that there had never been a network run successfully in a high school so how could a primary school be contemplating putting one in... we sort of put our heads down for a while and thought ummm...
>
> ***Researcher:*** *When was this?*
>
> **Shirley:** This was in the mid-1990s... and it was not until I went to the first Compaq conference, and they were telling schools that was what they should be doing, that I felt that we must be going in the right direction...
> (Shirley, interview, 2003)

Resistance to the computer initiatives was not confined at the time to criticism only from outside of the school. Questions were being asked by other staff members in relation to the level of expenditure being invested on computer resources and infrastructure, and as to whether this investment could be justified in terms of the learning benefits for students. According to Peter, it was this criticism that bit the deepest, and was motivated more, he considered, by a deep suspicion of technology held by the teachers, and a lack of understanding of the aims and purposes of educating children for life in the 21^{st} century. To a considerable extent, such criticism still existed within the school at the time of this study, as by no means were all teachers embracing new learning technologies within their programmes.

> **Peter:** In the early days there were two issues which have since proven to have no validity. The first one was that computers would take over the teachers (if anything the teachers have taken over the

> computers – at least some have…) and the other one was "why should we do it?" Many people couldn't see the validity in the expenditure – there have been a lot of questions even about setting up Room 1 (the e-classroom) – people saying how much this will cost, and with all the expenditure, shouldn't there be a report from that teacher at the end of the year (as to the progress from, and benefits of the room). The issue that's really struck me (and I never really thought of at the start) is that I have been staggered, saddened in fact, by the reluctance of the other teachers to embrace and integrate the technology they have into their programmes… and I think I have failed somewhere in that respect.
> (Peter, interview, 2003)

Peter attributed the reluctance by many of his staff to embrace the learning opportunities offered by computers, to what he referred to as 'flawed pedagogy'. He identified the 'traditionalist' teaching approaches adopted by many of the older teachers in the school as being a considerable obstacle to overcome in gaining school-wide integration of computers into classroom programmes (Peter, interview, 2003). This was attributed to a fundamentally flawed view of the role of education for the 21st century, of the sort of skills, knowledge, and capabilities teachers should be developing in their students to enable them to function effectively in the future. The perception held by these teachers of curriculum as being defined by a finite body of knowledge or facts that must be 'delivered' to students, was seen as a major impediment to the use of computers in the school. Peter considered that this view reduced education to a process of information delivery that took little account of the cognitive, affective, and social processes involved in knowledge construction.

> **Peter:** (the lack of computer uptake is linked to)… a flawed pedagogy, and a misunderstanding of what education is really about. I actually believe that for older teachers they see education as a delivery of information, rather than something which is provocative and stimulating to the intellect, and encourages higher levels of responsibility and independence. I think many of our teachers are of the mindset that they need to deliver a package of factual stuff and measurable skills, rather than delivering a package where the question is the answer…
> (Peter, interview, 2003)

Shirley, however, took a harder line in her analysis of this issue. She pointed to a lack of willingness on behalf of the teachers to accept technology into their programmes, as being related to a reluctance of staff to invest the time and effort into upskilling themselves in the operation and usefulness of hardware and software. She adopted a far more 'technicist' approach, in commenting on the apparent lack of impact technology has had in some teachers' classrooms.

> **Shirley:** One of the things I find most disappointing (but also understand) is how slow the teachers have been to embrace it all. Right in the very beginning I thought that once I show people this is what you can do... they will be off and wanting to do it... and that has probably happened to about five... and Sarah will be one of them. It is ultimately up to the individual... they need to realise that they need to make sacrifices and give up the time to learn to use it...
> (Shirley, interview, 2003)

Shirley identified Sarah as being the only person in the school who had been prepared to utilise the computers to their fullest extent in her programmes, and as being prepared to put the effort into learning about and exploring the potential of them. Whilst the other teachers in the school all had access to one or two computers in their classrooms, it was the willingness of Sarah to optimise their use in that situation and articulate benefits from doing so, that led to initial discussions surrounding the establishment of the e-classroom.

Peter elaborated on this further, by stating that the manner in which Sarah used technology in supporting a wide range of outcomes for her students within the conventional classroom setting, was paramount in making the decision about investing considerable resource into the e-classroom.

> **Peter:** ...a classic example is (that) the reaction of Sarah to computers has led to the establishment of Room 1 (the e-classroom) and no other class in the school has got that, as I can't see it being relevant for them at this stage. But if I saw another teacher or teachers doing the same kind of thing... the board has already given approval to establish one-two-three or as many as we need to... so there's no problems there. But I have to ask the question of whether or not we should do it... I haven't seen one other person (teacher) who I think could benefit from a small pod...
> (Peter, interview, 2003)

It was apparent that such a view was deeply seated in Peter's vision for computers in the school, and the balance of resources and personal teacher attributes that were required to carry this out. He was not prepared to simply 'dump' the technology into classrooms, where he did not consider it would be supported by the necessary programme and pedagogical shifts required to take full advantage of it (Peter, interview, 2003). He identified the teacher as being the critical element in this equation. He lamented that many of his staff appeared to lack an understanding of the importance of their role. They did not have a deeper conviction or philosophical understanding of why changes to existing teaching methods and strategies were needed, in order to deliver the type of outcomes he considered possible with computers (Peter, interview, 2003). However, in this discussion, Peter did not lay the cause entirely with his teachers. He cited the impact that the Education Review Office[2] had had in stifling innovation in his school, and in actively working against his school-wide vision for computers. He claimed the reviewers had little understanding of what the school was trying to achieve by its use of computers, but were more concerned with standardisation of systems and the delivery of measurable outcomes, based on a very narrow range of achievement criteria (Peter, interview, 2003).

The review process, according to Peter, had a hugely negative impact on his school. He felt it did not take into consideration the unique needs of the students, and the innovative manner in which school programmes, of which computers were an integral part, were attempting to meet these needs.

> **Peter:** ...unfortunately we are being driven by drabness and conformity... we had ERO (the Education Review Office) come and have look at the programme in Room 1, and to be quite honest they were totally out of their depth... the only thing they found was some kid's file that had a swear word in it... they had to find something negative and that was it... and Sarah was gutted by it. They found the one thing negative and reported on it. They are still hamstrung by the expectation that people have oodles of data.

[2] The Education Review Office has the responsibility for monitoring school performance nationally, and at this time had specific emphasis on reporting on student achievement and academic standards, and curriculum and legislative compliance.

> We have been doing a lot of questioning as a staff... a lot of work saying, for example, not to worry too much about ERO... just to go on and do the things that are relevant to our kids, sticking to what's relevant and not gathering oodles of data because ERO say we should... try to get them to gather data which is necessary, and not data which you collect because someone else (ERO) is going to 'grade' you on it. We have been successful to a point in developing a culture based on the needs of our kids, and being proud to stand outside of the square... still, many teachers find this hard... the pressure to conform is huge...
> (Peter, interview, 2003)

The pressure on staff from external monitoring agencies to conform to a set of pre-determined criteria, Peter viewed as being directly contrary to what he saw as being the essence of good teaching, and his desire to accommodate and nurture the talents and strengths of individual teachers. He viewed his school as very much a learning community, where his role was to identify the capabilities and passions of the individual, and then provide them with the resources and environment to apply those passions for the good of the children (Peter, interview, 2003).

However, he reflected on his perception that teaching was quickly becoming a 'passionless' profession, and that after a decade and a half of heavy compliance requirements, teachers had 'lost the will' for innovation and creativity in developing their programmes. He illustrated this by reference to the proliferation around the school of what he called "safe, pre-made, standardised resources that can be run off on the photocopier, with little apparent thought as to whether or not they meet the learning needs of the kids" (Peter, interview, 2003).

This attitude, he stated, also applied to the reluctance of most teachers in the school to embrace the use of computers. The notable exception to this was Sarah whom he identified as possessing unique qualities, knowledge and attitudes, which allowed her to benefit from access to the e-classroom.

> **Peter:** I don't think that anyone else has the qualities that Sarah has... that's the first thing.
>
> ***Researcher:*** *What are those qualities?*
>
> **Peter:** The ability to question the role of the teacher as an educator, the ability to quantify the needs of the children in her class, her ability to understand intuitively (or otherwise) the need to 'customise' the classroom in a way that will lead towards (that) independence and sense of responsibility. There is no person as reflective in my teaching experience as Sarah, there is no person who reads as widely... reflects on that reading, and tries to fit her classroom into her philosophical schemata... I don't know anyone like her... she's pretty unique...
> (Peter, interview, 2003)

It was clear from this analysis, that the strong philosophical beliefs held by Peter in the capacity of computers to help facilitate communication, and to develop thinking and critical analysis capabilities in children, was instrumental in determining the overall direction taken by Parahaki School in relation to computer implementation.

Furthermore, it was his belief in the need to foster the individual capabilities and passions of teachers on his staff for the greater good of the students, which led to the establishment of Room 1, or the e-classroom. His recognition of Sarah as possessing the necessary attributes and skills to carry his vision through, led to her establishment in this room. The next section of this chapter will examine the nature of the e-classroom environment, with a particular focus on the role and perspectives of Sarah within that environment. It will interpret how *she* viewed having access to such quantities of technology impacted both upon her own practice, and upon the performance of her students.

4.2.2 Sarah and the e-Classroom

Sarah joined Parahaki School in 1995 as a basic scale teacher, having taught in a number of primary schools in the Northland region and overseas, since beginning her teaching career in 1985. Her early experiences in using computers began around 1991, when she returned to New Zealand after spending two years teaching in the United Kingdom. It was at the time when the first microcomputers were being introduced in this country, and a few schools were experimenting with how they could be used within the learning environment. Her first appointment when returning to New Zealand was to a position in a school where computers were in the early stages of implementation. She quickly identified the potential for using even this most primitive technology, to assist her students in completing a variety of learning tasks.

> **Sarah:** When I came back to New Zealand in 1991, I always had a computer in my classroom, not when I was here (at Parahaki School), but when I was at Morning School I did. That was just basic because it was a Commodore or something, but I used it with the software that it came with, because I had a new entrant room and a lot of the software was really good for that level.
>
> I think I really started to make progress when we got good computers in the classroom, and then I started to see what I could do with them... when you had a spreadsheet in Maths for example... because we hadn't used them before... so we started making graphs and bringing it into our statistics units.
> (Sarah, interview, 2003)

During her first few years at Parahaki School, like most other teachers, Sarah did not have access to large numbers of computers, but rather had to explore how to optimise the use of one or two computers in her 30-plus student classroom. She commented on the value of this phase in her development, in that it forced her to look at alternative ways of organising her programme, and adjusting her teaching strategies so that she could make the best use of the scarce resource.

> **Sarah:** Because when you've only got one (computer), if you've got a task that you want to have done, then they are going to have to be at it at different times. Or the other way around it was... is that when you're doing Maths, then the Maths task can be done with the computer also. It balances itself out over the day... like in first part of the morning people are doing language related things after doing Maths, then they do some of the Maths related tasks in the afternoon. It becomes a task that's based around the Centre of Interest... and say if their task is to do a character chart after Reading, someone will say "can I do it on the computer – can I

> make my flow chart on the computer?" Fine! So it's directed by me, but also the children have some choice...
> (Sarah, interview, 2003)

She also reflected on how much her view of how computers should be used in the classroom had changed since the early days, when she saw them as merely a 'publishing tool' with the capacity to make student writing neater and more legible.

> **Sarah:** We thought that it (publishing) was a good thing... that children would come down and have their copy there, that they could produce on computer. I shouldn't really confess, but one of the rules was that you had to have a draft before you can use the computer! And in a way that's probably where we had to start, because for them to be using it they had to have some skills... they were new to it too. Now I cringe at the thought!
> (Sarah, interview, 2003)

As more computers were progressively purchased at the school, a pod of eight machines was established in the small resource room adjacent to Room 1. These were all hooked into the school's existing network, which allowed students to access their files and use the same software they had on their classroom computer. The pod was organised on a rotational basis, with the senior classes each being allocated a day a week to use the machines within their normal programmes. Sarah planned this access into her weekly teaching programme, so that the day was profitably used by the students, usually engaged in topic-related study or in the presentation of unit outcomes. As Sarah stated, "when they're in the pod they're all doing different things... we made use of the pod one day a week at the time we had... in addition to the classroom computer (Sarah, interview, 2003).

It was during this time that Peter identified in Sarah the understandings, attitude, and capabilities he considered could be capitalised upon, by having sole access to an e-classroom environment (Peter, interview, 2003). This was triggered by the observation that other teachers in the school saw no apparent value in using the computer pod during their allocated time, and that Sarah was always quick to seize upon any vacancy or cancellation which became available. The decision to progress with the e-classroom concept was further motivated by the fact that at the time the school was going through a redeployment process, due to a falling school roll. Peter had asked the staff if there was anyone considering moving on that it could make the task of reallocating positions easier.

> **Sarah:** ...I have been thinking about why that is (the e-classroom). I had identified that I needed to do something different... I needed to make a change and I had actually said to Peter that I was going to finish at the end of the year before we got the computers... we were heading into redeployment, and he had asked if anyone was thinking of leaving then could they please come and tell him... it could help... and I thought "that's a good idea". So I went to Peter and told him I was going to move on... (I hadn't told my husband!) But I told Peter that, and then we started to talk about how I was using the pod... the 7 or 8 computers next door, and I had the one in the classroom... the door was open and basically my class was on them all the time, unless the class whose day it was was in the pod. If they came I would tell my kids to come back or we would share them... but that didn't happen much... we could really use them all the time. I guess it grew from there.
> (Sarah, interview, 2003)

With the establishment of the e-classroom in 2001, Sarah was able to more fully integrate the use of computer technology as a 'natural' part of the way she planned and implemented her curriculum. At the same time, a decision was also made to limit the number of computers in the e-classroom to 12. However, there was to be no restricted entry to the class or 'hand picking' of students, nor any reduction in the number of students artificially, in relation to other classes in the school. These decisions were made deliberately. Both Peter and Sarah identified that one of the most powerful capabilities of computers when available in sufficient numbers to allow for small group work, was their ability to stimulate debate and discussion, and enhance group and social dynamics (Peter interview, 2003; Sarah, interview, 2003). Peter considered this factor as particularly relevant in the senior area of the school where the e-classroom was situated. He felt that smaller class sizes at this level did not provide an environment in which such interactions could be readily formed (Peter, interview, 2003).

Additionally, both Peter and Sarah were aware that to an extent the decision to establish an e-classroom, meant that the school was placed 'under the microscope' by parties from both within and outside of the institution (Peter, interview, 2003; Sarah, interview, 2003). As the concept was largely unproven, and there were no other examples of its type in the Northland region to draw on, they felt under pressure to make it succeed, and to have it succeed on its own merits. They were acutely aware of criticism of the concept from other schools in the area, and considered it important to establish the room in such a way that it could not be considered to be 'elitist', or 'artificial' in any way.

> **Peter:** Something that I believe in though is that I think small classes... the movement towards small classes is somewhat flawed, particularly in the upper end of the school where the dynamics are fairly important. As a teacher, I hated getting less than 30 kids in a class, as I couldn't do the things that I wanted to do. And the things I wanted to do involved interaction, and a variety of interactions in a variety of forms throughout the day... and that's what Sarah does using the electronic medium. There are times when the kids can work independently, and there are times when they have to work collaboratively and cooperatively, and she's able to capitalise on the electronic medium to do the type of things that I know I would have liked to have done, if I was in the classroom. She (Sarah) has a thirst for doing things differently, and one of the buzzes for me as a principal is being able to provide her with that kind of resource (the e-classroom) to make it happen. I think it also needed to be proven that it could make a difference, and that if it was going to happen then it needed to be in as 'normal' a setting as possible... we didn't want to 'stage' it by giving her smaller numbers or hand-picked kids... in fact some people have said this and we tell them... they (the students) are hand-picked all right, they are the ones that nobody else wants...
> (Peter, interview, 2003)

This last point was, in reality, exactly what happened. Sarah's apparent abilities in managing difficult children led to a disportionate number of these students being allocated or sent to her class. In many instances during the course of the research, students who became unmanageable in other teachers' rooms were shifted either temporarily or permanently into Room 1. Whilst this had undoubted benefits for the teacher in the room from which the student came, in many instances it had a destabilising influence on the students in the e-classroom, which often took considerable time to overcome. In addition, it was apparent that in at least one such 'transfer' case, the student had deliberately caused a sufficient level of trouble, in the knowledge that this would lead to a transfer to the e-classroom.

4.2.3 The e-Classroom Environment and Organisation

The e-classroom was set up in a manner which allowed for maximum flexibility in terms of layout, and to accommodate the widest possible range of learning situations. The adoption of the hexagonal group layout as illustrated previously in Figures 3.1–3.3, Sarah considered allowed students sufficient area in which to mix the use of paper-based learning materials such as reference books, with the electronically-based resources. They could also choose to work individually if they so wished – providing there was an available machine – or in collaborative partnerships or small groups, usually of no more than three students. However, the fact that there was only 14 (including the two research) computers in the room and up to 33 students, meant that in most cases the students were required to work in groups to complete their learning tasks. The composition of the groups was generally left up to the children to decide, and in most instances these compositions remained reasonably stable, irrespective of the learning task. There will be further discussion of group selection and organisation in the next chapter.

Limiting the number of computers in the classroom to 14 (including the two research computers) was once again a deliberate decision made by Peter and Sarah (Peter, interview, 2003; Sarah, interview, 2003). It was considered that this number could help provide an environment in which the social objectives of having the e-classroom could be delivered. With any more machines, it was considered that it would be very easy for teaching practices and methods to revert to those of those of the 'traditional' classroom.

> **Sarah:** I think that if you were a traditional type of teacher who needs to be 'in control' and have everybody doing the same thing at the same time, it (the e-classroom) wouldn't work. It would

> mean taking that environment that I am in and turning it into a traditional classroom...
>
> ...and that's the trouble with computer labs... you all trot down and do the same thing at the same time... the more (computers) that you get, the easier it becomes for you to revert to that individual kind of learning thing...
> (Sarah, interview, 2003)

Sarah also commented on the manner in which some of the students, even in the present environment could become somewhat 'territorial', by restricting access by others to a particular computer. Some students, particularly those who choose for various reasons to work alone, she had observed as being somewhat possessive of the computer. In the past this had caused a level of conflict with others who had been denied access. Whilst she understood and accepted the reasons for these students choosing to work alone in this environment, she claimed that increasing the number of computers in the room could only serve to make the situation worse.

> **Sarah:** ...you get the child who really wants to do things on their own, and the more they are in that situation of being one-on-one the more individual it will become... I think with more computers, more kids would become 'territorial' about the whole thing...
> (Sarah, interview, 2003)

The capacity of the e-classroom environment to facilitate high levels of group interaction and cooperation, was one of the most significant advantages Sarah identified. She identified the complex nature of the interactions of the students as they worked together to complete their learning tasks using the computers, and the skills, risk-taking, and problem solving strategies they utilised in negotiating inputs, as being particularly powerful. The sophistication and richness of these processes and strategies, she claimed, was far in excess of those which she experienced when teaching in the traditional classroom context, and were more enduring.

> **Sarah:** ...the more I see the kids interacting on the task, there's so much learning happening there... the questioning, the negotiating increases, also I think the kids see skills in each other that in a traditional environment they wouldn't see.

> They take more risks, and they feel more confident to try different things. I don't think they are as constrained...
> (Sarah, interview, 2003)

Sarah claimed the sophistication of these strategies was not restricted only to decision-making or negotiation processes. She stated that in many cases, the students organised themselves in groups according to the perceived level of input each member could contribute to the overall project, and within that structure, organised themselves according to their individual specialisation. Sarah observed that while such work organisational practices were highly sophisticated and could be successful for some groups, for other students, this process was quite destructive. She identified specifically those children who may be viewed as 'isolates' – those who nobody else wanted to work with – as being the losers within this organisational system (Sarah, interview, 2003).

In this class, initial perceptions indicated that such children were seen by other students as having little to offer to the group effort, and as such were the last ones to be selected or were not selected at all (case notes, 2003). However, such a perception and the subsequent decision to exclude these children from groups in many cases was based on social grounds, and had little to do with the individual's ability to contribute to the overall task. This exclusion process could be highly damaging to those being excluded, and for some individuals, further entrenched their isolation and led to progressively more territorial behaviour.

> ***Researcher:*** *Do they (the students) choose their workmates accordingly (to level of perceived input?)*
>
> **Sarah:** Depending on what task they are doing or what activity they are in, some people are recognised by the kids as having an ability to do something well... sometimes I think they do... yes they do... they will work with people who can contribute... but there are some children who unfortunately don't have anybody... you actually have to say "you are working with so and so"... this year I have got two (girls) who really stick out (in this respect)...
> (Sarah, interview, 2003)

Whilst for some individuals this process could be somewhat of a negative experience, for the majority of the class allowing students the ability to self-select groups and work collaboratively, was an important element in helping Sarah to establish her vision of her classroom as a 'learning community' (Sarah, interview, 2003). She described the e-classroom environment as being fundamental in facilitating quality inter-group interactions between her students. According to her, it allowed students with a range of different capabilities across a diversity of areas, the chance to contribute to achieving a variety of learning goals.

> **Sarah:** I think what I am trying to get in my room is a place where everyone is accepted for the contribution they make to the classroom... that everyone's skills are recognised... that everyone's recognised as having some skills and something that they can contribute. That they feel safe enough to take risks to do things... that they can actually suggest their own learning across a range of contexts and opportunities and stuff...
>
> ***Researcher:*** *Do you think this IT environment assists here – I mean, in helping to develop this collaboration?*
>
> **Sarah:** Absolutely, I don't remember ever having this situation in a conventional classroom where you have so many different groups doing different things, yet people prepared to work with different people in such a variety of ways. It's just that the environment... everyone's keen to work on the computer, and they share and you can set up different things, or they can just self-select – it "breeds" collaboration...
> (Sarah, interview, 2003)

The collaborative manner in which the students approached their projects in the e-classroom, and the developing recognition by all class members of the talents and capabilities that exist within the group, Sarah considered contributed significantly to the self-efficacy of most students (Sarah, interview, 2003). According to her, this manifested itself through noticeable improvements in the motivation of students in completing their work, and the development of higher levels of work independence. She cited as two examples of this, the fact that students were able to continue with work tasks independent of teacher input, by using the built-in software tools, and a tendency for students to make their own decisions in the absence of teacher guidance. The ability of the technology to motivate students into higher levels of on-task time, she claimed has been greatly underestimated in the evaluation of the impact of computers in the classroom. She referred to the fundamental importance of this for students such as hers, which she identified as being, at best, "reluctant learners" (Sarah, interview, 2003).

> **Sarah:** ...there's more enthusiasm for doing things. I don't really recall having kids when I didn't have those computers, who would start working on things. It may not necessarily have been school work, but actually be creating things, the minute they come to school. So they turn the computers on and they start using them to do things the minute they come to school... and they don't want to go out at morning tea and (you know) they stay and it's self-selected – they aren't forced to work. They stay to create things... and it gets to about quarter to nine *(school start time)* and you know, we could just kind of start working now, because most of them are just in there doing things anyway.
>
> ***Researcher:*** *Do you think it makes the kids learning more independent?*
>
> **Sarah:** I think so... they just go off and do things. There is so much they can do, they don't have to wait for you. Not like in a traditional setting where say, they might not be able to go away and create a picture or something because you may not have the paint or the paper... it can be done with the computer... you don't have to wait for words or whatever. Especially if you are working with someone else, you can get instant feedback... or use things like the spelling checker or grammar checker to help. We don't have long queues waiting for spelling words. In fact nobody asks for spelling words much anymore.
> (Sarah, interview, 2003)

Associated with increased levels of teacher independence, enhanced motivation and self-efficacy, Sarah has also attributed a turn-around in the behaviour of some students to their inclusion in the e-classroom programme. As previously noted, Parahaki School attracted a considerable number of students with moderate to severe behavioural issues, and that this class had a disportionate number of such students within it. Although it would be very difficult to categorically state any cause and effect relationship in this respect, for some individuals in the class there had been major improvements to the manner in which they interacted with other students and teachers around the school. This had displayed itself in fewer disciplinary incidents for these students, which had warranted the attention of school authorities.

When compared with the average of the previous three years for these students at this and other schools, overall there had been:

- 65% fewer principal referrals;
- an 80% decrease in the number of stand downs from issues related to student behaviour (with reduced stand down periods); and
- for the 2002–2003 period, a significant drop in student absences – from an average per student of 94 half-days during the 2002 school year, to 48 half-days in the 2003 school year.

  (case notes, 2003)

Whilst it would be difficult to identify any component of these decreases which could be attributed to the presence and use of computers for core curriculum tasks, Sarah considered this to be the case (Sarah, interview, 2003). She illustrated this by referencing changes she had noticed in two of the previously most troublesome students.

> **Sarah:** …and there's somebody… Stephen… he's an extreme behaviour problem, but he isn't as extreme… so you notice extreme behaviour from him and everything, but he is a lot better than he used to be… way better.
>
> ***Researcher:*** *Why the change?*
>
> **Sarah:** I think because he can use a computer – and I suppose you could argue that he was just getting his own way – and he wasn't learning anything, he just spent some time creating something. He's developing an attention span… where in a traditional classroom he would just be wandering around annoying everybody, getting into more trouble.
>
> You know he saw Dawn and Kiri doing all the audio for their slideshows, which inspired him to go back to his Powerpoint that he had started about the features of the school… he had all the slides… he had the whole thing there… it was just the content he couldn't be bothered putting in. He went back to that entirely on

> his own, because he saw those two doing it… even though he only recorded the audio for the headings… it is a start.
> (Sarah, interview, 2003)

Sarah also identified another student who, in her observation, had made significant progress in dealing with anger and behavioural issues, and was beginning to show signs of improvements in reading and writing since entering the e-classroom half way through 2002. This particular student had been to six schools in her first five years of schooling, and had been expelled from three of these and experienced prolonged stand downs in others. During the year she had been in the e-classroom, her reading age had progressed by over two years, and she had begun to create pieces of written work of a standard that Sarah claimed had previously been unattainable.

> **Sarah:** I really don't think that you would see the turn-around in Dawn if she had been in a traditional room… and the output… I mean she's writing and reading… and in a traditional room, I'm sure she would just float off and cut up... you know… and definitely she would never be in a situation of teaching people how to do things (like she is now). I think it has been good for her classmates to see her as someone who has skills. But it has taken nearly a year to develop that.
> (Sarah, interview, 2003)

Whilst Sarah attributed some of this change to the motivational and efficacy benefits for Dawn in completing her work using the computers, she was also realistic in linking this assessment to her own philosophy in terms of her attitude to, and strategies in dealing with, student behavioural issues. She stated that the combination of her unwillingness to 'give up' on these students, the impact of the e-classroom resource, and the manner in which students were encouraged to work collaboratively within the environment, tended to "diminish the past history of these students" (Sarah, interview, 2003). It also allowed her a greater range of options in dealing with their behavioural issues.

> **Sarah:** …with the input from the computers and my belief that there is something in there (the student) of worth, and her (Dawn) knowing that, and also knowing that I am not going to give up the minute she calls me something unpleasant. That's the big key to

> those kids… knowing that (almost) no matter what she does you won't give up. It doesn't mean you are not going to take some action on what she does… but it doesn't allow her to bail out.
> There has been a real change in both Dawn and Jordan since they started in this room… although some of the ways they regulate the behaviour of their peers is a bit… well, it makes me go ohh… when they tell them to shut up or something. But these are two of the kids who have been labelled by staff as probably the worst in the school… and here they are trying to control the others so they can get on with their work. That's a really big thing.
> (Sarah, interview, 2003)

The previous discussion has identified significant elements of Sarah's role, teaching philosophy, and value and belief structure, and how they integrated in underpinning the working environment in the e-classroom. However, it must to be remembered at this point, that the discussion relates to Sarah's *perceptions* of the situation as based on her previous teaching experience and anecdotal observations. While for a few students the above may have indeed been the case, significant data will be presented in the following chapter which indicates that this was not the situation for all.

4.2.4 Curriculum Design

Whilst it would be fair to say that the presence and use of computers for most learning tasks played a significant part in the unique nature of this environment, it needs to be acknowledged that the teacher, and the way in which she designed and managed her curriculum, was also of critical importance. Sarah commented on how having access to computers in this way, and being given the freedom to explore their fullest potential without the constraints of school structures such as timetables or assessment regimes, impacted positively on her teaching (Sarah, interview, 2003).

She discussed the manner in which her teaching style had evolved with her exploration of the capabilities of the computers, and how having access to computers in this way had enabled her to develop a level of 'customisation' of her programme. The earlier years of her teaching career she described as being relatively 'traditional' (Sarah, interview, 2003). Curriculum was designed around conventionally-timetabled subject blocks usually programmed to fit in with other classes in the school, and planned cooperatively with other teachers of the same class level. Even after the advent of the pod of computers in the adjacent resource room, she maintained a reasonably standard programme in her classroom, with defined subject breaks and formal teaching of subjects such as reading and mathematics. Sarah considered that such an approach was needed at this time, as she was still in the formative stages of exploring the potential of computers in her teaching. She was acutely aware that she was under a level of scrutiny from other teaching staff who held somewhat skeptical views of what she was attempting (Sarah, interview, 2003).

However, as her confidence and knowledge developed in terms of the sort of learning experiences able to be supported by software, and with the support of Peter, she began to explore alternative ways of organising her programme. These ways focused on how to more fully utilise what she viewed as the capability of computers to enhance curriculum "individualisation and flexibility" (Sarah, interview, 2003). Her observation of the manner in which computers were able to motivate her students to higher levels of work independence, enabled her to change the design of her programme from "teacher sustained to student sustained" (Sarah, interview, 2003) and adopt a more individualised, project-based approach to running her daily programme. Traditional subject divisions were dropped in favour of a curriculum design which actively sought to integrate via thematic projects, numeracy and literacy skills normally delivered as separate subjects. These thematic projects involved individualised research, and integrated a range of curriculum areas.

According to Sarah (interview, 2003), the change in programme design had a 'flow–on' effect with regards to the organisational structure of the day. It enabled greater flexibility in the use of time, and increased the level of choice students had in how they organised the completion of their work tasks. This change Sarah identified as being critical in terms of developing a level of student task 'ownership', which she saw as paramount in further enhancing motivational levels and learner independence.

> **Sarah:** ...well, that's gradually evolved (the project-based curriculum) because probably in the first year (in the e-classroom) I did stop... say to do writing. We would be doing our writing, you know, that traditional kind of literacy stuff that we would do... then we would stop that and we would come onto the mat and do our group reading and so on. But the more I have worked in that environment (the e-classroom) the more all those skills... and particularly the more we are able to get access to web-based things... we are able to develop these as part of our usual work.
>
> ***Researcher:*** *Does it bother you? (that you don't teach reading and maths, for example, as other teachers do)*
>
> **Sarah:** Not any more, but it used to a lot.
>
> ***Researcher:*** *Why the change?*
>
> **Sarah:** Because after the first year I could see that it wasn't doing any harm. So having the approach changing somewhat (in that we were doing less structured group reading)... but because of the sort of questions you can feed into the type of activities you can do, the children are still engaged in developing those skills. I know this approach is not doing them any harm, because when we do the STAR reading test every year they still fit nicely on the bell curve. They still have access to lots of words... like when they use Encarta for research, it's amazing to see what they are able to understand and explore on their own.
> (Sarah, interview, 2003)

According to Sarah, the computer-supported transition to a more student-centred approach to teaching, greatly enhanced her levels of job satisfaction (Sarah, interview, 2003). This was aligned to her perception that more of her time was spent in guiding and prompting students engaged in learning activities, than in dealing with management issues, which she considered was the case before the advent of the e-classroom. She described her teaching role as having changed from one dominated by the need to continually manage student behaviour, to one where she helped students develop strategies to solve learning problems as they occurred, or to provide some basic skill input on a specific needs basis.

> **Sarah:** ...and that's why as the teacher I find it really quite enthusing working in this environment. Because I'm not spending as long... I'm not spending very much time saying... you know... get on with your work... they actually are doing work, so the interactions I have are related to whatever content, or what they are making or writing... or doing. Or you're engaged in solving problems they are having, helping them find out how you do it... and then there's a certain level of skills stuff... but it's more like advice... you know, "it's not going to all fit on the page so you need to change your page setup"... that sort of stuff.
> (Sarah, interview, 2003)

Sarah identified the opportunity of being given a relatively 'free reign' to work in the e-classroom environment, as "giving her renewed energy and enthusiasm for the role" (Sarah, interview, 2003). She identified it also as the most critical factor in assisting her to determine her future direction in teaching, after considering leaving the profession some years earlier. The 'evolution' of Sarah's teaching practice in response to her increased knowledge of the capabilities of the computer, impacted significantly upon the design of curriculum and her teaching strategies. However, for many students the assumption that this led to improvement in outcomes proved to be misguided. The response of the students to the curriculum and approaches adopted by Sarah in the e-classroom will be presented in Chapter 5.

4.3 Chapter Summary

The establishment of the e-classroom at Parahaki School was primarily based on the vision of the principal, Peter, who, from an early stage in his career, held an innate belief in the capability of computers to be able to facilitate "powerful learning experiences" (Peter, interview, 2003). He saw the potential for computers to help motivate and engage students at his school and "make a difference" (Peter, interview, 2003) to many students who had severe behavioural difficulties, and suffered from a negative perception of school and institutional authority generally.

Even from the early stages of development, he adopted a 'bottom up', curriculum-driven approach to implementation, acknowledging what he considered to be the unique blend of characteristics required in a teacher to enable them to make best use of the resources. He was not prepared to simply 'inject' computers into classrooms as has been done in other schools experimenting with such approaches. Rather, he took what he saw as a more rational and measured approach, observing teachers and their work practices, and discussing with them the ways in which computers could support their programmes. To date, Sarah has been the only one in the school to have had made available sufficient numbers of computers to enable her to attempt to develop e-classroom programmes, which reflect the school's social, affective and cognitive goals.

The chapter also outlined Sarah's perceptions of how having access to computers had facilitated a gradual change in her teaching methodologies, and the manner in which she designed and implemented the curriculum in her classroom. She considered that computers enabled her to develop higher levels of individualised programme design, and to operate a number of different learning activities concurrently, without the need to structure student learning using conventional subject divisions or timetables. This was enhanced by the advent of the e-classroom, which enabled her to implement this approach across the class, rather than just with small groups of students as was the case when she only had access to the smaller pod. Sarah also attributed, at least in part, what she viewed as significant changes to some of the more troublesome students, as being a result of their participation in the e-classroom. While she was quick to admit that some of these apparent turn-arounds could have been the result of a blend of factors of which the computers was just one, she speculated that such results could not have been achieved without the motivational and affective benefits of her digitally-dominated programme.

Sarah also indicated her perception that her students were more engaged with their work, and that they spent greater periods of time, often without teacher initiation, working on their tasks. She equated this with higher levels of work independence brought about by the ability of the computers to sustain interest, and support progression in learning through the use of built-in software tools such as the spelling and grammar checkers. While this might have been the case for a few students, data presented in Chapter 5 indicates that for most students, the above perceptions were not entirely reflected in the realities of student classroom practice.

Chapter 5 presents and analyses data related to how the e-classroom environment, defined by the blend of computer use, teacher philosophy and methodology, and curriculum design, impacted upon student social, affective, and cognitive development.

CHAPTER 5

The Students, the e-Classroom, and the Facilitation of Social, Affective and Cognitive Elements

This chapter presents and analyses data related to the second research question, namely:

> **How does the e-classroom environment impact upon the cognitive, affective and social development of its students?**

This chapter provides a comprehensive analysis of student work in the e-classroom, and features the processes by which students interacted with each other and the computers, in making decisions and undertaking learning tasks. Firstly, it presents and analyses data relating to the variety of groupings and organisational frameworks which students developed, and how these influenced their work practices. Next, it identifies how social, affective and cognitive elements interacted in developing unique work processes, and how these, in turn, impacted upon the students' ability to gain learning advantages from the computers. These elements have been detailed separately to enable a clear illustration of the nature of each and the impact they had on student practices to be developed. However, it should be noted that in actuality all three elements worked together in an integrated manner in the formation of work processes for each group of students. Finally, the chapter presents and analyses data in relation to how the students interacted with the software, and how the features of this software impacted upon their performance.

Data for this chapter have been drawn from an analysis of observational case notes, the Camtasia video capture software, and student interviews.

5.1 Student Workgroup Selection Processes

5.1.1 The 'Self-select' Group Organisational System

Sarah allowed the students the opportunity to work in self-selected groups on their learning tasks. This was both a philosophical decision related to what she identified as the potential for the technology to help facilitate collaborative and cooperative activity, and a logistical one, in terms of the number of computers in the classroom. The composition of the groups varied relatively little during the course of this research, with most of the students choosing to work with a limited number of others (2 or 3), usually from within a reasonably defined "circle of their peers" (case notes, 2003). From task to task the actual composition of each working group altered slightly, however for approximately three-quarters of the class, the groups comprised various combinations of the same 4 to 6 students.

The process by which the students selected their workmates varied considerably. Approximately half the class (16 students) formed their groups on the basis that they could identify in their colleague or colleagues, specific qualities that would enable them to complete the set task either more quickly, or to a higher standard (student interviews, 2003). These qualities were technically, cognitively, and socially based. The composition of a small number of these groups was determined by technical attributes, such as an individual's ability on the keyboard or known capabilities in operating the software to be used (student interviews, 2003). In other cases, the perceived level of content knowledge held by individuals in relation to the topic or learning problem to be solved, was viewed as an essential criteria. However, the most predominant influence on group composition was social selection, as students chose to work with those who they knew well, or knew they were able to get along with (case notes, 2003; student interviews, 2003).

Social and technical justification is illustrated in the following excerpt.

> ***Researcher:*** *Why do you chose to work together so regularly on the computers?*
>
> **Simon:** … because we are best friends and we think alike.
>
> **Zane:** … and we help each other out a lot when we get stuck… we have been friends for a long time.
>
> **Simon:** … when we first started to play rugby in Room 12.
>
> ***Researcher:*** *You said something about "that you think alike"… what does that mean?*
>
> **Simon:** We nearly always say the same thing when the teacher asks us a question, and the teacher always gets us mixed up.
>
> ***Researcher:*** *Tell me about solving problems….*
>
> **Zane:** At the start of the year, some programs I didn't know where they were or how to do some things… and Simon, well, he's the resident computer whiz…
> (Simon & Zane, interview 2, 2003)

Students in the groups established within the half-class grouping identified above, were very clear in their understanding of the strengths of others, and the extent to which each was able to contribute to the overall achievement of collective group goals. Much of this understanding was based on a comprehensive social knowledge of their friends or workmates. Comments were made about the importance to others in their group to be seen to be 'pulling their weight', and not free-loading or 'riding on the coat tails' of others. For example:

> ***Researcher:*** *What is it about each other that you like… that makes you want to work together?*
>
> **Hemi**: Team work. That's important to us.
>
> ***Researcher:*** *So what's good teamwork to you?*
>
> **Anton**: Like not just someone sitting there and the other person doing all the work. See… I'm good at typing, and reading stuff about Squash (the topic under study at time of the interview).

> **Hemi**: And I'm good at writing stuff, reading, and stuff like that.
>
> **Anton**: And when one person is on the mouse or on the keyboard, the other person reads what they are writing to make sure it's OK…
>
> ***Researcher:*** *So do you do that often... I mean, is it that same person doing the same thing all the time in your group?*
>
> **Hemi**: We usually do a paragraph each… it depends if it's big, then one person writes and then the other person… we swap over…
> (Hemi & Anton, interview 2, 2003)

Another significant factor in group selection for these students was the need to ensure continuity, especially for tasks or projects which were ongoing. They were already familiar with the work systems and processes of their partner/s, and did not have to 'relearn' how another student works or thinks. This factor they viewed as very important, as the peer networks operating in the classroom were well-defined (case notes, 2003). Selecting others with whom they were familiar or worked with regularly, meant that if one of the group was absent, help was readily and willingly available from others, either within or outside of the group. Additionally, some of these students mentioned the need to ensure that they would get a 'fair go' when working in the group (student interviews, 2003). They needed to feel that other members of the group would not dominate the keyboard or mouse, and impose only their ideas in developing the final outcome. For example:

> **Marcia**: …other people are just bossy sometimes, and they don't let you have a go. And, like when I get to school late and don't know what to do, she (her workmate) knows everything. She shows me.
> (Marcia, interview, 2003)

Two such students, Simone and Hinemoa, who undertook virtually all learning tasks together, identified strong historical and social links to their relationship as being the basis upon which their work processes were developed (Hinemoa & Simone, interview 2, 2003). This pair displayed superior understanding of each other in terms of their individual strengths and weaknesses, and actively sought to support and scaffold each other where deficits in knowledge and skill capability were identified (Camtasia video clips, 2003). The strong social bond between this pair was significant in terms of achieving learning goals. It was apparent from interviews and the Camtasia video analysis, that the high level of trust and respect they held for each other and each other's ideas, allowed them to progress at a faster rate and achieve superior results, than was the case in most other grouping arrangements. This is illustrated in Simone's comment:

> **Simone:** ...we know each other's strengths... like, we help each other learn. If we've got a weakness at Maths or something, we know that, then we'll help them... well, I'll help Hinemoa if she's got a weakness I know... then I'll help her.
> (Hinemoa & Simone, interview 2, 2003)

For the remaining students in this room however – those who may have joined the class part way through the year, were less forthright, or had not established themselves as part of a defined social group, the adoption of a group self-selection process caused issues (case notes, 2003, student interviews, 2003, Camtasia video clips, 2003). This group numbered approximately 17, and as the number of computers required students to work together to complete tasks, they often were the ones who got left behind. It took them longer to find someone to work with and to establish productive working relationships. Generally, these students did not have a firmly established or tight circle of friends and workmates, but tended to swap between combinations of up to 6 or 7 other students, often on a basis of who was left after the others had all 'been taken'.

Whilst this aspect did not appear to worry these students socially, it did have implications for the continuity of their progress as often, within any single task, they may have had up to three different workmates. In practical terms, this required them to do a lot of 'establishment' work before they got down to the task at hand, as they needed to spend additional time recapping with their new workmates what they had done, and where they were up to. This rather fluid group of students tended to experience more issues related to completing their tasks, as they did not have a consistent and known social framework which they could simply 'slot into'. It often took them considerable time to re-establish this on each occasion, according to the person with whom they were working (case notes, 2003). This point is illustrated by the following comments:

> **Sherilee:** ...it is usually that all of the computers are taken, but if one of us is working by ourselves, then the other one just comes and joins them. It just depends on who's on their own. We don't really just have one person we work with all the time...
>
> ***Researcher:*** *So it doesn't really matter who you work with?*
>
> **Susan:** We have a range of people who we work with... yeah...
>
> **Sherilee:** ...and if they want to work with someone else, then we will go and find someone else... but it slows us down a bit... we need to work out what each other is up to.
> (Sherilee & Susan, interview 2, 2003)

For five students, an important basis upon which work practices and functions were established appeared to be a desire to avoid conflict with others, and they went out of their way to ensure that conflict did not happen. As one of these students commented, "(I) just find something else to do while my mate is on the keyboard" (Sherilee, interview 2, 2003). Students within this sub-group preferred not to collaborate by challenging or debating ideas in arriving at a consensus on the nature of the input to the task, but rather shared their 'time' at the keyboard and recorded their ideas separately.

> **Susan:** ...then if they want to do all the work then... yeah... that's OK.
>
> **Sherilee:** ... and when we work together we don't really say much
>
> ***Researcher:*** *Well, how do you get any work done?*
>
> **Sherilee:** I just write down what I think and if the other person doesn't agree...
>
> **Susan:** ...I just find something else to do... but still on that topic.
>
> **Sherilee:** When one person gets a bit sick of typing, then we just swap over and the other person gets a turn...
> (Sherilee & Susan, interview 2, 2003)

Two students in this class consistently opted to work individually for all of their computer-related topic work. Although occasionally others chose to work alone on various tasks, for these two this practice was a deliberate decision on their behalf, rather than the result of being 'left over' after all the others had formed their groupings. Although there were only two such students, the fact that they preferred this option meant that in some instances, insufficient computers were available for other groups to use (case notes, 2003). This occasionally caused friction between these students and the others in the class, although during the course of the research the addition of the two specialist research computers alleviated this problem somewhat. As recorded in the researcher's log:

> ...having the additional 2 computers in the room helps when isolates choose to work independently. Wendy ran to E3 (pod computer number) and started work while Sherilee and Susan were organising their folios. When they returned and saw her there, they went to Research 1 instead...
> (Case notes, 2003)

It should be noted at this point that these students opted to 'go it alone' for virtually all classroom tasks, and that this behaviour was not limited to their computer-related tasks alone. When talking to Sarah about these students, their relative isolation had a strong historical basis (case notes, 2003). Since their commencement at the school, they had consistently pursued this pattern of non-interaction with other students and in other classroom situations (case notes, 2003). It would therefore be fair to assume that this behaviour was not a result of their presence in the e-classroom, but rather a continuation of already established behavioural patterns.

The decision of these two students to work alone was based on a perception that they felt they would be able to achieve a lot more without the interference of others. One of these students commented that on one of the few occasions she was required by the teacher to work with another student, she could get nothing done (Wendy, interview, 2003). The student she was working with dominated the keyboard and mouse, and would not let her touch them to record her ideas. As a consequence, she decided to spend the rest of the session "trying to make herself look busy" (case notes, 2003) so as not to draw teacher attention to herself.

> **Wendy**: …I'm just used to working by myself.
>
> ***Researcher**: Do you find that easier?*
>
> **Wendy**: Yeah…
>
> ***Researcher:** Why is it easier?*
>
> **Wendy:** Because when I have to work with someone else they usually say "can I do the keyboard instead of you?" and they take over and just leave me with nothing to do… or if I've got the computer, they come and interrupt me and say "can I have it?" and they just take up all the work…
> (Wendy, interview, 2003)

During their work activities, these two individuals did not actively seek the help or advice of others in the class. Rather, they relied heavily on the built-in software tools to support them with issues related to such things as spelling and grammar (Camtasia video clips, 2003). Whilst this undoubtedly assisted them in maintaining a level of desired work independence from others in the class, it also held implications for their rate of progress, and the quality and accuracy of their outcomes. These factors are discussed later in this chapter and in Chapter 6.

5.1.2 Student – Computer Interactions in the e-Classroom

Regardless of the groupings students adopted when working on their tasks, generally they followed a consistent pattern of interaction with the computer in generating responses to learning activities (Camtasia video clips, 2003; case notes, 2003). This operational sequence resembled a basic input-output system, where students, using a variety of strategies the nature of which were often influenced by group composition, decided on inputs which were in turn made via the keyboard and mouse. The computer-generated outputs from these inputs were then evaluated by the students in terms of the expected or desired response, before a new input was decided upon and trialed in much the same way. This process was iterative in nature, and depending on the strategies adopted and the capabilities that students collectively or individually possessed in relation to the knowledge and skills required to complete the task, they were able (or not) to make reasonable progress towards task completion.

The manner in which students developed inputs to this process was highly variable, and as will be illustrated later in this chapter, this factor held significant implications for the quality and accuracy of the work they produced. Student work and decision-making practices varied on a continuum ranging from non-collaborative at one end, to full collaboration at the other. By far the highest quality task-oriented interaction occurred between students who most consistently displayed collaborative practices, working usually, but not exclusively, in pairs. The collaborative practices of these students were categorised using data from Camtasia video clips (2003) and case notes (2003), and related to the strategies they displayed which enabled them to *combine* their intellectual and skill-oriented capacities in completing learning tasks. Such strategies and skills included task persistence, negotiation, debate, accommodation, problem analysis and solving, cognitive engagement, peer interdependence, and scaffolding. Within this classroom, approximately 16 students displayed what were considered to be collaborative work practices the majority of the time.

At the other end of the continuum, there existed work practices which were categorised as non-collaborative (Camtasia video clips, 2003; case notes, 2003). The more extreme of these practices included being disruptive, intimidating, verbally and physically aggressive, loutish and bullying. Within this class, five students consistently exhibited practices which were categorised as non-collaborative. However, it should be noted at this point that although the two students who opted to work alone by choice could have been viewed as displaying non-collaborative practices, they did not display any of the strategies as described above, but rather worked alone primarily for social or perceived 'work-benefit' reasons.

Between non and fully collaborative practices, there existed a range of variable work practices which were often utilised by students according to who they were working with, and/or the perceived importance and nature of the task (Camtasia video clips, 2003; case notes, 2003). These practices fluctuated along the continuum, at times displaying characteristics of mild non-collaborative practice, to at other times those more akin to fully collaborative. As will be illustrated in the next section, patterns were revealed as to when and for what collaboration was forthcoming (Camtasia video clips, 2003, case notes, 2003). Although at times almost all students (excepting the non-collaborative five) displayed variability in their work practices, 10 or 11 students (depending upon the class roll) displayed such practices the majority of the time.

The next section provides illustrative examples of the above practices, and analyses how they impacted upon student performance. Data displaying the range of student work practices along the non-to-fully collaborative continuum will be presented and analysed. However, in order to structure the presentation of this data, it has been organised using the sub-headings non-collaborative work practices, collaborative work practices, and students working as individuals. It must be acknowledged that while there were at times overlaps between these categorisations for most students, the following analysis attempts to describe these practices and their impact on the work of the students, rather than ascribed them as 'labels' to specific and defined student groupings.

5.2 Student Work Practices in the e-Classroom

5.2.1 Non-collaborative Work Practices

Students who adopted non-collaborative work practices displayed little regard for the 'learning rights' of any person with whom they were supposed to be working. These students generally gained access to the keyboard and mouse, and controlled the flow of data which were inputted to the computer, effectively acting in a 'censor-like' role in determining the nature of inputs (Camtasia video clip, 2003; case notes, 2003).

In these cases, other group members were limited in the amount of collective input they could have in determining the shape and form of the final outcome. This was primarily due to the 'filtering' effect the individual who had control of the input devices had on determining what went up on screen. Students appeared to be well aware of this issue, and although they attempted to select their group members as much as possible to avoid this situation occurring, in many instances this was not possible, or it still occurred anyway.

> **Marcia:** ...I don't like working with Cherrie as she gets the mouse and stuff and just takes over. If she has something she wants to put down, then she just types it in. I don't get to put down any of my ideas, and if I do say something, then she usually just says it's dumb and ignores it anyway...
> (Marcia & Kath, interview 2, 2003)

Whilst the domination of input devices by a non-collaborative group member was the exception rather than the rule in this class, their behaviour nonetheless impacted significantly on this classroom environment. If a student displaying non-collaborative practices did not manage to physically get to the keyboard and mouse quicker than others in the group, then often they would cause disruption or deliberately become obstructive to the work of the other students, in order to 'get their way'. This also occurred if a request had been made by the teacher for the group to be organised in a particular way, to meet a specific objective.

For example, Melanie and Keri had been assigned by the teacher the task of completing individual digital work portfolios for presentation at a parents' information evening. Sarah had asked Melanie to assist Keri, who had been absent, in 'getting up to speed' with the operation of Microsoft Powerpoint, the program to be used for this project. However, Melanie was instead keen to continue with her own folio, and from the moment the pair started working, Melanie engaged in a series of tactics designed to intimidate Keri into allowing her access to the keyboard.

Keri had just opened her draft folio ready to begin work...

Melanie: Can I go on my one now?

Keri: I need to do this part… I haven't even got going…
Five second pause

Melanie: Can I please do my one now?
Three second pause

Keri: I said I need to do my one… just need to get these books out of my way *(moves pile of books on table to one side)*

Teacher intervention – suggests time allocation of 15 minutes slots for each student. Keri begins work – enters three words on first slide. No input from Melanie – appears to be conversing with student on adjacent computer. Two and a half minute pause.

Melanie: You're taking a long time… you've only got one minute left…
Ten second pause

Melanie:
20…19…18…17…16…15…14…13…12…11…10…9…8…7… 6…5…4…3…2…1… time's up. Stop.

Teacher intervention – "Fifteen minutes Melanie... that's not 15 minutes... no way is that 15 minutes... you've got another 10 minutes there Keri...!"

Melanie: Ohhh!
Keri continues with her work. Fifteen second pause.

Melanie: Come on then… get on with it… God, you're so slow!
Melanie then turns to student on adjacent computer and starts rehearsing times tables.
(Keri & Melanie interview, 2003; Camtasia clip, 2003; case notes, 2003)

In another example of more extreme non-collaborative practice, a student who was unable to access the keyboard directly, engaged in verbal and physical violence and 'stand over tactics' to ensure that his ideas and perspectives were prioritised (case notes, 2003, Camtasia clip, 2003). He did this firstly by attempting to physically remove the hands of his 'partner' from the keyboard, by pushing them aside and 'shouldering in'. When this failed, he stood over the top of his partner and tried to type over his shoulder. In turn when this tactic was unsuccessful, he proceeded to engage in a verbal exchange with his 'partner', and literally 'shouted him down' to such an extent that his 'partner' chose to leave. The student then assumed the keyboard and began his own work (case notes, 2003).

Although there were only five students in this class who consistently adopted non-collaborative practices, their detrimental influence on the work progress of others was profound.

5.2.2 Collaborative Work Practices

For some group combinations, the presence of a student displaying non-collaborative work practices had a disportionate influence over the nature and composition of outcomes. However in other instances, the work practices other students displayed led to outcomes which were more coordinated and planned. Students displaying collaborative work practices generally organised themselves in either pairings or threesomes which were formed within the stable social framework as described earlier in section 5.1.1. Within this e-classroom, approximately 16 students *consistently* adopted collaborative work practices in completing their tasks.

As in other groupings, students working collaboratively normally had only one person at a time inputting data using the keyboard and mouse, but unlike other work practices, the data that were entered was usually the result of a collaborative effort between the members of the group. Generally speaking, the greatest level of collaboration existed between the student who had access to the input devices (usually the keyboard and mouse) and the person who was sitting next to them. If there was a third person involved in the group thereby forming a threesome, in most instances this person contributed only peripherally, and appeared to be the most easily distracted by surrounding events (Camtasia video clips, 2003; case notes, 2003).

Initial observations indicated that this pattern of performance was at least partially due to the arrangement and size of the furniture, which did not allow the third student ready access to the screen or any input device (case notes, 2003). That is, they were usually located between and behind the two students who had most immediate access to the computer. However, when this issue was raised with a group of students – Bondi, Wiremu and Anton who appeared to be working collaboratively (case notes, 2003), it was revealed that their organisation was a deliberate strategy employed in order to "share the work around" (Bondi & Wiremu, interview 2, 2003). That is, although these groups were self-selected, often with recognition of the contributions that each member was able to make to the 'team effort', a negotiated decision was made prior to the commencement of any work session as to who the 'third person' was to be for that session. This person then appeared to be granted a 'free licence' to 'cruise' for the duration of that particular activity, only inputting when and where they wished and being under no pressure from the others in the group to do so!

The term 'cruiser' (student interviews, 2003) was well known to many students, and it was apparent that this was a cleverly orchestrated strategy used by some groups with three members, to rotate the avoidance of work. This 'cruising' phenomenon was observed on several occasions being used by two groups of boys in particular (case notes, 2003). When quizzed on this, they commented on the range of strategies used to avoid detection. For example:

> **Wiremu:** …or sometimes when we don't want to do work, then we just sit by someone and cruise… you just sit by someone… tag alongs…
>
> ***Researcher:*** *How do you mean... cruise... tag alongs... what's that?*
>
> **Bondi:** We just sit by them and pretend we're working… that's what Anton does…. although we all get our turn…
>
> ***Researcher:*** *(Laughs). Tell me more about this…*
>
> **Bondi:** Well, it's always us two, and Anton will come along and say "let me do some work and…"
>
> **Wiremu:** …then Bondi says… "no way, go away", but I say… "no he's cool… I can cruise…"

> ***Researcher:*** *So what do you do then?*
>
> **Wiremu:** I just stay there…
>
> ***Researcher:*** *And…?*
>
> **Wiremu:** I just stare at the computer and make it look as if I am working… but only when the teacher is looking, otherwise I just sit there and look around the class… then back at the computer… then I have a talk to someone… it's cool…
> (Bondi & Wiremu, interview 2, 2003)

Although 'cruising' was employed regularly by two groups, it did not appear to inhibit the overall attainment of learning goals or the completion of set tasks to any extent. In fact, the students who employed this strategy were able to justify its use in terms of the speed advantages afforded by the availability of computers. They perceived that when compared to previous years in conventional classrooms, they were able to complete their work more quickly and to a higher standard using computers, thereby freeing up time which could be spent on other things. For example:

> **Wiremu:** …we can do it faster in here (than we could in other classes), and still talk and do it at the same time…
>
> **Bondi:** yeah… like we can work at it and then stop for a little while… and have a bit of a talk…
>
> **Wiremu:** …or if we don't know the work or the words and we are thinking of it, we end up talking…
>
> **Bondi:** …but we still seem to get it done quick enough.
> (Bondi & Wiremu, interview, 2003)

'Cruising' was a strategy employed by two groups of boys in particular, but its application varied according to the nature of the task, and the extent to which imperative existed for all three students to contribute, such as that which applied to the preparation of the digital portfolios as introduced earlier.

The most effective work practice came from students who organised themselves in pairs, and who consistently displayed collaborative strategies as defined earlier in 5.1.2. These students out-performed all other arrangements in terms of their work efficiency, and quality of outputs (Camtasia video clips, 2003; case notes, 2003). Although from time to time these pairs were joined by a third group member, this was usually on a casual basis. This was often when there was a need for specialist task-related or technical skills which were perceived to be held by the additional member (Camtasia video clips, 2003; case notes, 2003). The duration of the 'visit' of the third student varied according to the task, but typically it could be from a few minutes on a 'consultancy' basis, to a whole work session where there was the need for more indepth peer tutoring or support. It was well-known amongst the students just who in the class held knowledge in particular areas of software operation. It was usually the solving of software-related technical issues or the desire to add visual enhancements to their projects, which necessitated the addition of other 'temporary' group members. In response to the interview question: "When you strike a problem with the software or whatever the task is that you have to do on the computer, what do you do?" (Appendix 2) – 72% of the students indicated they would call upon the services of firstly the teacher, and if she wasn't available or was unable to help, they identified members from the same group of five class peers (student interviews, 2003). For example:

> **Hemi:** ...you just ask the teacher...
>
> ***Researcher:** What happens if she doesn't know or if she is busy?*
>
> **Anton:** We ask someone else who knows more about it... someone who has used that thing before or knows how to do it...
>
> ***Researcher:** Are there people like that in the class?*
>
> **Anton:** There are some... like Wiremu, Simon, Hinemoa, or Bondi...
>
> **Hemi:** ...or if they don't know we go and ask Mrs. C (Shirley).
> (Hemi & Anton, interview 2, 2003)

Another perspective on this was provided by Marcia and Kath:

> **Marcia:** ...we ask someone next to us, or if we freeze it we just go control-alt-delete and go and get the teacher... but I don't do that

much because sometimes Mrs. Wilson growls me when I do a mistake.

***Researcher**: You mentioned other people Kath, how does that work?*

Kath: We talk to other people about it.

***Researcher:** Are there particular people you go to all the time...?*

Marcia: We ask Wiremu because he is really brainy, Hinemoa...

Kath: ...and Bondi... but sometimes we ask Sally...
(Marcia & Kath, interview 2, 2003)

For pairs who consistently adopted collaborative practices, work arrangements changed very little during the research period, and were very stable. The foundation of this stability appeared to be strongly socially-based (student interviews, 2003; case notes, 2003; Camtasia video clips, 2003). For these students, it was apparent that both had developed high levels of understanding of the way in which their partner thought and functioned, and openly recognised the contribution that they were able to make to the attainment of learning goals.

This was illustrated by Simon and Zane in their response to the interview question: Why do you choose to often work with *xxxx* when you do your work in room one? (Appendix 2).

Simon: ...we are best friends and think alike...

Zane: We help each other out a lot when we get stuck...

Simon: ...yeah, and we know what's happening and all that...

***Researcher:** What do you mean "you know what's happening?"*

Simon: See like if Zane's doing something on the one day, and I go to Dan and I say "Dan, what have you been doing?" and that usually takes up about a quarter of our time explaining what we have to do... so I would rather work with Zane.

> **Zane:** Yeah…it's a lot easier if you just work with the same person. You get to spend more time with your friends and it's easier to actually know what you're doing, instead of trying to catch up. Like if Simon's away and I have to work with someone else, then I don't know what they're doing…
> (Simon & Zane, interview 2, 2003)

Some pairs working in this way commented that the knowledge they had about each other's relative strengths and weaknesses allowed them to develop a level of 'task specialisation', whereby each person was able to contribute to a task in the areas they were most competent in. For some, task specialisation related to technical abilities such as capability at using the keyboard, or specific knowledge of the software being used. For others, it was based on cognitive aspects such as the level of knowledge held by individuals in relation to the content to be developed, or their numeracy, reading, spelling, or general language capability (case notes, 2003; student interviews, 2003).

Task specialisation did not, however, lead to the adoption of 'cruising' tactics by the particular student not actively engaged at the time, as was the case for the two groups discussed earlier. Rather, it was clear that there was a level of expectation that both students would continue to engage with the project by actively contributing to the content, and by checking the work of the other student as they entered data through the keyboard (student interviews, 2003). These arrangements typified the collaborative approach to working adopted by these students, and as illustrated by this interview excerpt from two students who consistently worked in this manner, they were very aware of its advantages.

> **Anton:** …like Hemi, well he's good at writing stuff and reading and all that… and he has some cool ideas we can use…
>
> **Hemi:** …and Anton, well he's really good at typing…
>
> ***Researcher:*** *So if Anton is working on the keyboard, what do you do then Hemi… only one person can get on the keyboard at a time, can't they?*

Hemi: Well, I can control the mouse and can read some of it… so can Anton – we usually read a paragraph each. Sometimes we swap over as well, I get on the keyboard and Anton does the checking…
(Anton & Hemi, interview 2, 2003)

Student pairs displaying collaborative work practices held a strong sense of responsibility towards the other student in the team. This reflected in high levels of peer tutoring in areas of perceived deficiency, or at the very least, not denying their partner the opportunity to progress or learn in that area (case notes, 2003). The contexts for such activity tended to vary considerably, but included:

- the provision of advice on technical skills such as mastering keyboard or document layout;
- understanding software operation;
- using the spelling or grammar checker, or other built in software tools;
- assistance with knowledge of grammar or sentence structure;
- assisting in the development of 'content-related' knowledge, for example, basic science concepts.
(case notes, 2003).

An example of the first two of these in operation was captured in a Camtasia video clip of two students working collaboratively. They were developing a spreadsheet of distances walked, as part of the class fitness programme. In this example, the students were keeping a daily and running total of the number of laps of the school they had walked during the half-hour fitness period, and entering them onto a spreadsheet. They were then comparing this to a 'destination sheet' which gave a comparison of distances walked in relation to landmarks around the city. Zane had opened his spreadsheet to enter his data, and was browsing the columns.

Zane: …now let me see…where does this go?
Browsing the columns with the mouse.

Zane: OK …now my buddy …my buddy was …Brady…

Simon: Brady who?

Zane: Brady Paki.

Zane writes Brady P in cell.

Zane: What's the date?

Simon: The date's the 23rd of the 7th
Zane enters the date in cell.

Zane: How much (many) laps have I done?

Simon: Four.
Zane enters lap total in column.

Zane: Where's the destination sheet?

Simon: *(calls out)* "Mrs W, where's the destination sheet?"
Simon goes and gets destination sheet after teacher response.

Zane: OK – so I put 20 in here…

Simon: No …that's not right …it goes over here *(takes mouse and indicates correct column)*…the 20 is the number of laps you have done altogether, not just today …you only did four today…

Zane: …but I have been putting it in there, and it's OK…

Simon: No …because that's not your running total…

Zane: What's a running total …does that mean how far you have run?

Simon: Well …it's kind of that …it says …umm …how far you have gone altogether. You use it to see how far you have gone.

You check them against the destination sheet …see…
Simon moves mouse to correct column and enters number. Spreadsheet is then 'autocalced' and comes up with a new, correct running total of total distance travelled. Simon now gets destination sheet and identifies the point where Zane has reached.

Zane: Oh …so this *(moves mouse to 'total daily lap' column)* times this *(moves mouse to 'lap distance' column)* equals this *(moves mouse to 'daily distance' column)* and when I hit the autocalc button *(moves mouse over autocalc)* it gives me a running total that I can check on the destination sheet…

Simon: Yep!

Zane: Cool …you're a genius…

Simon: …I know! *(laughs).*
(Simon & Zane, Camtasia clip, 2003)

The day following the completion of this particular session, the two students involved were played back this segment of the Camtasia clip and asked to comment on the example. When asked if they helped each other in this manner very often, they replied:

> **Simon:** ...well ...when I work on the computer I am bad at spelling and we don't get homework, so I need to catch up on my spelling...
>
> **Zane:** Yeah ...his family's not the spelling type, but the Maths type – and I'm the spelling type and not the Maths type...
>
> ***Researcher:*** *So you help each other when you see they don't know...?*
>
> **Simon:** ...and I'm good at typing but I'm not good at spelling, so I type it up and he tells me when I have made a mistake ...and if we have to do Maths like yesterday and he makes a mistake, then I tell him and try to explain where he went wrong...
> (Simon & Zane, case notes, 2003; informal interview, 2003)

In another example two students, Kath and Marcia – earlier identified as a pair consistently displaying collaborative work practices, were set the task of researching a range of simple machines for a science topic they were undertaking, using websites stored on the school intranet. The website had photographs of a range of pulleys, levers, wedges, wheels, inclined planes and screws being applied as simple machines, with a basic caption at the bottom of each page inviting the student to identify which they felt could be placed in each category (Camtasia video clip, 2003). Marcia had logged into the intranet and was viewing the 'Simple Machines' homepage.

> **Kath**: You need to hold down the control key to make the links work...
> *Marcia clicks link with control key held down.*
>
> **Marcia:** OK – oh ...so why is it on the same thing?
>
> **Kath:** ...cause it is still on the page and we don't want it on the page...
>
> **Marcia:** Palleys...!
>
> **Kath:** You mean *pulleys* ...go into pulleys.

Marcia clicks the 'pulleys' hyperlink. Marcia and Kath scan through photos of pulleys 'in action'. Some verbalisation related to what photos showed ...after 30 seconds they exit.

Kath: Levers …go into levers…
Marcia clicks 'levers' page link.

Kath: Levers…
Marcia scrolls down the page.

Marcia: How do you know it's a lever, what's a lever?

Kath: …a lever is a thing that you use to lift stuff up. Like …I could get a pair of scissors like this and lift up this book …this could be a lever… *(demonstrates)..*

Marcia: Ohhh…

Kath: …that could be a lever *(after Marcia moves mouse to photo of spatula).*

Marcia: …what about this one? *(moves mouse to photo of fork).*

Kath: What do you think?

Marcia: …well …I suppose it could be…

Kath: How?

Marcia: Well, it can be used to lift up scoops of food! *(moves mouse over fork and indicates via movement of mouse how it could act as a lever in lifting food).*

Kath: …yeah that's it …I think so anyway...
(Kath & Marcia, Camtasia clip, 2003; case notes, 2003)

In this example, Kath was scaffolding the development of Marcia's science knowledge of simple machines, with the computer being used as an interactive medium through which examples of these concepts could be observed and manipulated. What was particularly relevant in this instance, was the manner in which the computer was interacted with by the two students. It was used to stimulate debate and discussion and to illustrate and test ideas held by one of the students in relation to the nature of levers. Although this particular webpage did not have animated gif images illustrating these simple machines in operation, other pages on this site did.

The two students interacted at some length with these particular pages, cleverly manipulating the gifs to see how machines such as screws and wedges could be applied in different contexts (Camtasia clips, 2003; case notes, 2003). The computer in this instance was being used as an interactive cognitive 'partner' – that is, a device to trial and test developing ideas related to the formation of basic scientific knowledge.

The learning and decision-making processes of students who consistently utilised collaborative practices differed substantially from others. It was apparent that these students were able to recognise the knowledge and skills possessed by their workmates, and were more prepared to validate this by arriving at inputs through a process of debate and negotiation. This process involved all students offering up ideas for scrutiny, which were then subjected to question and debate, before a final decision was made as to what was to be entered via the keyboard and mouse (Camtasia video clips, 2003; case notes, 2003). What resulted from this process was a single set of inputs, which fairly represented the pair or group's collective perspectives in terms of the task requirement. Some of the strategies employed by these students during this process were relatively sophisticated, and in many cases, indicated advanced levels of analysis and critique of the perspectives and views of others (Camtasia video clips, 2003; case notes, 2003).

Furthermore, the adoption of collaborative behaviour did not appear to be dependent upon whether or not the outcome was to be a collective or an individual effort (Camtasia video clips, 2003; case notes, 2003). That is, students working collaboratively adopted collaborative practices even when working on individually specified tasks, such as in the following example analysed from a Camtasia video clip (2003). Sally and Julie had been set the task of completing individual multimedia Powerpoint folio presentations, to be used at a parent interview evening. The folio was to represent the best examples of their work in the e-classroom to date.

Sally had logged into Powerpoint, and had created a blank slide.

Sally: *(to Julie)* What should I call it?
(enters WordArt resource).

Sally: Should I use that one *(mouse moved to WordArt option),* or that one *(mouse moved to another option)* or that one? *(mouse moved to third option).*

Julie: This one *(points to purple sloping: option 1).*

Sally: What should I call it?

Julie: Successes… no, 'Portfolio of Successes'.

Sally: I know… just portfolio.

Julie: OK.
(enters WordArt font option).

Sally: How do you spell 'portfolio'? *(types 'port').*

Julie: 'f-o-l-i-o'

Sally: 'f-o-l-i-o' *(types into WordArt).*

Julie: Now… change that to a bigger font.
(Sally chooses Jokerman 26 pt.).

Julie: Jokerman's cool… choose Jokerman… *(Sally confirms Jokerman – positions WordArt on page with ongoing guidance from Julie as to position and sizing).*
Julie: That looks cool!
(Sally types her name).

Julie: You should put that in purple as well?

Sally: Is it that purple? *(selects medium purple colour).*

Julie: No, it's a dark purple.

Sally: About that? What'ya think? *(selects different purple).*

Julie: It's lighter, but it still suits 'cos there is some of that colour in the heading!

Sally: …and I'll do a gooey purply background or maybe bright green… what d'ya think?

Julie: …white looks quite good as well.

Sally: Na… I don't like white.

Julie: Then maybe you don't do one yet, and see what it looks like at the end?

Sally: Yeah …but I will just have a look to see what some look like.
(enters format–background–colour palette, selects lime green…applies to slide).

Julie: That looks cool… just keep that in mind and we can go back to it later on and put it on all the slides.

Sally: OK!
(Sally & Julie, Camtasia clip, 2003)

The two students in this example carried on with this discourse for over an hour, and at the end of the session had created four slides for Sally's folio, which included the use of appropriate audio clips, animations, and hyperlinks. The high levels of verbal exchange, negotiation, critique, and challenge that went on as these students undertook their task, appeared to be supported and facilitated by the capacity of the computer. It allowed ideas to be tested and trialed freely, without the danger of 'messing up' the final outcome, or getting into a situation from which retrieval would prove to be a difficult or time-consuming undertaking.

In response to the question: Do you consider that you produce more or better work when working with someone else, or when working by yourself? (Appendix 2), students displaying collaborative practices, without exception, identified performance advantages when working with a colleague. The basis of this advantage reflected the perception that "two heads are better than one – you get better work done faster" (Hemi & Anton, interview 2, 2003), and how the presence of a peer who challenged and prompted "pushed them to learn new things" (Simon & Zane, interview 2, 2003).

When asked about the high levels of verbal interaction when working on tasks, two students, Simone and Hinemoa earlier identified as working collaboratively, were quick to point out the difference between what they termed 'working talk' and 'work and talk' (Simone & Hinemoa, interview, 2003). 'Working talk' was identified as a natural component of their work practice, and was focused usually on clarifying issues, establishing task roles, or negotiating content. However, 'work and talk' they labeled as "what a lot of the other kids do" (Simone & Hinemoa, interview 2, 2003) – that is, non-task related discussion.

> **Simone:** ...it just depends on what we are doing... if we know more about it, or if we don't understand anything properly. If we don't understand it, then we talk amongst ourselves until we do... we explain it to each other... that's working talk...
> (Simone & Hinemoa, interview 2, 2003)

Some students who displayed collaborative practices also appeared to have a view that having access to the computers, and the freedom to work with their self-selected peer, enabled them to produce what they considered to be superior outcomes (student interviews, 2003). Some claimed that the work they completed with their peer was better than that which would have been possible through the use of more conventional book-type resources (Simone & Hinemoa, interview 2, 2003).

When asked about the differences in working using the two mediums, this pair stated:

> **Hinemoa:** ...we normally just... like... put... if we're working on computer one person types and we just put in ideas and stuff, but if we're working in our books... she normally works in her book, and I work in my book and we just...
>
> **Simone:** ...go from there...
>
> **Hinemoa**: Yeah, we write different ideas...
>
> ***Researcher**: Are there any advantages you can think of in working together on the computer?*
>
> **Hinemoa:** We get more things done...
>
> **Simone:** ...or we get more down... it's funny... if we are working separately we tend to wander around more and talk to others... but when we are together working on the computer that doesn't happen.
> (Simone & Hinemoa, interview 2, 2003)

Students who consistently adopted collaborative practices were generally able to develop self-sustained work activity, which appeared to be productive and required little teacher input. In most instances this collaboration was based on existing social relationships, which provided students with a stable and consistent framework within which to work.

However, as introduced in section 5.1.2 a group of approximately 10 or 11 students displayed highly variable work practices, and fluctuated along the non-to-full collaboration continuum, often in response to who they found themselves working with, or the nature and importance of the task which was set for them.

Unlike those students who consistently worked collaboratively, students who adopted variable work practices often did so on a 'case-by-case' basis, deciding the levels of collaborative or non-collaborative practice according to who it was they found themselves working with (case notes, 2003; Camtasia video clips, 2003). Students adopting such strategies were generally outside of the well-defined social structure discussed earlier in relation to collaborative practice, but tended to be the 'peripheral' students who created working groups after the others existing within the defined social structure had been formed. For these students, work strategies varied from at times mild forms of non-collaboration and individually-focused 'resource sharing' arrangements, through to occasionally collaboration, usually on specific aspects or components of their work.

Students adopting variable work practices differed from students who displayed consistently non-collaborative or consistently collaborative practices. Unlike the aforementioned arrangements, there were high levels of inconsistency in the way in which these students interacted with each other, and the work strategies they applied in completing tasks. This inconsistency was often seen within single work sessions, where at times students were captured collaborating on such aspects as the proof-reading of work or assisting each other in the technical operation of hardware or software (Camtasia video clips, 2003). However, at other times, these same students were also captured working non-collaboratively, although generally not utilising the same extreme strategies or demanding the same exclusive outcome as detailed earlier in relation to the group of five, who consistently worked in this way (Camtasia video clips, 2003; case notes, 2003).

An illustration of these both of these practices within the one work session was captured using Camtasia, when two students, Susan and Abby, had been assigned by the teacher to work together to produce a multimedia show to present to their 'buddy' class. Susan was on the keyboard and was beginning to enter information about the 'buddy reading' programme when, as can be seen in Figure 5.1, she made an error in the heading, starting to spell 'Rading' instead of 'Reading'.

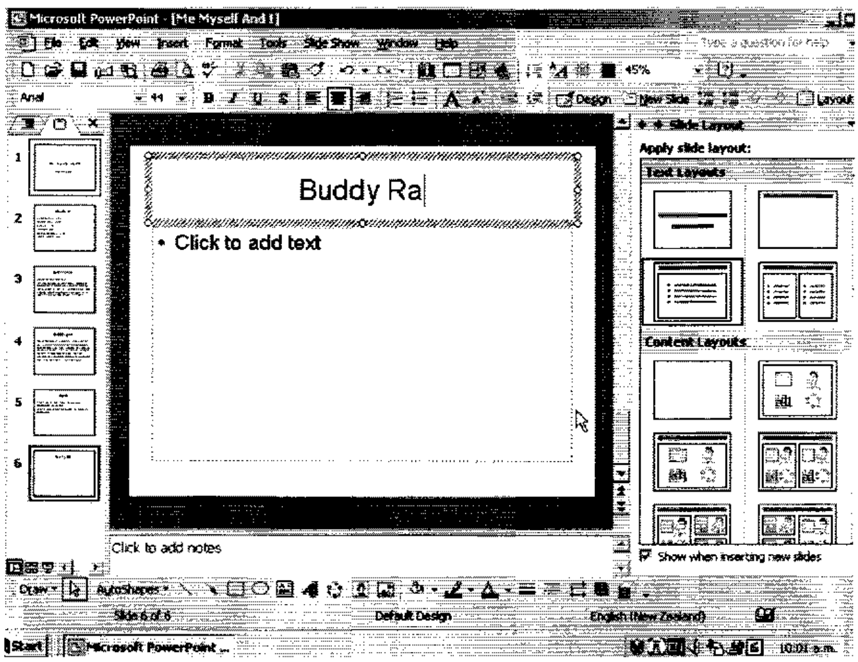


Figure 5.1: Susan Enters Incorrect Initial Blend for 'Reading'

At this point, the following dialogue was captured by Camtasia.

> **Abby:** Ahh… ahh… ahh… no. That's not how you spell 'reading'… you put R-a and it's R-e…
>
> **Susan:** No I didn't… I did R-e-a…
>
> **Abby:** No, R-a…

Susan: R-e-a…

Abby: R-a!

Susan: No, R-e-a!

Abby: I know… *(presses Ctrl-Z repeatedly to undo previous commands until she got back to the error point).* See… R-a…

Susan: Oh… all right then… *(starts typing again).*

Abby: R-e-a-d-i-n-g! *(Victoria enters correct spelling of 'Reading' – Figure 5.2).*

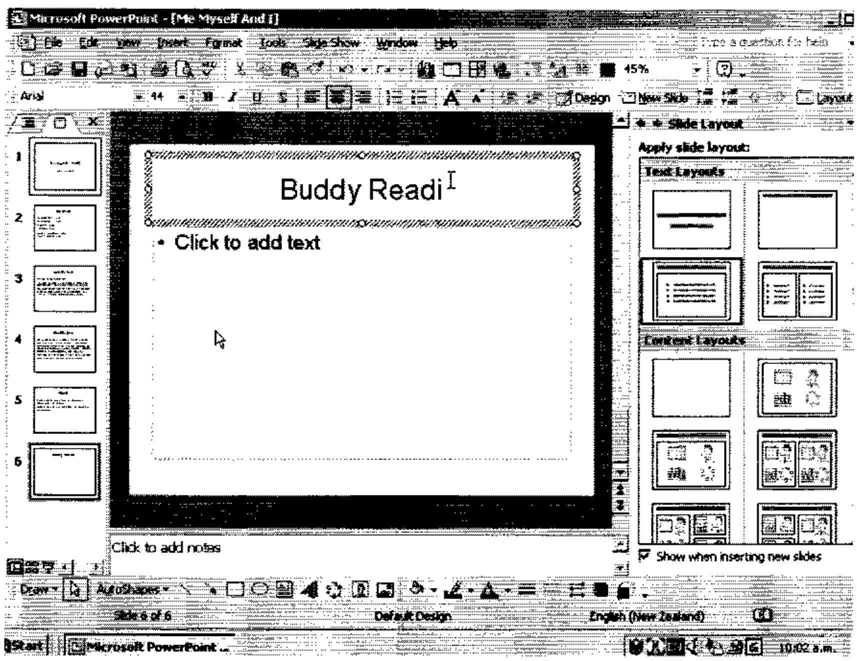


Figure 5.2: Susan Enters Correct Spelling of 'R-e-a-d-i-n-g'

The dialogue then continued as follows:

Abby: See… I told you… can I write something… I'll write something now… *(tries to access the keyboard).*

Susan: NO! I'll write all over your thing then… *(seizes keyboard back and continues writing).*

This example illustrates the variability in work practices which was reasonably typical of this group of students. It was very much a case of 'reluctant collaboration' which seemed to concentrate primarily on the technical accuracy of work, as in the above example (Camtasia video clips, 2003; case notes, 2003). This was markedly different to students who consistently displayed collaborative practices in pairs or threesomes, and who brought to bear the combined intellectual and technical talents of all group members in the creation of outcomes.

Other students working in this way adopted something of a 'time-sharing' arrangement, where in place of single inputs resulting from a process of negotiation, debate and discussion, they opted for individual inputs, usually organised on a time-allocation basis. That is, for any set task, both students were able to have their views represented by virtue that they were both able to have time at the keyboard, usually on a 'rotational' basis (Camtasia video clips, 2003; case notes, 2003). Such practices were applied to tasks in which a single outcome was to be produced, as well as those where students were expected to work together to develop individual outcomes (case notes, 2003).

The impact that these variable practices had on the nature of outcomes was significant. Unlike students who consistently functioned collaboratively, these students appeared unable to combine their knowledge in the production of an outcome which reflected negotiated understandings. Instead, they ended up with a piece of work which was a compilation of individual efforts, and as a result, was often disjointed and lacked coherence. That is, it reflected the sum of two separate efforts which had been put into one. Some issues surrounding working in this way were revealed in a pair interview with Rose and Melanie, two students who consistently displayed high levels of variability in their work practices.

> ***Researcher:*** *Can you think of any disadvantages, bad things about having to work together?*
>
> **Rose:** You have different point of views…
>
> **Melanie:** Like sometimes you will be writing something like Cherrie, well, she held the mouse down so I couldn't write anything... let me write… let me write… she really went on. But she had nearly writ (written) all of it and I was just going to do a cartoon and animation, and she had nearly done all of it.

> **Rose:** You see other people have point of views and have a different way of doing it... but you have to try to work it out.
>
> ***Researcher:*** *Do you find that an easy process Rose?*
>
> **Rose:** Not really... 'cos they will just keep going 'till they get what they want, some people.
>
> ***Researcher:*** *What do you do when that happens?*
>
> **Rose:** I usually just sit there until they get tired or something and then I have my go... or sometimes I might look at what they're doing and see if they make any mistakes.
> (Melanie & Rose, interview 2, 2003)

As can be seen by the above descriptions, student arrangements adopting variable practices could be somewhat dysfunctional. While these students did not necessarily demand *exclusive* access to the computer by utilising extreme strategies as detailed previously in relation to the five consistently non-collaborative individuals, they were generally not prepared to contribute intellectually to the work of each other either, in any way other than technically (Camtasia video clips, 2003; case notes, 2003). While this may be viewed as non-collaborative behaviour, it was qualitatively and quantitatively different to the group of five, and served to inhibit, rather than totally prevent, outcome development.

5.2.3 Students Working as Individuals

As mentioned earlier in this chapter, two students opted to work individually on the computers in completing their learning activities. Although from time to time others chose to work by themselves, these two consistently selected this arrangement unless instructed otherwise by Sarah. These individuals displayed some interesting strategies in approaching their learning tasks, and revealed a number of issues relevant to working alone in this environment. One of these students, Keri, was profoundly deaf in one ear and had 50% loss of hearing in the other, while the other, Wendy, chose to work alone, opting out from having to "rely on other people to get things done" (Wendy, interview, 2003). For these students, a one-on-one relationship with the computer appeared to establish a 'learning microworld' which to an extent was self-sustaining, and meant that they needed to have little to do with others around them. When asked why they chose to work in this way, Wendy commented:

> **Wendy:** I'm just used to working by myself...'cos they usually say – can I use the keyboard instead of you? – and they leave me nothing to do.
>
> ***Researcher:*** *So they take over?*
>
> **Wendy:** Yeah... I like to figure out things for myself.
>
> ***Researcher:*** *Are there any disadvantages you can think of in working by yourself? Is there anything you think you miss out on through working by yourself?*
>
> **Wendy:** I'm not sure really.
>
> ***Researcher:*** *You just like working by yourself?*
>
> **Wendy:** Yes... I'm just not used to working with other people. I... like... don't usually hang around with other people much...
> (Wendy, interview, 2003)

An interesting work characteristic that these students displayed was high levels of vocalisation addressed both to the computer, and in terms of 'thinking aloud' in relation to developing the content or strategies for completing tasks (Camtasia video clips, 2003; case notes, 2003). In some examples this dialogue lasted for several minutes, as the students vocalised progressively through the stages of their work, commenting on such aspects as whether they thought they were doing a good job, or what they needed to do next. For example:

> *Wendy had been creating a Maths pattern for a game by herself, but needed to refer back to a website on the school's intranet for further instructions... she 'talks' to the computer during this process.*
>
> **Wendy:** ...right... I need to go back on the internet... *(saves pattern to folder and closes Microsoft Works Drawing).*

Wendy: ...so it's called 'untitled' then eh... no *(changes name of file).*

Wendy: 'Internet'... come on... you're really slow today! *(waits...).*
(Wendy, Camtasia clip, 2003)

In another example, Keri was working on an Inspiration mind map, planning out concepts related to her selected 'Leisure' topic. She had arranged a number of concepts on-screen, and was manipulating their position and their links. As recorded by Camtasia:

Keri, recording into concept bubbles within Inspiration...

Keri: *(reading quietly to herself and computer)* ...what do you do in your spare time?... *(pause)*... what do you do when you go to school...? and what do you do to be good...? *(pause).* That arrow goes there... *(creating arrowed link)*... and this one goes over here... *(pause)*... now... what do you do if no one is home... where would you go...? *(moves bubble to new location).*
(Keri, Camtasia clip, 2003).

The use of verbalisation appeared to be a deliberate strategy by these students to clarify the content to be recorded, and the processes involved in organising and developing this on-screen. Through the use of this strategy, it seemed to provide these students with the type of reflective feedback that they may have received from peers. In relation to developing the content for her portfolio, in her interview Wendy commented that:

Wendy: ...I agreed with myself on what I was going to do for it... like if I should put pictures in it... and...

Researcher: *How do you mean – agree with yourself?*

Wendy: ...well, I thought like... maybe I should do something else... like I just pretend someone else is here and say... should I do that... or that? Like if I was with someone else... another person... trying to agree (on) something... like if there was a dog and a cat and I had to feed them, then I might say to myself... should I give the dog the chicken or should I give the cat the chicken...? I know... I will give them both chicken... it's like that when I'm working here by myself (in the e-classroom).
(Wendy, interview, 2003)

Although allowing students a reflective 'voice' in developing their outcomes, the effectiveness of this practice in terms of progressing student capability and learning within this environment was somewhat limited.

For students working individually, the capacity of the computers to provide an environment in which the necessity to interact with others could be minimised whilst still maintaining a level of momentum in their work, appeared to impact positively on their attitude to school and learning. However, many comments in this respect related to the capacity to use visual enhancements such as animation and other imaging, or the ability of the technology to make their work aesthetically pleasing. In the absence of external teacher or peer feedback, there was little doubt that for these students such aspects were of high importance, and contributed significantly to the sense of efficacy they gained through internal reflections on their efforts. For example:

> **Wendy:** ...I really like being in Room 1 (the e-classroom)...
>
> ***Researcher:*** *Why?*
>
> **Wendy:** 'cos of all the computers... and I like going on computers...
>
> ***Researcher:*** *Do you think you do better work on the computer?*
>
> **Wendy:** Yeah.
>
> ***Researcher:*** *How do you know that?*
>
> **Wendy:** 'cos it's much more interesting and... like you can't create things that move on paper... I work really well on computers.
> (Wendy, interview 1, 2003)

Despite the lack of input and any positive feedback from others, students working individually did not view the effort they put into their work as being diminished in any way. It was apparent that the motivation they had towards their tasks was high, and this did not appear to diminish over time (case notes, 2003; student interviews, 2003). Much of this motivation derived from an innate enjoyment of using the computers, and a belief that they were privileged within the school. Wendy commented that she "felt good"

(Wendy, interview, 2003) about being in Room 1. This was because in her observation, it was a classroom which many other students in the school aspired to get into, and it was for the more "brainy kids" (Wendy, interview, 2003).

The next section examines such notions further, by presenting and analysing data which indicates how the e-classroom environment impacted upon students' attitudes and motivation towards learning tasks, and influenced their perceptions of school generally.

5.3 Affective Elements of Student Work in the e-Classroom

This section presents and analyses data related to the manner in which the e-classroom environment influenced motivational and attitudinal aspects of student work. It examines the manner in which having access to high numbers of computers and undertaking virtually all learning tasks using them, influenced the students' perceptions of school, the work processes used in developing learning outcomes, and the quality of those outcomes.

As detailed in the literature review, the development of motivation and attitude towards learning tasks is a complex process, derived from unique 'blends' of cognitive, environmental, and social elements. It must therefore be acknowledged at this point, that the following analysis does not attempt to *quantify* the level of input the computers had into changing or developing attitudes to learning tasks. Rather, its purpose is to describe, in terms of the participants' perceptions, how they viewed computers as influencing their work practices. As in the previous section, data have been drawn from student interviews, case notes, and Camtasia video capture software.

5.3.1 The e-Classroom, Student Motivation, and Attitude Formation

With a few exceptions, the e-classroom environment was seen by students as making a positive contribution to their perception of school, but the reasons for this were diverse (student interviews, 2003). Approximately 25 students indicated that the presence of the computers and the fact that they were utilised for virtually all curriculum tasks, added to their enjoyment of school and made their work easier (student interviews, 2003). This perception appeared to be founded on the view that the computers took away some of the 'physical' nature of school work that the students found less appealing in the conventional classroom. Aspects such as handwriting, the need to make constant reference to paper-based materials such as dictionaries and encyclopaedias, and issues associated with difficulties in maintaining a consistent standard of accuracy and neatness, all featured prominently in this analysis (student interviews, 2003). When asked during the individual student interview to describe their feelings about being in the e-classroom, several students mentioned the computers as being a primary differentiating factor with regard to work satisfaction. For example:

***Researcher:** So how do you like being in Room 1 this year?*

Anton: It's fun because of all the computers.

Nick: Fun... it's fun to play on the computers.

***Researcher:** What do you mean, play?*

Nick: You get to draw stuff and all that.

Abby: I think it's cool... 'cos of all the computers... it's better than writing in your book!

Susan: I feel great because it's a cool class.

***Researcher:** Why is it so cool?*

Susan: 'Cos of all the computers.

Hinemoa: It's cool... you get to work on computers all the time...

***Researcher:** Why are the computers so cool?*

Hinemoa: 'cos I get frustrated all the time when I have to write with my hand.

Victoria: It's good... it's different to the other classes...

> ***Researcher:*** *How?*
>
> **Victoria:** ...it's got heaps of computers... I like working on the computers because they are fun to work on.
>
> **Dan:** It's exciting ...'cos there's heaps of computers and that...
>
> ***Researcher:*** *Why is that exciting?*
>
> **Dan:** ...because you don't have to handwrite... it makes it easier.
>
> **Paul:** It's fun and it's easier because of all the computers. You don't have to work so hard...
>
> ***Researcher:*** *What do you mean?*
>
> **Paul:** ...you don't get a sore hand from writing all the time. On the computer you just have to tap the key.
> (Student interview 1, 2003)

In addition to alleviating some of what might be termed the more 'laborious' physical and mental activity of traditional classroom work, students also commented on the range of tools that were built into the software and hardware, as helping them to gain greater satisfaction from their work tasks. Tools such as the spelling checker and the grammar checker were used extensively by all students. However, the benefit derived from their use differed considerably from group to group, often according to the level of conceptual or technical knowledge the particular students held. The wordprocessing software used in this class was configured to underline in red and green respectively, any spelling or grammatical errors or inconsistencies it detected. This provided the students with a visual cue or prompt which they could choose (or not) to respond to. Many students considered these features to be worthwhile and used them regularly in conjunction with peer feedback and checking, to ensure that their work was accurate. When asked to explain the process by which they used these tools, two students commented:

> **Melanie:** ...a little red line appears beneath a word which tells you the computer thinks you have spelt it wrong.
>
> **Rose:** Yeah. Then you go into the spelling checker.
>
> ***Researcher:*** *How do you use the spelling checker?*

Rose: Well, it's got this little button up the top that you click on… or you can use the mouse.

Melanie: …or you can press F7.

Rose: It's got a key on the keyboard saying F7… then it brings up the words one at a time… the words it thinks you've spelt wrong… and it's got a list of words there that the computer thinks you might mean instead of the one you've written… and then you just pick the right one.
(Melanie & Rose, interview 2, 2003)

An effective use of the spelling checker in this manner was captured using the Camtasia software as two students, Julie and Victoria, working collaboratively, were engaged in editing their multimedia portfolios. Victoria was entering data on her 'Contents' page in Powerpoint, while Julie was acting as the checker.

Julie: There's a line under 'succeses'.

Victoria: I know… I'll deal with it in a minute.

Julie: You've also spelt 'chalanges' wrong.

Victoria: OK !
Victoria moves mouse to 'succeses' and right clicks on it. Sub menu becomes visible, selects 'spelling'.

Julie: Success… successes… that's it!
Points – Victoria changes word and red line disappears.

Victoria: Right… now for 'chalanges'.
Victoria moves mouse to 'chalanges' and right clicks on it. Sub menu becomes visible, selects 'spelling'.

Victoria: 'Challenges'… *Victoria replaces word, red line disappears.*
(Julie & Victoria, Camtasia clip, 2003)

Tools such as the spelling and grammar checker were used extensively in this class, and were closely aligned with the view that they "help make your work easier and more enjoyable" (Anton, interview 1, 2003). However for other students the use of these tools was viewed as "cheating and making you lazy"

(Melanie & Rose, interview 2, 2003). They considered these tools did not assist them in learning to spell for themselves, but rather encouraged the taking of short cuts which lacked the level of intellectual rigour required of "real learning" (Sherilee & Susan, interview 2, 2003). Whilst these students appeared to understand the advantages afforded by the computer regarding the ease with which they were able to edit and change their work, they appeared to be caught somewhere between this view, and the view that such ease was not compatible with 'real learning'.

> ***Researcher:*** *When you are going to check your work, are there any things on the computer that help you do this?*
>
> **Susan:** Spell checker.
>
> ***Researcher:*** *So you use that... is it a good tool?*
>
> **Susan:** No...'cause you need to learn to spell it properly.
>
> ***Researcher:*** *You mean yourself?*
>
> **Susan and Sherilee:** Yeah!
>
> ***Researcher:*** *Do you think the spelling checker doesn't help you to learn how to spell?*
>
> **Susan:** It might a little bit but... if you use a word you don't know how to spell, you just choose a word in spell check... and you don't know if that's the right word or not.
> (Sherilee & Susan, interview 2, 2003)

These students also displayed a compatible view regarding how using the computers for their work somehow lessened the value of that work, in that it took less effort to produce something using the computer than it did to produce the same outcome by hand. With reference to a letter writing task, Sherilee commented:

> **Sherilee:** I think that we are cheating.
>
> ***Researcher:*** *What do you mean?*
>
> **Sherilee:** Well, not cheating in that sense of the word, but... like... they might think that she's too lazy to write with her own hand!

> ***Researcher:*** *Do you think that the computer makes you lazy?*
>
> **Sherilee and Susan:** Yes!
>
> **Susan:** You don't have to use your hand.
>
> **Sherilee:** I think I've got fatter since I've been in this class!
> (Sherilee & Susan, interview 2, 2003)

Five students who made comments such as these, indicated a change of attitude to using the computers for all their work, between the time of the first and the final interviews (approximately one school year). Although they still derived enjoyment from using the computers, by the time of the final interview they commented that they were looking forward to getting into a class where they would be able to use pen and paper again. These students considered that using the computers continuously got boring after a while, and that they needed variety in the mediums they used for their learning. Melanie suggested that this problem could be solved by halving the numbers of computers in the classroom, enabling only half the class to be working on the computers at one time.

> **Melanie:** I think the computer is fun, but I think it would be better if only... say half the class was on books, and the other half could use the computers, and then we could swap over.
> (Melanie & Rose, interview 2, 2003)

Other students commented that they felt the concentration on using computers had affected other capabilities, such as their ability to write neatly by hand. This impacted upon their perception of the quality of the work they produced in the e-classroom, and the level of satisfaction they gained from doing it. Marcia commented that by having to use the computer all the time she was not able to produce her best work, and therefore was not as satisfied with her outcomes as she could have been.

> **Marcia:** Sometimes I'm not OK with it (her work) 'cos I know that I could have done better if I had been using handwriting and stuff... so I think we should have a choice.
> (Marcia & Kath, interview 2, 2003)

There was also a perception amongst these students that they were different to other students in the school and in other schools in the area, and they did not perceive this as being an entirely positive thing. Simone commented that her friends from other schools always asked her what it was like to be using computers for all her work, to which she replied "that it's a good opportunity and all that, but I miss not being able to work in a book" (Simone & Hinemoa, interview 2, 2003). She went on to comment that one of the issues she felt in relation to this was the difficulty she experienced in being able to get feedback on how she was going, or on the quality of what she was producing. According to her, using a book to record her work allowed her to share it more readily with other people – for example, to take it home and show her parents or relatives. This feedback was important to her in reinforcing her efforts, and served as a permanent record of her progress (Simone & Hinemoa, interview 2, 2003). This she viewed as something that was not possible when all she had produced for the year was stored on a computer hard drive in another location. Whilst she acknowledged the role of the teacher in providing formative feedback as she was working, she felt it was also important to be able to 'celebrate' her achievements with others from outside the school, and gain feedback from a wider audience. In some way, she considered the electronic medium 'depersonalised' what she had developed.

> **Simone:** I think that if I had to choose between computers and writing in books, I would probably choose books, because it… it's actually your own work… you've got something to keep and show others what you've done.
> (Simone & Hinemoa, interview 2, 2003)

Student attitudes and motivation towards their work in the e-classroom also appeared to be linked to the level of technical skill they possessed in using the hardware and software required to complete a task. For example, students who had physical or technical limitations in using input devices such as the keyboard or mouse, viewed their work less favourably than those with some level of competence (case notes, 2003; student interview 2, 2003). To an extent, the system of task specialisation as described earlier and adopted by some students who worked collaboratively, served to exacerbate this problem. For these arrangements, whilst assisting in the development of a quality outcome, task specialisation did not allow students the opportunity to develop skills in areas in which they were deficient (case notes, 2003; Camtasia video clips, 2003). Some students felt frustration at not being able to master the technical aspects of software applications, or when the person with whom they were working simply did it for them as part of the task specialisation arrangement. The degree of scaffolded learning occurring in groups which adopted task specialisation was not as pronounced as like-groupings which did not adopt such strategies (Camtasia clips, 2003; case notes, 2003).

Other difficulties indicated by students related to issues associated with hand/eye coordination, in that they felt that often it was more difficult to 'get it right' on-screen using programs like 'Paint', than it was using conventional pen and paper medium (Simone & Hinemoa, interview 2, 2003; case notes, 2003). Others found the operation of some of the software constraining in terms of its idiosyncrasies, or limited what they were able to do. For example:

> **Simon:** I'm good at writing on the computer and not by hand, but I am better at drawing by hand than on the computer.
>
> **Zane:** I haven't got good mouse control… its my hand!
>
> **Simon:** Yeah… I don't like to use the mouse when I draw. I like to do it by hand… it's not the same.
>
> **Zane:** 'cos in Paint it's a bit annoying having to change everything all the time.
>
> **Simon:** Yeah, and when you do a mistake you have to do control-Z and do it all over again, and then you might do another mistake… on paper you just use the rubber.
>
> **Zane:** And sometimes there is a grid or something and it won't go away.
>
> **Simon:** Like you can't get into properties and change it on Works like on some other programs, like Inspiration.
>
> **Zane:** And it stops you doing what you want to do.
> (Simon & Zane, interview 2, 2003)

This frustration manifested itself by some of these students indicating a preference for working in their books. Simon commented that when a substitute or relief teacher was in the room she generally made them work in their books, which was welcomed.

> **Simon:** Sometimes I like to work in my books 'cos I work on the computer all the time, and I just want to work in my books for a change. And that's the good thing when Mrs Mac comes when Mrs. Wilson is away… because she doesn't really like the computers, and likes us working in our books mostly.
>
> **Zane:** Yeah… that's good because I am not very good at typing.
> (Simon & Zane, interview 2, 2003)

However despite these students' issues with using computers for learning tasks, all saw relevance in learning to use them. Many indicated an understanding of how the skills developed in the e-classroom would be useful to them when they went to Intermediate School, and in their future work. However, this perception was generally based on the importance of acquiring a technical-level understanding of the operation of the hardware and software. They viewed this as being important for the world of work, and they did not appear to hold a wider understanding of any benefits aligned to a more inclusive role for the computers (student interviews, 2003).

Two students commented that being in the e-classroom had enabled them to develop a level of knowledge that they were able to share with others. In one of these instances, Marcia had tutored her parents in particular skill aspects they were unfamiliar with. This provided her with high levels of satisfaction, and further reinforced her positive view of what and how she was learning in the e-classroom. For example:

> **Marcia:** It's really important at any age to learn about computers… 'cos when you're older you might get a job, and if you haven't used a computer before, you might not be good at your job so… but if you are good, the boss might put you up to the next level and you might become a genius with computers or something… I know more than my Mum, and she went on a computer course!

> ***Researcher:*** *How do you feel about that?*
>
> **Marcia:** Cool… she learnt nothing on the course, and I sit down sometimes and teach her things… it's good being able to do that.
> (Marcia, interview 1, 2003)

However, three students indicated that they felt the time they had spent in the e-classroom, in this case two years as they were year six students, needed to be 'made up' in terms of the type of work that "normal kids" (Simon & Zane, interview 2, 2003) would have been doing in a conventional classroom. Zane discussed how he had to spend some of his time at home keeping up to date with things like spelling and basic facts (times tables). He was concerned that when he got to Intermediate School (years 7 and 8), he would be behind the others in his class in what he had learnt in 'traditional' curriculum areas. While he considered his time in the e-classroom to have been valuable, he also felt there needed to be a balance maintained between using the computers for learning, and learning more conventional content by more conventional means.

> **Zane:** It's good because if I hadn't have been in this class, then I wouldn't have been able to learn how to do things on my computer… but we've missed a couple of years of actually having experience… 'cos if we want to have say our basic facts or anything, then we have to do it in our own spare time.
>
> ***Researcher:*** *Does that worry you?*
>
> **Zane:** Yes… we miss out on a couple of years of working on paper… we will be working on paper when we get to Intermediate and I won't know all the stuff.
> (Simon & Zane, interview 2, 2003)

As introduced earlier, one of the most powerful factors influencing student motivation and attitude in this e-classroom was the nature of the software being used (case notes, 2003; student interviews, 2003). Specifically, this related to the features that the various software packages had, and how they acted in providing visual and aesthetic enhancements to student work. Almost three-quarters of the students in this classroom indicated that one of the significant benefits of using computers for their learning tasks, was that they enabled the production of outcomes which were tidy and attractive (student interviews, 2003). This factor appeared to be aligned with the perception that computers allowed students who may have had deficits in handwriting or general neatness of presentation, to produce work which was of the same standard, at least aesthetically, as all the others in the room. For these students, there was little doubt that this factor greatly benefited their self-efficacy.

When they made mistakes in their work, the process of editing or erasing the mistake did not mean any decrease in the neatness or appearance of the final outcome, unlike was the case when they used pen and paper. As Simone commented:

> **Simone:** ...like when you make a mistake on the computer you can just go control-Z or use the delete key and it will go away... you can do it again and it doesn't affect what your work looks like. But in your books you have to rub it out.
>
> **Hinemoa:** ...or cross it out which is... um... it makes your book look untidy... the computer doesn't smudge it or anything.
> (Simone & Hinemoa, interview 2, 2003)

The computer's ability to enhance work aesthetics appeared to make a positive impact on student work satisfaction, which in turn 'fed back' into the effort they put into their work. Wendy commented that by always producing outcomes which were uniform and attractive, the computer allowed her to concentrate on the ideas she wanted to get across. For example:

> **Wendy:** ...it looks better (her work) and it's tidier, much tidier... and I don't need to look at the keyboard either. I look at the screen. I don't have to work out what the letters are to write words on the screen, so I can concentrate more on what I am writing.
> (Wendy, interview, 2003)

While some students commented on the advantages of being able to more readily edit and change their work and how this motivated them to take additional risks and try new things, other students admitted that some features of software could act as 'diversions' from the tasks they had been given (student interviews, 2003). Virtually all students showed a preference and motivation towards software which held the capacity to provide interaction, both during the outcome development process, and at an end-user level (student interviews, 2003, Camtasia video clips, 2003). Software such as Microsoft Powerpoint and to a lesser extent, Microsoft Publisher, were two packages which rated highly in these respects. Student preference for these two programs typically related to their capacity to incorporate, amongst other things, wordart, animations and hyperlinks, which the students found highly appealing. While there was a policy in the classroom that no work should incorporate clipart (case notes, 2003; Sarah, interview, 2003), the students were able to include animations and hyperlinks where they were "viewed as contributing to the quality of the overall outcome" (Sarah, interview, 2003). Data relating to the use of such software features within this class, and its impact upon student work practices, will be presented and analysed later in this chapter.

5.4 Cognitive Elements of Student Work in the e-Classroom

This section presents and analyses data related to how students approached and engaged cognitively with their learning tasks in the e-classroom. As was the case in the previous section, it was not possible to categorically *quantify* the contribution which the component labelled as 'cognitive' made within any learning episode. As previously described, student activity formed from an interaction of cognitive, affective and social factors, which varied for each individual, and between events. However, this research has identified that these students did display different cognitive strategies when completing their computer-based learning tasks, and applied critical, creative and reflective thinking skills to greater or lesser effect in undertaking them. This section presents and analyses data related to these strategies, and their impact upon student performance.

5.4.1 Cognitive Strategies Applied to Learning Tasks

Cognitive strategies, in terms of the manner in which students approached problems within learning tasks, varied considerably within this class. They were closely aligned with the make-up of working groups as identified earlier, and to an extent, the design and features of the software in supporting a range of different cognitive approaches (case notes, 2003; Camtasia video clips, 2003). For some students, usually but not exclusively those in non-collaborative or variable working arrangements, when faced with a situation or a problem within a work task or a particular program, the primary strategy was to ask for immediate teacher assistance, and not to proceed until this assistance had been received (case notes, 2003; Camtasia clips, 2003). This strategy often meant lengthy delays in progressing their work, as the availability of the teacher in this environment was at a premium, and the time between requesting and gaining assistance was often protracted. Due to these students existing mainly on the 'periphery' of the established social structure of the class, the network of peer tutors which was available to students working in consistently collaborative arrangements, was not always accessible to provide support (case notes, 2003).

According to Sarah, the reliance of some students on teacher input and guidance as the only problem-solving strategy had possibly been established much earlier on in their school careers. She claimed that for these individuals, the transition to an environment in which they were encouraged to solve their own problems had proven to be difficult (Sarah, interview, 2003). This she labeled as "teacher dependence" (case notes, 2003), and she speculated that this situation would probably have been the same, regardless of the learning environment in which these students found themselves. She commented that:

> **Sarah:** …for some of these kids, I think that's just the way they are. They have become sort of conditioned to asking for help and I don't think this environment is going to change that.
> (Sarah, interview, 2003).

For other students, generally those adopting consistently collaborative practices, while the teacher was viewed as a resource for assisting them to develop solutions to their learning problems, she was not seen as either the primary, or even the initial source of support. These students usually solved problems through a process of peer debate and experimentation, or through the negotiation and progressive application of a range of different strategies, until a workable solution was found (Camtasia clips, 2003). Their ability to 'bounce' ideas off one another, and their willingness to explore the software often through a process of reflective trial and error, meant that they were able to progress their work at a quicker rate than other students, and learn from each other in the process.

It was apparent in this respect the manner in which the use of software helped facilitate the problem-solving strategies of these students. The computer acted as a 'cognitive partner' in allowing them to 'play' with their thinking and ideas, as they sought to refine their understandings (Camtasia video clips, 2003). Its capacity to readily and conveniently support ongoing modification and changes to inputs, and encourage the testing of ideas and the manipulation of data, would not have been possible in any other way.

In the following illustration of this process, two students, Hinemoa and Simone, working collaboratively, were undertaking a Mathematics task developing a number line using Microsoft Publisher. They had been asked by the teacher to plot out on the number line from 0 to 1, a range of decimal fractions such as 0.07, 0.5, .025, 0.9, .05 (etc.) locating them in their appropriate positions. This data, captured using Camtasia and documented with case notes, provides a good example of the socio-cognitive strategies these students applied when approaching learning problems. Hinemoa had logged in and opened a blank Publisher document, and had drawn a single horizontal line on screen, with an upstand at each end.

> **Hinemoa:** OK... *(draws small text box at left end of number line)*... so what's that number... it's...

Simone: Zero

Hinemoa: Is it 0.0? *(enters 0.0 at far left of number line... moves mouse and draws text box at far right of number line)...* and what's that one... is it 1.0? *(enters 1.0 in text box).*

Simone: Yes... so we have 0.0 and 1.0...

Hinemoa: ...and now we have to do half way... *(moves mouse to half way along number line, draws another upstand and text box).* What goes in here?

Simone: 0.5... here, I'll write it... *(writes 0.5 in text box, then proceeds to draw and position four additional upstands equidistant between 0.0 and 0.5).*
Right... 0.15... we'll just put them down here in a box first.

Hinemoa: A graph box? *(spreadsheet – draws spreadsheet box).* How many cells? *(counts 1,2,3,4,5,6)* so 6 by 6... not sure if that's right... what d'ya think?

Simone: No... just do one of these normal boxes *(indicates text box).*

Hinemoa: So what's that one... that's 0.8.

Simone: No, the first one's 0.07.

Hinemoa: Isn't that after here? *(indicating with mouse to the right of 0.5)...* see it says 0.5... so here must be 0.7... *(indicating point past 0.5 – drags text box to correct position for 0.7).*

Simone: No, just put them all in their own boxes and we can arrange them all later *(Hinemoa moves text box back to left position).* Anyway, it's 0.07, not 0.7.

Hinemoa: What d'ya mean?

Simone: Zero point zero seven *(types into text box).* See, put them in their own boxes so they're easy to move later on... 0.13, see, not 0.013... *(types 0.13 into new text box... proceeds to do the same for others 0.14, 0.08, 0.15, 0.22).*

Hinemoa: Right now... let's see, so the seven one, this one *(moves 0.07 to incorrect position to right of 0.5)* goes here... *(ditto for 0.08, 0.13, 0.15 etc)...* we've also got to fit in 0.22 as well... *(indicates to far right of line).*

Simone: Hey, that can't be right... how can 0.22 be bigger than 0.5?

Hinemoa: What'ya mean?

Simone: Well, look... here's .5 *(moves mouse to middle of number line next to 0.5)* so how can 0.22 be bigger?

Hinemoa: Umm...

Simone: I reckon it should go here... *(moves text box with 0.22 into approximately correct position, to the left of 0.5).*

Hinemoa: So where do the other ones go?

Simone: Well, I think 0.13 will go about here... *(slides text box with 0.13 to approximately correct position)* and 0.07 will go about here... *(slides text box with 0.07 to far left of number line).* See... it's (0.07) littler than 0.13...'cos of the other zero!

Hinemoa: OK... I get it... so 0.08 will go about here *(slides 0.08 into approximately correct position, just to the right of 0.07)* and 0.14 will go about here *(slides 0.14 into approximately correct position).*
(Simone & Hinemoa, Camtasia clip, 2003; case notes, 2003)

This example provides a good illustration of how computers, when embedded within collaborative student practice, can act in supporting the development of knowledge, by providing a flexible and 'risk-free' medium in which to trial ideas and refine understandings. Although not able to be illustrated in text, the discussion which occurred throughout this process was highly animated, and involved a great deal of 'screen-pointing' and passionate explanation, as Simone scaffolded the development of Hinemoa's knowledge of decimals (case notes, 2003). The computer effectively complemented this process, by providing an interactive and malleable platform through which Simone visually demonstrated to Hinemoa her knowledge in this area. Although the computer did not actually 'provide' the knowledge as such, it did operate very effectively by enabling Simone to share hers.

5.4.2 Accessing and Using Technical and Procedural Knowledge

Whilst identifying the capacity of students working collaboratively to collectively develop solutions to a range of learning problems, it must be acknowledged that these students generally appeared to possess a well-developed base of subject-related or technical knowledge upon which to draw (Camtasia clips, 2003; case notes, 2003). This greatly enhanced the accuracy of their work, and their capacity to utilise the features of software appropriately in optimising their digitally-produced outcomes. This is illustrated by two students, Simon and Zane, who consistently engaged in collaborative work practices, in relation to the use of hyperlinking. They commented that the capacity to hyperlink was particularly useful in the development of their multimedia portfolios, when they wanted to be able to 'bring in' samples of work from other applications, without the need to navigate via the Windows file management system.

> ***Researcher:*** *What's a hyperlink?*
>
> **Simon:** It's when you can click on one word or an object, and it goes to a completely different thing...
>
> **Zane:** ...like in his portfolio he (Simon) made one – and when you clicked on it, it went to one of his pictures...
>
> ***Researcher:*** *Do you find hyperlinking useful?*
>
> **Simon:** Yes...'cos if you... say... have got better on Paint or Inspiration... then my Dad might say, "why have you?"... then you have to go Start... Programs... get the program, and then My Documents... my folder... and then it will take a while to load as well... but if you do hyperlinks, then you can just click on it... and it goes straight there.
> (Simon & Zane, interview 2, 2003)

In another example a group of students, Victoria, Julie, and Sally, functioning collaboratively, were recorded working on a multimedia presentation fact file related to their topic of 'Mammals'. They identified and discussed how the animation feature of Microsoft Powerpoint could be used to draw the viewer's attention towards particular aspects of their presentation, in this instance, the 'Interesting Facts about Dolphins' slide. They had identified that by using the 'add effect' feature of the software, they could itemise each fact and introduce them separately. If the effect they selected was appropriately chosen, then it could add impact to their presentation, not only in terms of getting their message across, but also by allowing the viewer reading it to do so at their own pace.

> **Victoria:** …if we use custom animation, I think it is... *(moves mouse to slideshow... custom animation...)* then we can highlight our words.
>
> **Sally:** Yeah… that's cool!
>
> **Victoria**: Add effect… what effect do we want?
> *Victoria selects text box on slide to be animated, and then 'entrance – fly-in' from 'add effect' box. Tries it.*
>
> **Sally:** It's OK, but I like 'spinner'… *(tries 'spinner')*... Nah… it takes too long to come in and I get giddy! Use the other one… how long are we going to leave it there?
>
> **Victoria:** Yeah… we want it to stay there long enough for the people to read it, eh!
> (Victoria, Julie, & Sally, Camtasia clip, 2003)

When developing knowledge and skills such as those identified previously, some students working within the well-defined social structure and functioning within collaborative arrangements, appeared to have more ready access to a 'knowledge hierarchy' which existed in the classroom (case notes, 2003). These students utilised the collective capacities of a known network of peer tutors when they encountered situations requiring new knowledge. If they were unsure of something, or were seeking advice on how to use the features of the software, they were easily able to 'tap into' the advice and guidance of their more knowledgeable peers, when and where required (case notes, 2003). As a result, these individuals very rarely approached the teacher for assistance, and usually only after all other avenues for solving the problem had been explored (case notes, 2003).

A general cognitive characteristic of all students in this class was their high level of technical understanding relating to the operation of the hardware and software (case notes, 2003; Camtasia video clips, 2003). This displayed itself in well-developed capabilities at being able to transfer knowledge about the technical operation of programs from one application to another. This capacity was undoubtedly supported by the uniform manner in which Microsoft applications are designed, and the fact that the school ran a limited range of programs. Regardless of this, by using processes of exploration, many students were able to work out for themselves a desired result, simply by applying understandings of 'what should be possible' from knowledge of other applications, or from what other students had done (case notes, 2003). This capability was not restricted only to the technical functions of various menu options. It also applied to more complex aspects such as conceptual transfer relating to the use of, for example – hyperlinks, between programs such as Inspiration, Powerpoint, and Publisher (case notes, 2003, Camtasia video clips, 2003).

5.4.3 The Importance of Knowledge in the e-Classroom

While some students working in a collaborative manner displayed organised and relatively effective strategies in approaching their learning problems, this was by no means the case for all students (case notes, 2003; Camtasia video clips, 2003). As introduced in the previous section, the effectiveness of the strategies adopted by students was very closely related to their level of subject-based conceptual knowledge, their understanding technically and procedurally of how software operated, and how the features of programs could be used to extend and enhance outcomes. For students who had such understandings 'in the bank', or were able to negotiate understanding with a capable peer such as was the case for some students working collaboratively, progress in many instances was rapid, with some very high quality outcomes being produced. However, for other students who did not possess such understandings, or were unable to access the knowledge of others – such as those outside of the established 'social hierarchy', the situation was very different. Within this class, approximately 11 or 12 students fell into this categorisation (case notes, 2003).

When encountering a learning problem, this group of students, in the absence of teacher or more-capable peer intervention, appeared to 'circle on the spot'. This usually took the form of engaging in on-screen activity which, although giving the appearance of work, was not contributing to the overall attainment of learning goals (case notes, 2003; Camtasia clips, 2003). These students were unable to secure the relevant knowledge or understandings to enable them to progress, and the computer-based learning medium did not provide them with this. As a result, many of these students tended to work within their known limits, and when they came across an issue or problem outside of the known, they reverted back to the point of 'last known comfort' (Camtasia clips, 2003, case notes, 2003). From there they either changed the nature or direction of their work to accommodate the problem, or, in some instances, closed the program and started again. That is, instead of trying to address the problem or issue, they would develop a 'work around' strategy which took the issue into account, without actually dealing with it. This usually resulted in an outcome, if one was achieved, which bore little resemblance to what was planned or anticipated, as the nature of the outcome needed to be considerably altered to accommodate the problem.

Several examples of this strategy were witnessed in this classroom across a range of different applications. In the first of these examples recorded using the Camtasia screen capture software, a student, Justis, working individually, had been set a Mathematics task by Sarah to create a Logo turtle procedure that would allow him to write his name on screen. He had spent 25 minutes manually moving the turtle around the screen using the basic fd/bk (x) and lt/rt (x) commands in the command line, and had completed the J and U letters of his name (Figure 5.3).

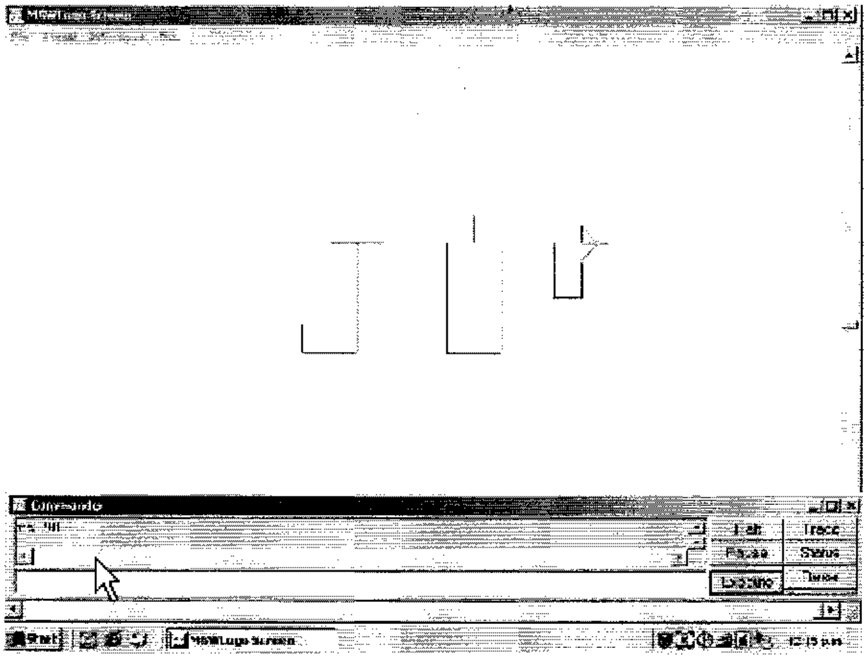


Figure 5.3: Justis – Initial Letter Completion

Justis was in the process of creating the next letter in his name, 'S', when as can be seen in Figure 5.3, he made a mistake by turning the turtle in the wrong direction and creating an unneeded line. At this point he paused for nearly four minutes before making this comment (initially) to himself:

> **Justis:** ...I just needed to do there and there... *(pointing mouse where he should have drawn. Teacher arrives.)*
>
> **Sarah:** ...so you are going to do your 'S' now?
>
> **Justis:** No, I'm going to back up first and do it again.
>
> **Sarah:** OK. So you want to cover the whole thing... good thinking Justis... *(teacher leaves).*
> (Justis, Camtasia clip, 2003)

At this point Justis once again paused before entering the PD (pen down) command, set the colour of the pen to white, and then proceeded to retrack over the incorrect pathway he had created, drawing white lines over the black lines as he went (Figure 5.4).

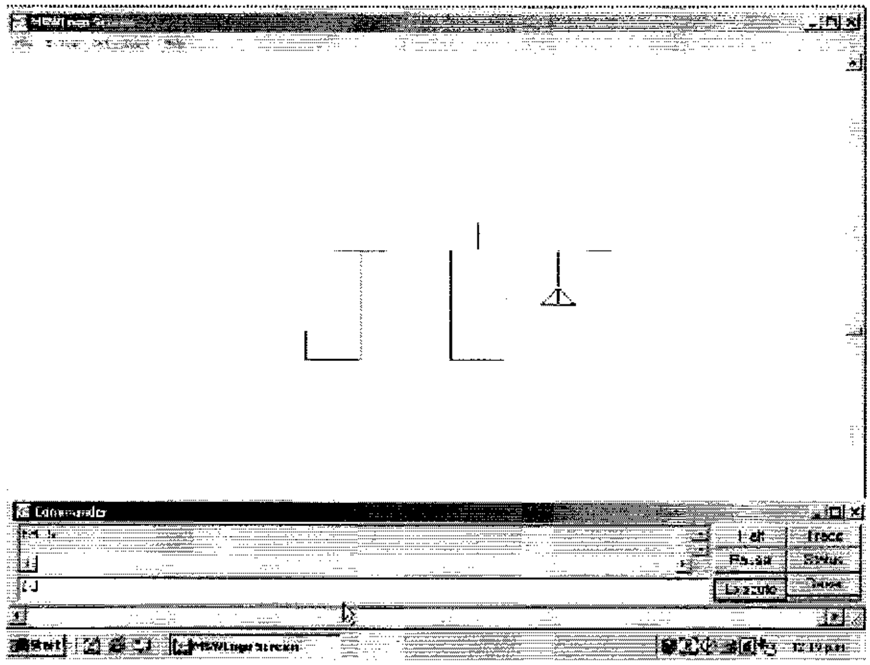


Figure 5.4: Justis 'Erases' Incorrect Pathway Using White Pen Colour

He had nearly completed this process when he made another mistake with the distance he was supposed to have rotated the turtle to enable him to completely erase the final line. He had entered RT50 instead of RT90, which meant that the turtle was pointing off in the wrong direction (Figure 5.5).

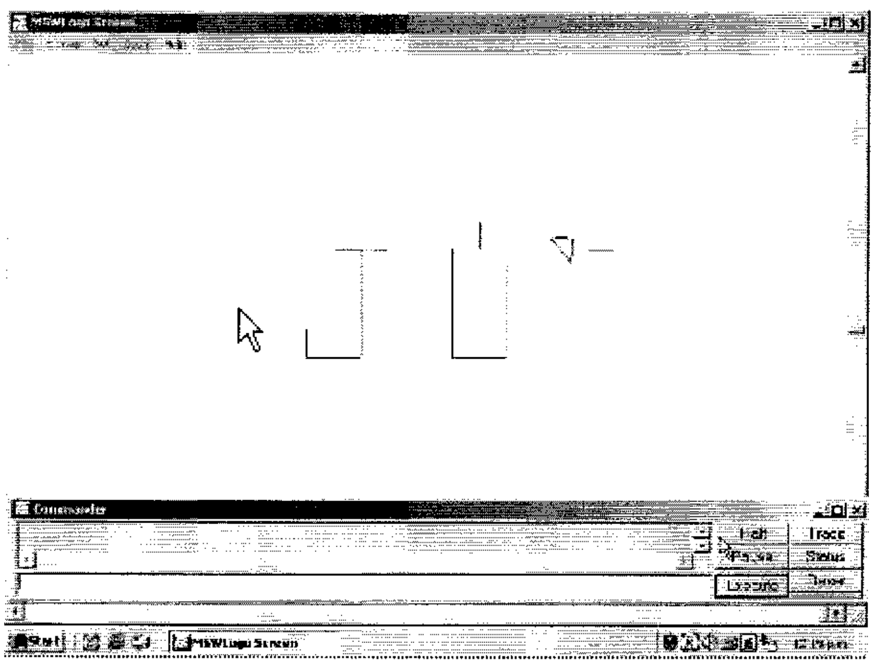


Figure 5.5: Justis Rotates Turtle Incorrectly for Final Erase Segment

He then made these comments to himself about his mistake.

> **Justis:** Damn… didn't go far enough… needed to be more than that, eh… I need to go back 50.
> (Justis, Camtasia clip, 2003)

At this point he entered BK50 into the command line, which then sent the turtle shooting off backwards in the wrong direction (Figure 5.6).

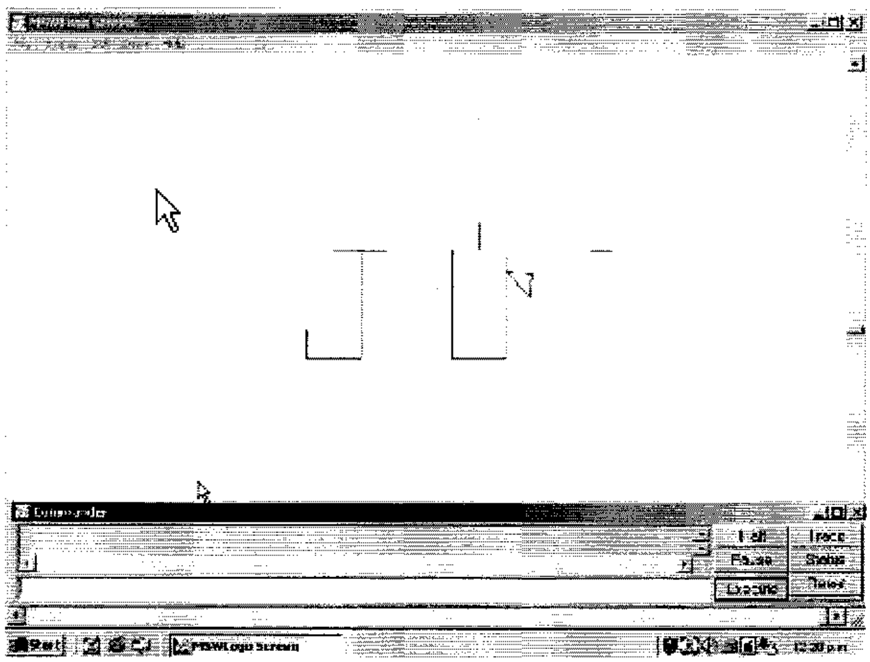


Figure 5.6: Turtle Shoots Backwards to Incorrect Position

Justis then compensated for this error by using an FD50 command to bring the turtle back to its original position (Figure 5.7).

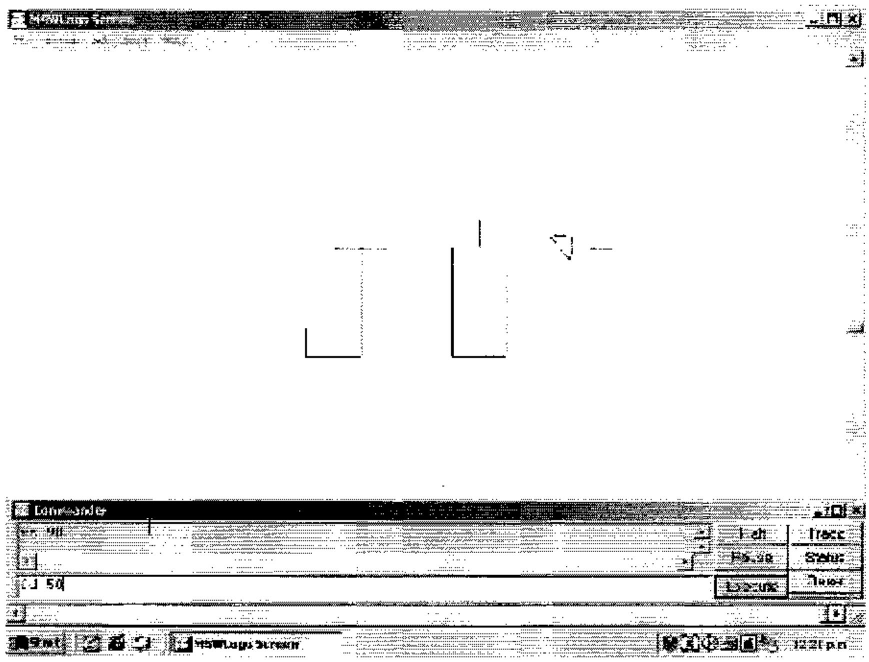


Figure 5.7: Justis Compensates for Error by Entering FD50 Command

By this time the session was drawing to a close, and Justis appeared to have run out of strategies which would allow him to create the next stage of this project. He commented to himself… "this is too bloody hard… I'll do something else next time" (Justis, Camtasia clip, 2003) and proceeded to close the program without saving his work.

This example is interesting in that it shows how Justis was limited by both his Mathematical knowledge and his procedural knowledge of the operation of the software. Whilst his strategy of using a change of pen colour and retracking over the lines he had made in error was undoubtedly creative, it was time consuming and proved to be inaccurate. The end result contributed to him reaching a point where he could no longer see a way of achieving his goal. Secondly, he lacked the Mathematics knowledge to enable him to work out the difference between the position of the turtle in Figure 5.5, and where he needed it to face, that is, an additional 40 degrees to the right. If he had been able to work this out, he would possibly have avoided the string of subsequent mistakes that eventually led him to abandon the project.

Although mid-way through this example there was a level of teacher intervention, the nature of this intervention did not appear to support any of

Justis's efforts to develop a solution to his problem. In fact, it tended to reinforce his idea of 'clearing' his project (Camtasia video clip, 2003).

In a second Mathematics example, two students, Bondi and Paul, had been set a problem of developing a Logo procedure for creating a series of heptagons, which were then to be filled with a variety of different colours. This pair, although working collaboratively in developing the strategies used to determine inputs, did not possess sufficient understanding in terms of geometric knowledge to enable them to successfully complete the problem solving task. Their response to this was not to seek help or access knowledge to enable successful completion, but to alter their outcome to accommodate their knowledge limitations (Bondi & Paul, Camtasia video clip, 2003).

The first two minutes of this example were spent by Bondi and Paul arranging the screen to suit, with the commander and the procedure areas being resized accordingly. For the next three minutes, the students appeared to 'warm up' by creating a range of different shapes on screen, erasing them, and then creating others (Figure 5.8). During this time, there was ongoing dialogue between the two as to the size of the heptagons that were to be produced, and the colours they were to be filled with.

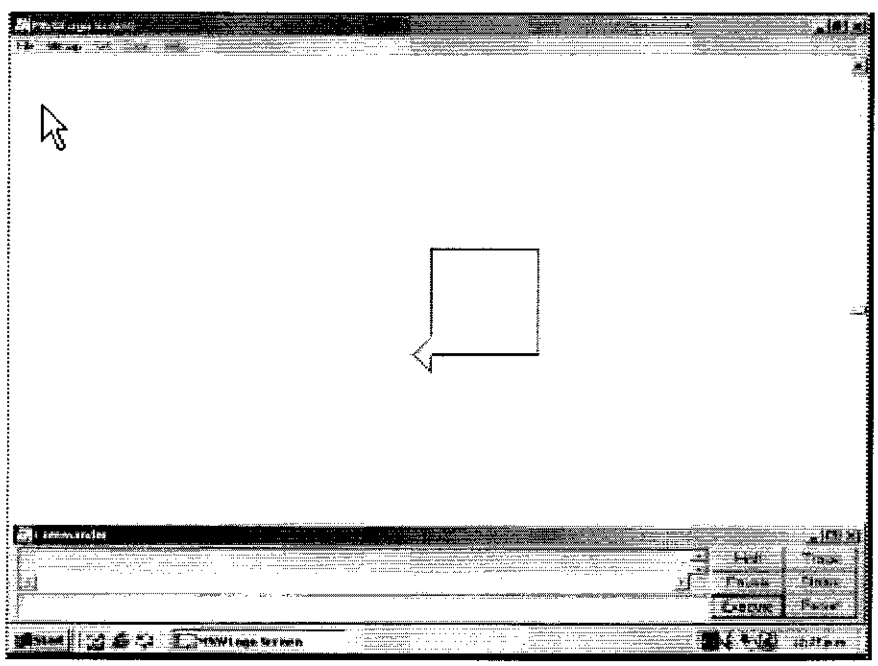


Figure 5.8: Bondi and Paul Appeared to 'Warm up' by Creating Unrelated Shapes

At the end of this stage, the screen was cleared and a repeat procedure was written to form the first heptagon, using a formula gained from a folder of procedures the teacher had created. The turtle was then rotated and the procedure repeated to form the second heptagon (Figure 5.9).

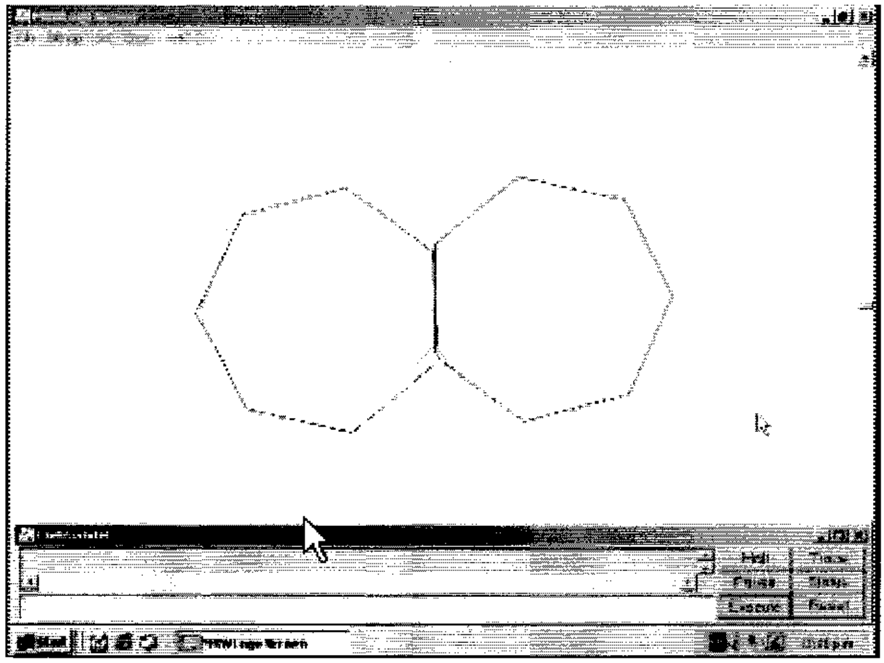


Figure 5.9: Bondi and Paul Develop a Single Procedure, then Rotate Turtle to Form Second Heptagon

At this point, there was considerable discussion between the students as to what the next step should be to enable the drafting of the third heptagon beneath the previous two.

Paul: ...try lt50.
Bondi enters lt50.

Paul: Nah... you have to make it get in line with that *(indicating base of second heptagon)* so you can get it down.
Bondi enters lt70 to bring turtle to base line (Figure 5.10).

Paul: ...now go fd100... but put the pen up first.

Bondi: What?

Paul: PU – pen up!
Bondi enters PU followed by fd100. Turtle moves forward but goes off line (Figure 5.11)

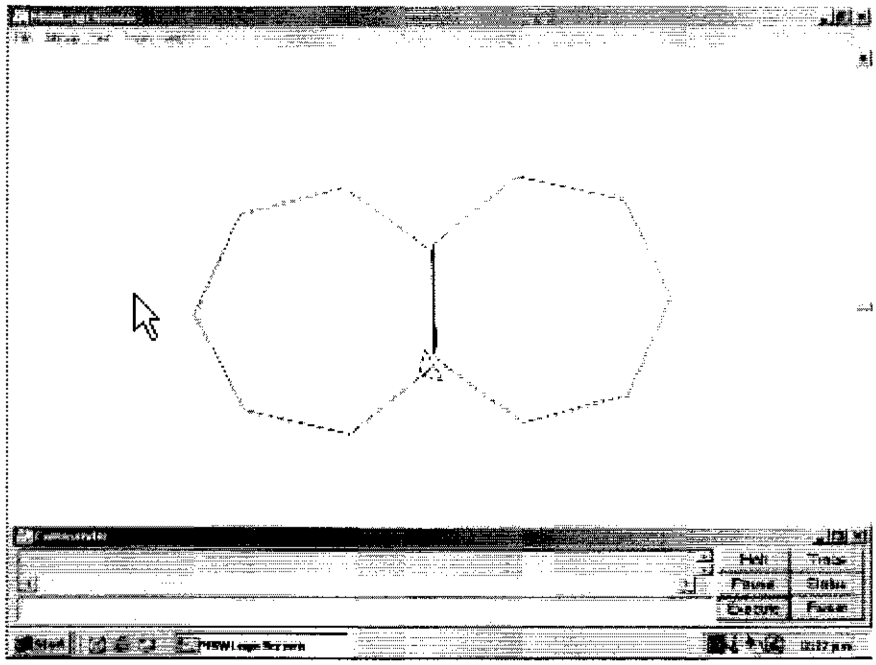


Figure 5.10: Bondi Enters lt70 to Bring Turtle to Baseline of Second Heptagon

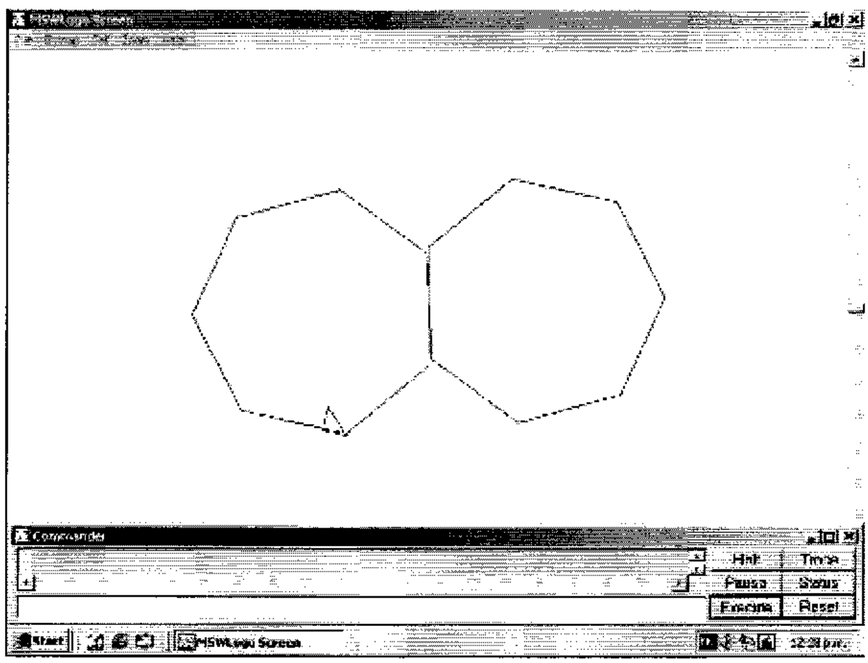


Figure 5.11: Turtle Moves Along and Off Base Line

Paul: It's gone off the line! *(pauses).*

Bondi: Yeah, what d'ya think we should do about it?

Paul: Dunno… *(pauses)* too much hassle trying to fix it… use CS
Bondi enters CS in commander and screen clears (Figure 5.12)

Bondi: I know, let's make a hexagon!

Paul: Yeah, that'll be easier!
(Paul & Bondi, Camtasia clip, 2003)

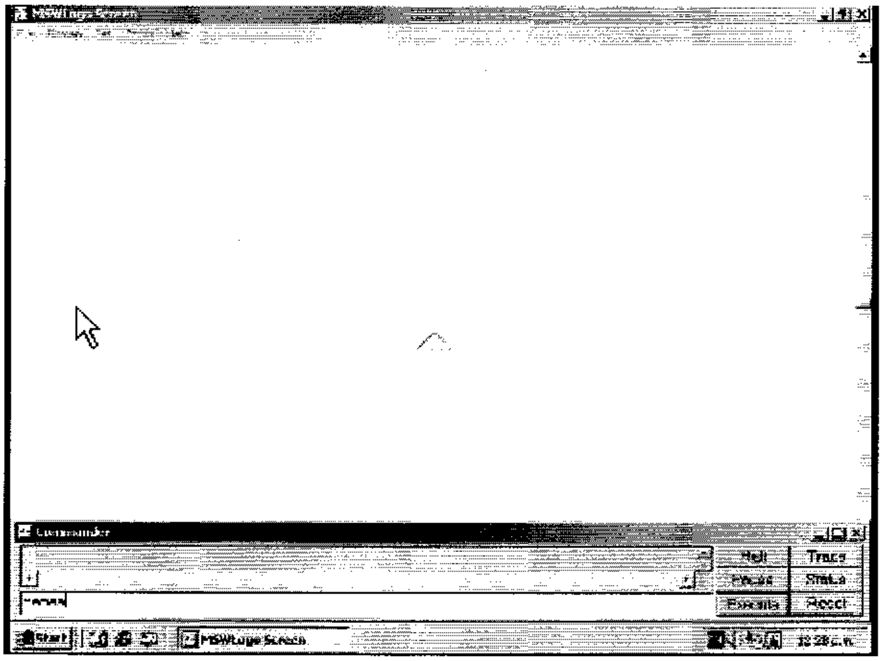


Figure 5.12: Bondi Clears Screen After Error Judged Too Difficult to Rectify

What is particularly relevant in this example, is that although these students were working collaboratively, they made no attempt to negotiate or debate a possible 'way out' of their problem. Nor did they seek advice from either the teacher or other students as to possible strategies they may adopt in solving it. The preference in many cases to close down the application or file, or clear screens and start again, held major implications with regard to the rate at which these students progressed. In some instances, it was possible for them to work for a complete session without actually achieving anything in terms of learning goals, having spent most of the time making multiple changes to an original, or restarting again from scratch (Camtasia video clips, 2003; case notes, 2003).

In another illustration, the reluctance of students to engage cognitively with a task was witnessed in an example where a student, Wendy, working individually, was designing and creating a Mathematics activity game as part of her 'Maths Week' programme. She had chosen to make a chequerboard design that could be used for a multiplication game she had seen on a

Mathematics games website, which had been cached on the school intranet. She decided to use Microsoft Paint to create her pattern on-screen, and then print this to paper and laminate it onto cardboard. The first seven minutes of this task Wendy spent 'playing' with the art tool palette of the Paint, drawing a range of different shapes, filling in the screen with different colours, and experimenting with brush widths and patterns (Figure 5.13).

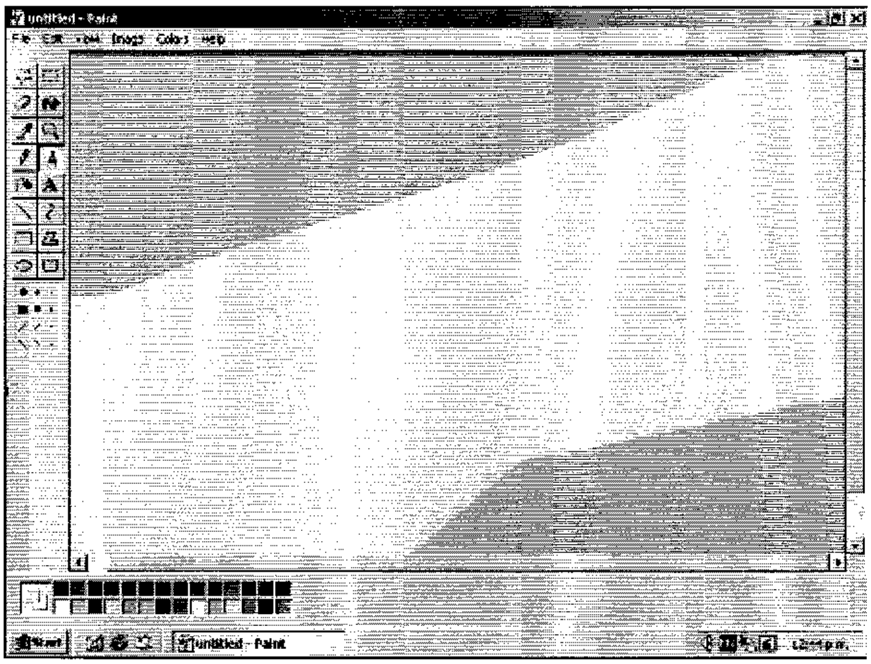


Figure 5.13: The First Seven Minutes Wendy Engaged in Experimenting with Brushes and Fills

After this experimental phase had been completed, Wendy cleared the screen back to a blank page, selected a standard purple colour from the palette, and proceeded to draw a series of squares to create a basic chequerboard pattern. She did this by a process of creating one square, and then copying, pasting, and positioning multiples of this on her blank board (Figure 5.14).

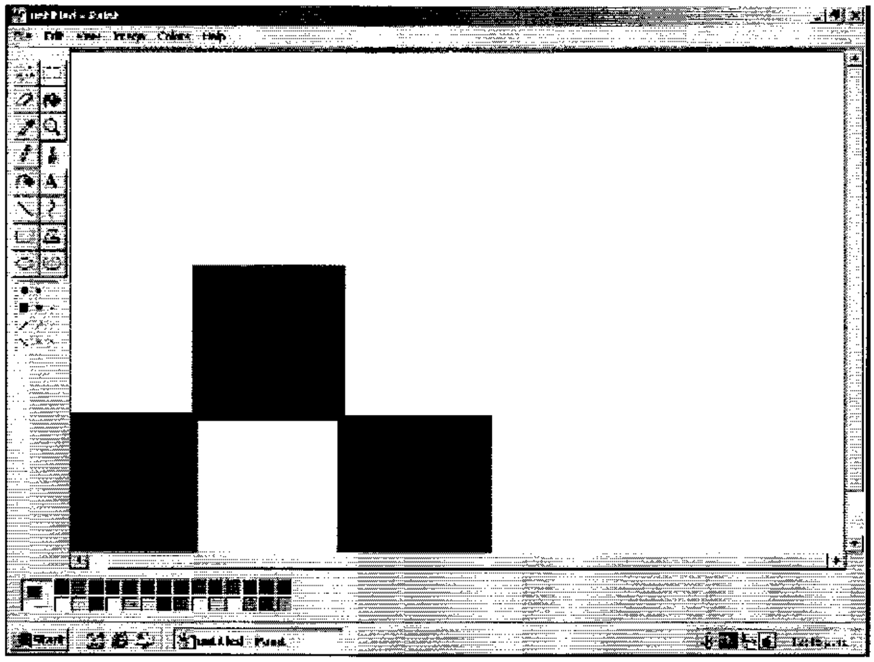


Figure 5.14: Wendy Created a Blank Board and Copied and Pasted Squares for her Chequerboard

She then proceeded to fill in the white squares with turquoise filler (Figure 5.15). However, when she had progressed this operation to the point of including about half the squares, she accidentally pasted squares incorrectly which caused the pattern to begin to disappear (Figure 5.16).

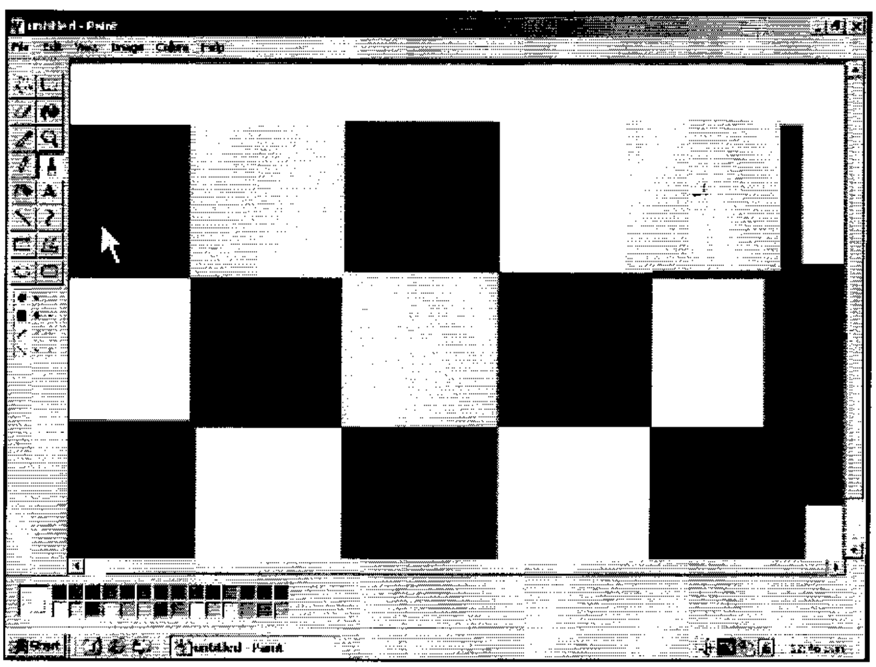


Figure 5.15: Wendy Begins to Fill the White Squares with Turquoise

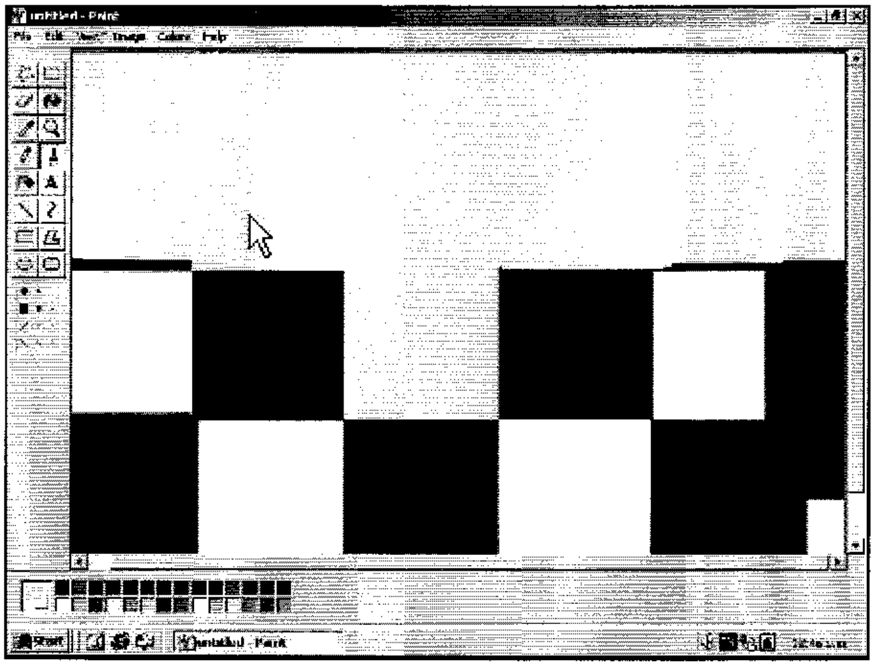


Figure 5.16: A Mistake Causes the Pattern to Disappear

At this point, Wendy called out "oh no… what's happened?" (Wendy, Camtasia clip, 2003) and she stopped working (case notes, 2003). After a few seconds pause, the following dialogue was recorded as she reflected to herself what her next step was going to be.

> **Wendy:** I don't know what happened then… *(pause)*. I know, I'll do a Scatterboard instead!
> (Wendy, Camtasia clip, 2003)

At this point Wendy minimised the Paint application, and re-entered the intranet to read the instructions for a 'Scatterboard' game she had seen there, when selecting her original project (case notes, 2003). She proceeded to read the instructions, close the internet browser, and restore her screen in Paint. She then selected the paint can from the art palette and flooded the rest of the screen with turquoise, before she changed to the spray tool and started to make her scatterboard frame over the top of the turquoise background (Figure 5.17).

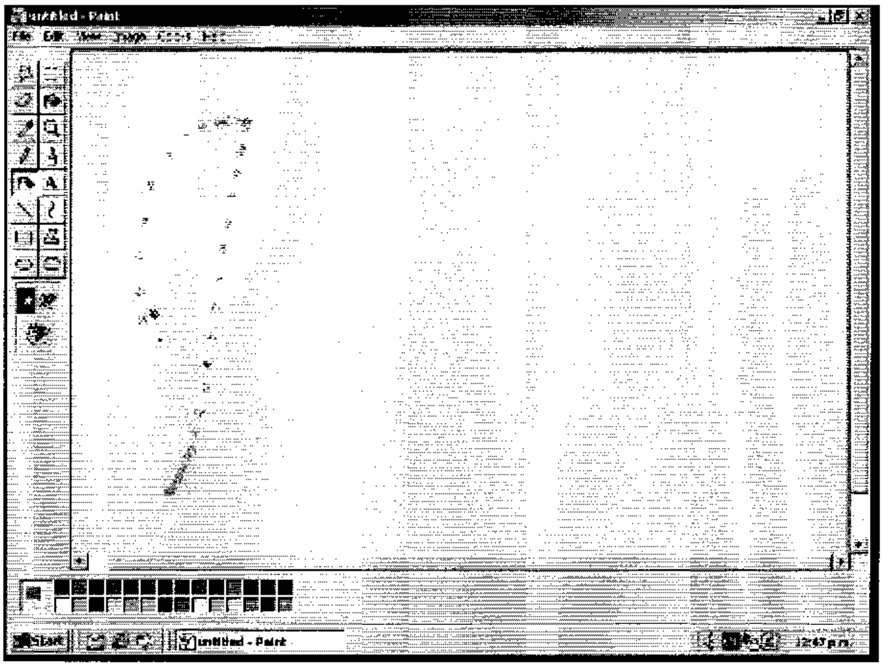


Figure 5.17: Wendy Commenced Work on the Scatterboard Frame, after Abandoning her Chequerboard

Although this strategy tended to be used more by students who were unable or unwilling to get assistance, such as those working individually or in variably-collaborative situations, it was witnessed being applied by other students as well (Camtasia video clips, 2003; case notes, 2003). As in the previous example, this strategy indicated a reluctance to engage in the cognitive 'effort' of solving the problem. However, instead of simply closing the application and starting again, these students changed their intended outcome as their response to mistakes made, or 'unsolvable' problems. This response was particularly prevalent in student use of Mathematics problem solving applications such as Logo and when using spreadsheets, where errors in the calculation of variables or formula could quickly lead to grossly incorrect outcomes (Camtasia video clips, 2003; case notes, 2003). As a result, the successful completion of teacher-set or student-selected tasks often did not occur.

5.4.4 Student Use of Software Tools and Electronic Information

The level of student knowledge also impacted upon the extent to which they were able to take advantage of, and benefit from, the use of built-in software tools such as the spelling and grammar checkers. As mentioned earlier, students who possessed well-developed strategies and knowledge related to, for example, initial consonant blends, or had competent word attack skills, were able to utilise these resources to enhance the accuracy of their written work. However, for students who did not possess such knowledge or skills, the tools could be misleading, and in some ways actually supported inaccuracy. A good example of both of these aspects in operation was recorded in a Camtasia clip of three students, Melanie, Dawn and Kath, who were working in a variably-collaborative relationship producing a mindmap on landforms. They had created a significant number of linked concepts related to this theme, and were adding the final few and completing an edit (Figure 5.18). As was the case for many similar working arrangements, the level of interaction between members of this group was minimal, with each member taking turns on the keyboard to add their ideas, with only occasional comment or input from the others.

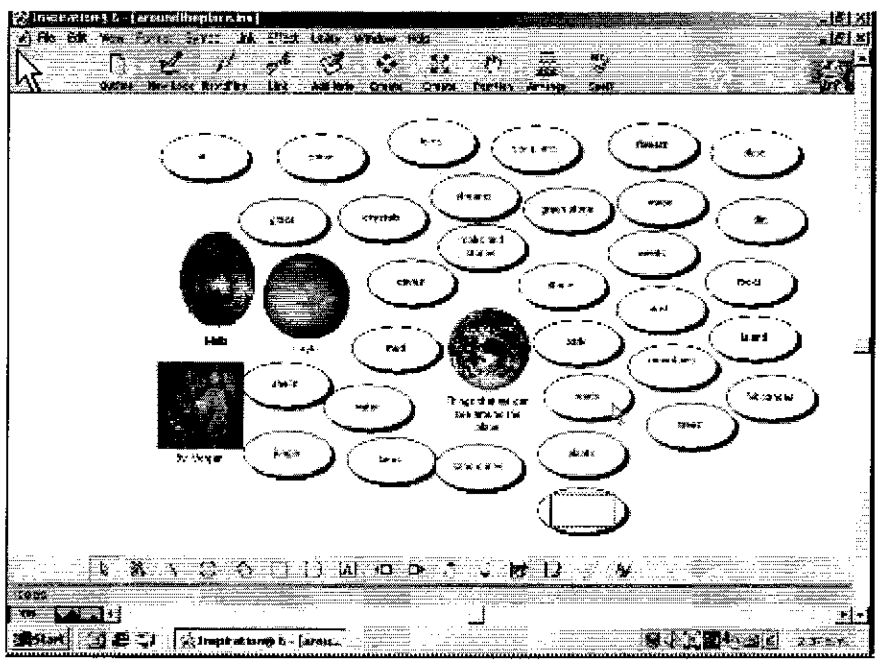


Figure 5.18: Melanie, Dawn and Kath Added Final Concepts to their Mindmap then Edited

Melanie had decided to add the concept of 'peninsula' to her map in the concept bubble to the bottom centre-right of the screen. As she typed her attempt into the bubble, she could be heard on the Camtasia audio, 'sounding it out' to herself.

> **Melanie:** pe… nic… ula. Penicula… that doesn't look right!
> (Melanie, Dawn & Kath, Camtasia clip, 2003)

She spelt the word 'penicula' instead of 'peninsula', but was quick to enter the spelling checker as she felt when she wrote it, that it was incorrect. She entered the spelling checker and surveyed the suggested word list (Figure 5.19).

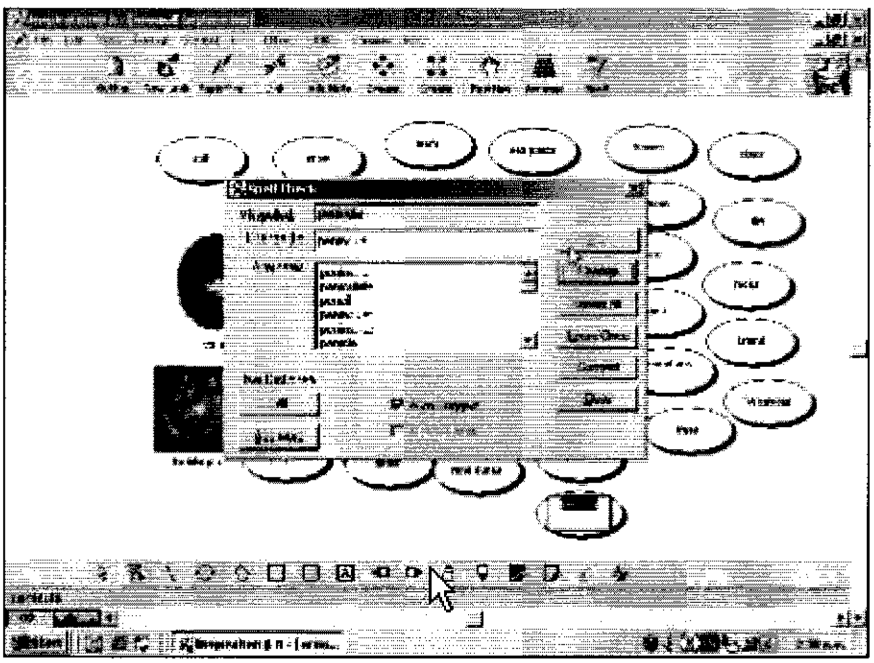


Figure 5.19: Melanie Entered 'penicula' to Concept Bubble and Initiated the Spelling Checker

Melanie worked her way through the list of spelling options in the dialogue box, but quickly settled on the first option in the list. Once again she displayed good 'word attack' skills, as she sounded out the initial blend and syllables of the words in arriving at her choice (Figure 5.20).

> **Melanie:** pen… in... su… la. Peninsula. That must be the one.
> (Melanie, Dawn & Kath, Camtasia clip, 2003)

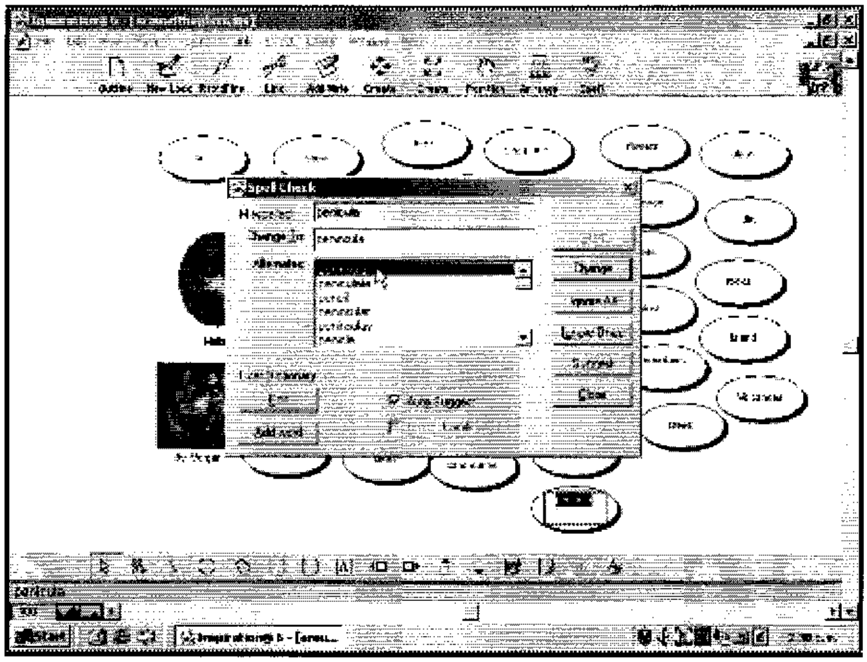


Figure 5.20: Melanie Surveyed the Range of Word Options then Selected 'peninsula'

The fact that Melanie had relatively competent skills in word analysis, in particular syllabification and initial consonant blends, enabled her to make accurate use of the spelling checker in refining her work. However, not long after this, the students changed over as Melanie's time 'was up', and Kath had control of the keyboard. She was continuing with the edit and was completing the final spell check of the document before it was to be printed out. The spelling checker had identified 'leefs' as being spelt incorrectly, and Kath was browsing the word list in the spelling checker dialogue box, looking for a replacement. She had found the word 'leafs' in the spelling checker word list and had selected this as the replacement (Figure 5.21).

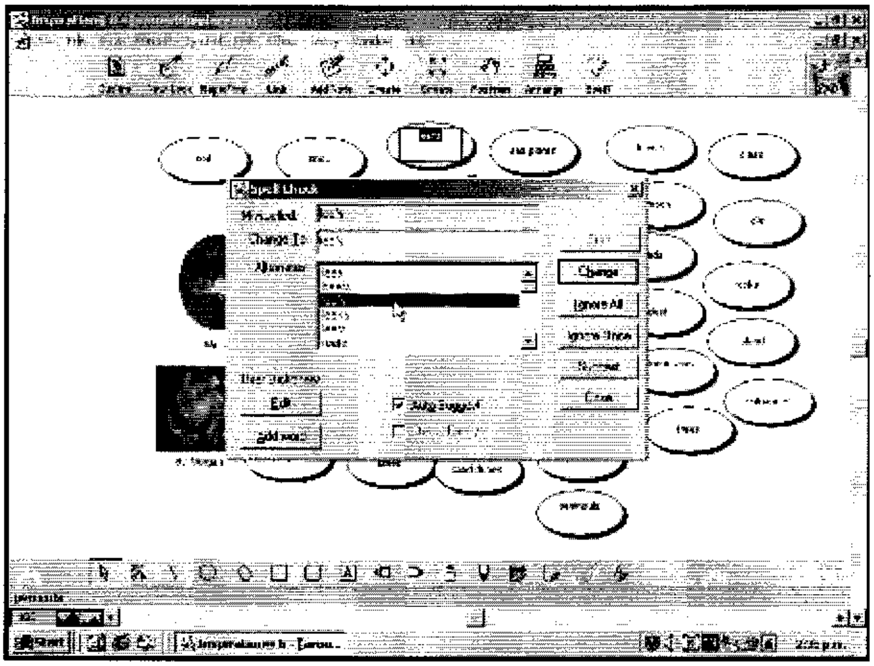


Figure 5.21: Kath Selected 'leafs' from the List as a Replacement

After the word was substituted, the spelling checker indicated that the check was complete, at which point she exited the dialogue box and saved the final edit (Figure 5.22).

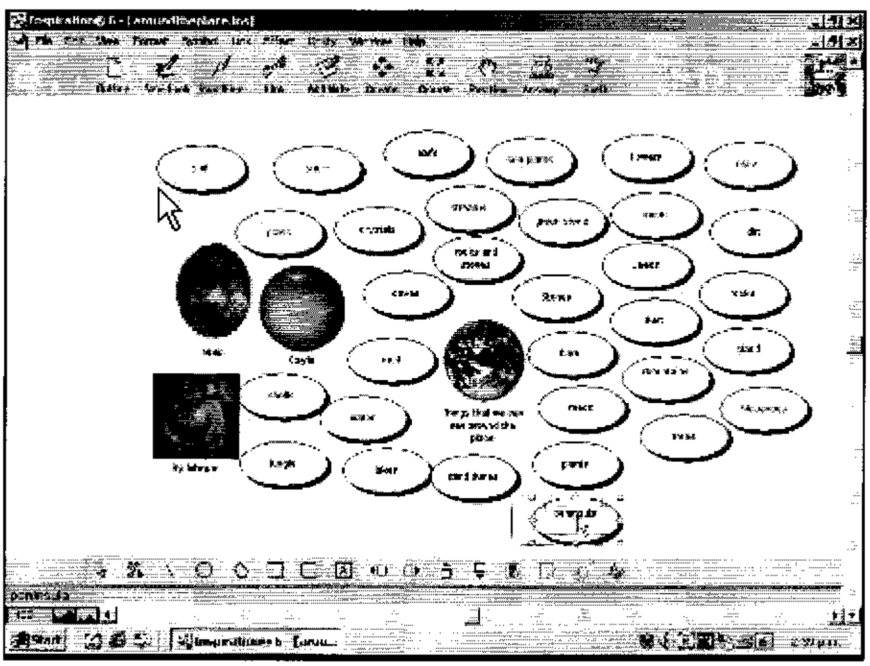


Figure 5.22: Kath Replaced 'leefs' with 'leafs' and Saved as a Final Edit

In this example, what was particularly interesting was that in spite of Kath's correct use of the spelling checker and her selection of a word that was apparently spelt correctly, the word was still the wrong one. The correct spelling and usage in this instance was 'leaves'. However, she did not have sufficient knowledge related to the formation of plurals from words ending with 'f' to be able to determine this for herself. When presented with 'leafs' by the spelling checker, this appeared to be the most viable option for her. It is possible that some time in the past another student had added the incorrect spelling 'leafs' into the computer's dictionary, thereby immediately identifying it to others as a correctly spelt and usable word. In this class, the way in which the school network operated in some ways exacerbated this problem, as the Microsoft applications ran from a single terminal server with a common dictionary, to which all students could add their words (case notes, 2003). This meant that the likelihood of there being incorrectly spelt words was increased, as within this class alone up to 33 individuals could interact with the resource, making changes and additions at will.

In addition, the manner in which Microsoft applications such as Publisher, Powerpoint and Works operated in terms of the placement of a red line under suspect words, meant that it was easy for students to replace a suspect word with another word, which although spelt correctly according to the computer's dictionary, was not the correct selection. This would make the red line go away, with most students then interpreting this as a correct selection, before moving on with their work (Camtasia clips, 2003; case notes, 2003). This was seen on several occasions with a variety of different applications, and usually occurred when there was an incorrectly spelt word in the dictionary, or if the students had correctly spelt a word, but it was the wrong word for the intended meaning. The following illustration is an example of the latter scenario, in which two students, Julie and Sally, were working collaboratively on Julie's Powerpoint folio. They were entering information on Julie's 'Mathematics Achievements' slide. Specifically, they were recording the challenges Julie had encountered in the year to date with regard to Mathematics, and were commenting on how difficult she found it keeping up with her basic facts.

Julie: I've been learning them at home. *(her times tables)*

Sally: Yeah, but you're quite good at them… put that down.
(Julie & Sally, Camtasia clip, 2003)

Julie started to enter information about her times tables into the 'Mathematics' slide (Figure 5.23).

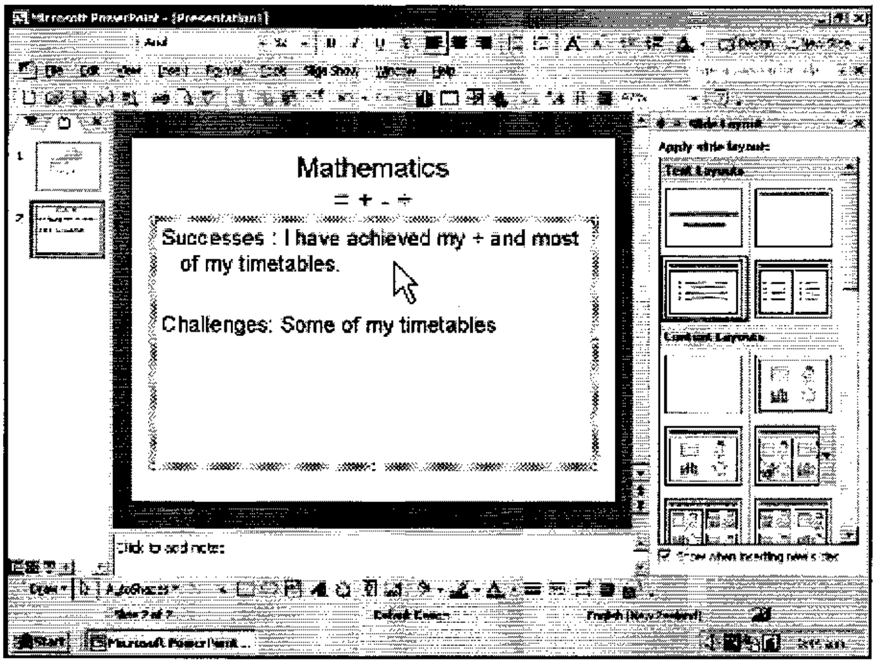


Figure 5.23: Julie Began to Enter Information on Her Times Tables Challenge

She continued recording the information on the slide, commenting on how she found basic facts tests difficult – "I don't like the tests…" (Julie & Sally, Camtasia clip, 2003). She then entered the word 'testes' on the slide, in place of what was supposed to be 'tests'. As 'testes' was in the computer's dictionary, it did not appear with a red line underneath (Figure 5.24).

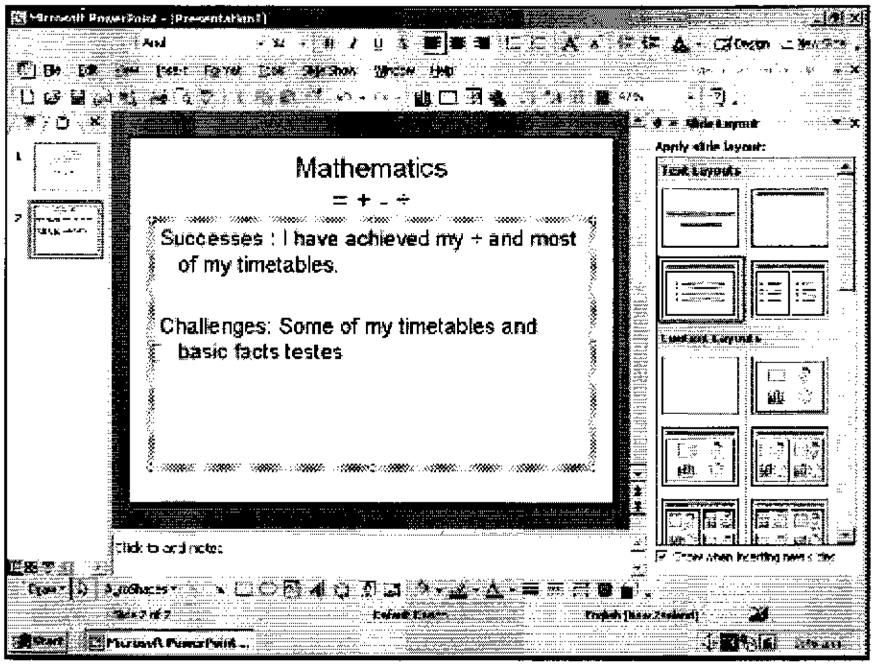


Figure 5.24: Julie Enters 'testes' in Place of 'tests' – Spell Checker Does Not Detect an Error

However, Julie seemed to be suspicious of whether or not the word was indeed correct, and carried out a manual spelling check of her own (Figure 5.25). When the 'check complete' notification came up she seemed surprised, and exclaimed "oh, it must be right then…" (Julie & Sally, Camtasia clip, 2003). She then continued on with her slide, accepting that 'testes' was spelt correctly, and was the word she wanted.

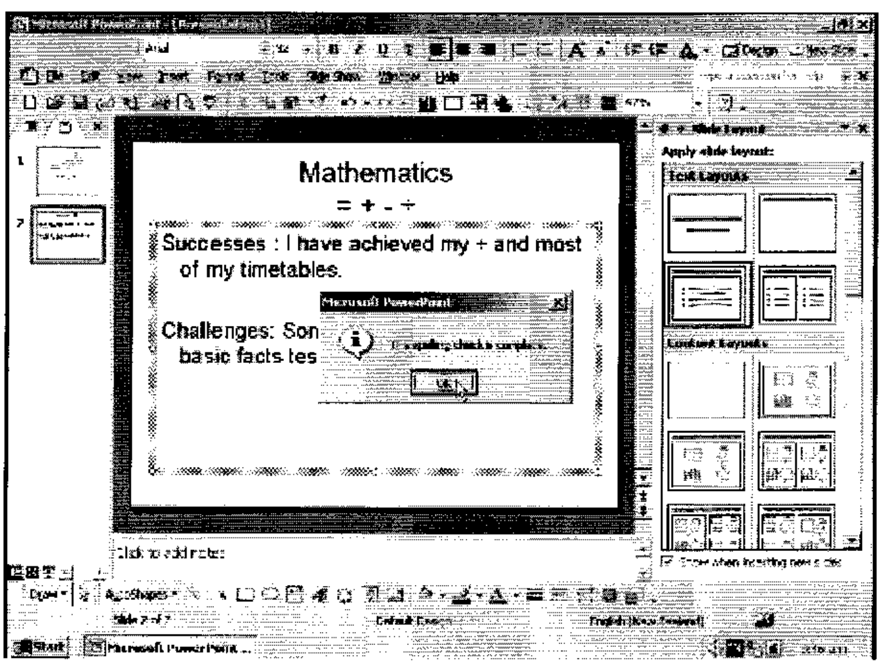
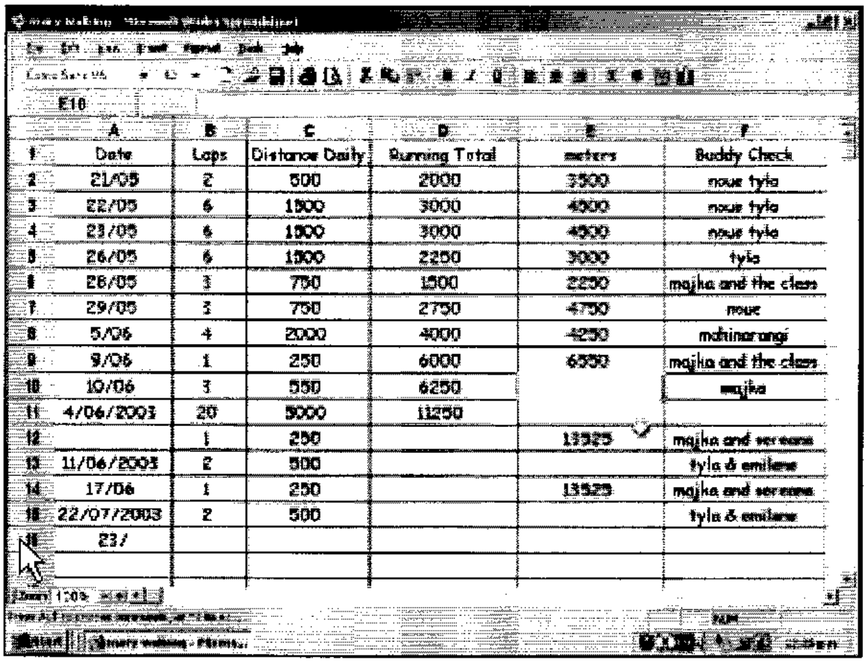


Figure 5.25: Julie Ran a Manual Spell Check to Check Spelling of 'tests'

This example, although slightly different to the previous two, supports the notion that without a sound base of knowledge across a range of areas, the usefulness of the built-in software tools could be limited for some students. Although Julie spelt the word 'testes' correctly it was clearly the wrong word, and neither the spelling nor the grammar checker was able to provide sufficient cues to alert her to this. What was also interesting in this example, was the manner in which Julie was prepared to accept uncritically, and without any cross-checking, the results of her 'manual' spell check. Even though it was clear from her comment that she was in doubt herself as to the accuracy or appropriateness of the word, she still did not check it using an alternative reference (Camtasia video clip, 2003; case notes, 2003). If she had taken the time to check the meaning in a dictionary, she would have been able to easily determine the inappropriateness of this selection. In reality, this would possibly have been the only way she could have detected and rectified her error independently, as the word 'testes' is also not included in the Microsoft Thesaurus.

The uncritical acceptance of 'digital responses' as being accurate and correct, was a feature of the work of almost all students in this room. This issue was particularly prevalent in student written work in relation to reliance on the accuracy of the spelling and grammar checker, and in areas such as Mathematics, with student use of spreadsheets. The following illustration is drawn from the latter of these, where a student, Marcia, was creating a spreadsheet, logging in distances walked as part of the school-wide fitness programme. She had created a basic spreadsheet with five columns (Figure 5.26), and was progressively entering the data into cells as she completed each day's activity.

The spreadsheet was based on a template designed by the teacher, and calculated across the cells, the number of laps completed (each lap was 250 metres), daily distance travelled, running total (cumulative total), and total number of metres covered. The final column was to log in verification by a buddy or peer.

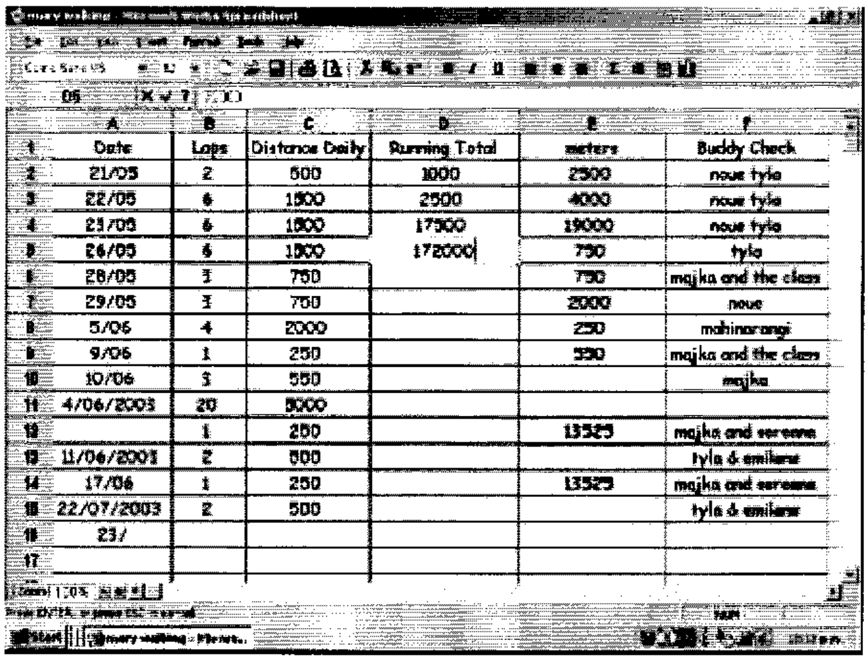


	A	B	C	D	E	F
1	Date	Laps	Distance Daily	Running Total	meters	Buddy Check
2	21/05	2	500	2000	3500	noue tyla
3	22/05	6	1500	3000	4500	noue tyla
4	23/05	6	1500	3000	4500	noue tyla
5	26/05	6	1500	2250	3000	tyla
6	28/05	3	750	1500	2250	majka and the class
7	29/05	3	750	2750	4750	noue
8	5/06	4	2000	4000	4250	mohinarangi
9	9/06	1	250	6000	6550	majka and the class
10	10/06	3	550	6250		majka
11	4/06/2003	20	5000	11250		
12		1	250		13525	majka and sereana
13	11/06/2003	2	500			tyla & emilene
14	17/06	1	250		13525	majka and sereana
15	22/07/2003	2	500			tyla & emilene
16	23/					

Figure 5.26: Marcia Created a Spreadsheet to Log the Results of the Daily Fitness Programme

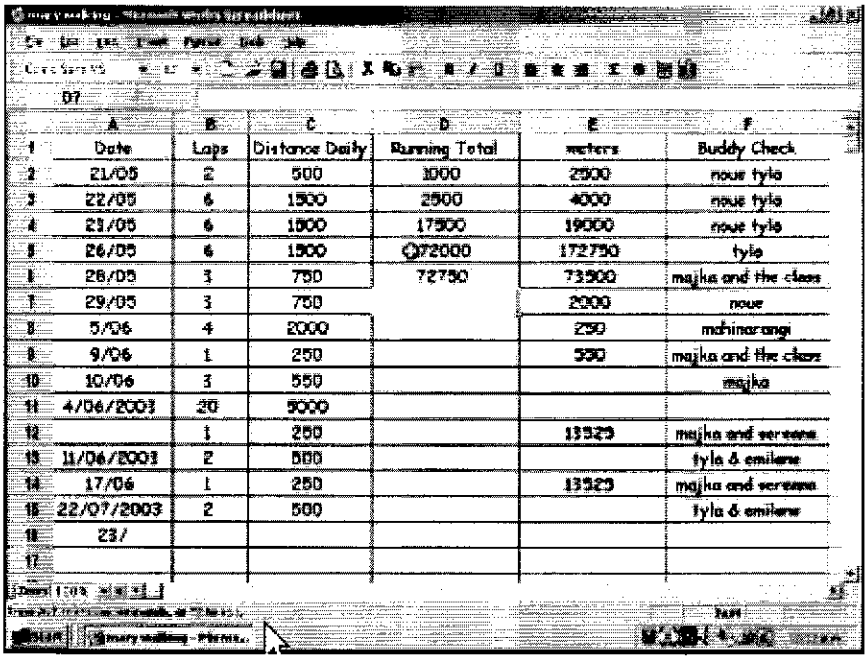
When Figure 5.26 is examined closely, it is apparent that the formulae had not been entered into the spreadsheet correctly in columns C and D, feeding in to column E. Calculations between columns B and C were carried out manually. As each lap number was entered and fed into the daily distance, a discrepancy between daily distance, the running total, and total metres covered, became very apparent. For example, in row two, the total laps covered was two, with a daily distance of 500 metres. This then calculated across to make an incorrect running total of 2000 metres, and a total of metres covered of 3500. This then continued on in a seemingly random manner throughout the spreadsheet until row eight, where Marcia appeared to make an incorrect manual calculation of four laps equalling 2000 metres. From there, the spreadsheet's accuracy diminished further as additional incorrect entries and calculations were made, until by the time the final entry was made, the totals were so inaccurate they were virtually meaningless.

At this point the researcher intervened to alert Marcia to these calculation inaccuracies, and offered input as to how she might rectify the problems. It was suggested that she first of all check the formula entered for the columns, and then work her way back through the spreadsheet from the first entry, checking the daily distance and the running total, and how these fed into the total metres covered. She was then given tuition on how this should be carried out. As can be seen from Figure 5.27, she began to partially do this correctly for the first two rows, but at row three 17500 was calculated as a running total, which of course grossly over-inflated the total metres covered. This was then followed by another incorrect calculation in the running total column of 172000, which further escalated the problem. Additional incorrect entries were then made as she progressed down the spreadsheet (Figure 5.28). It was apparent that once again the formulae had not been entered correctly in some rows.



	A	B	C	D	E	F
1	Date	Laps	Distance Daily	Running Total	meters	Buddy Check
2	21/05	2	500	1000	2500	noue tyla
3	22/05	6	1500	2500	4000	noue tyla
4	23/05	6	1500	17500	19000	noue tyla
5	26/05	6	1500	172000	750	tyla
6	28/05	3	750		750	majka and the class
7	29/05	3	750		2000	noue
8	5/06	4	2000		250	mahinarangi
9	9/06	1	250		550	majka and the class
10	10/06	3	550			majka
11	4/06/2003	20	5000			
12		1	250		13525	majka and sereana
13	11/06/2003	2	500			tyla & emilana
14	17/06	1	250		13525	majka and sereana
15	22/07/2003	2	500			tyla & emilana
16	23/					
17						

Figure 5.27: Spreadsheet was Only Partially Corrected. Incorrect Formulae Remained



	A	B	C	D	E	F
1	Date	Laps	Distance Daily	Running Total	meters	Buddy Check
2	21/05	2	500	1000	2500	noue tyla
3	22/05	6	1500	2500	4000	noue tyla
4	23/05	6	1500	17500	19000	noue tyla
5	26/05	6	1500	72000	172750	tyla
6	28/05	3	750	72750	73500	majka and the class
7	29/05	3	750		2000	noue
8	5/06	4	2000		250	mahinarangi
9	9/06	1	250		550	majka and the class
10	10/06	3	550			majka
11	4/06/2003	20	5000			
12		1	250		13525	majka and sereana
13	11/06/2003	2	500			tyla & emilene
14	17/06	1	250		13525	majka and sereana
15	22/07/2003	2	500			tyla & emilene
16	23/					
17						

Figure 5.28: Marcia Continued to Make Incorrect Entries Causing Further Inaccuracies

This pattern was continued for several more entries, and it was not until the second round of intervention from the researcher which alerted her to the compounding inaccuracy issue, that she was even aware of the problem (case notes, 2003). Although from the audio track recorded on the Camtasia video clip it was quite clear that there was an element of surprise at the results, she made no attempt to cross check or change these in any way as she went about her work (Camtasia clip, 2003). She appeared to be willing to accept the results the computer presented her with without any critical review. In addition, she did not seem to have a level of Mathematical understanding that would have allowed her to detect, through approximate estimation, that her results were so far off track (case notes, 2003).

For some students, the lack of critical analysis of information or results presented by the computer extended also to their use of the World Wide Web and online encyclopedias (case notes, 2003; Camtasia video clips, 2003). Many examples were seen of students who would either download information directly from a website or CD to their work, or fail to critically analyse the information contained in these resources to look for inconsistencies or inaccuracies (case notes, 2003). It was apparent from discussing the contents of their projects that some students had learnt very little from their work, choosing instead to access the information online and reproduce it as their own (case notes, 2003; Camtasia clips, 2003). Although this practice was not widespread amongst the students, it was certainly a strategy used by some, particularly those who had a habit of finishing work quickly and wanted to get onto other things. The outcome from this process in most instances was limited student knowledge construction, as they failed to read and comprehend the information they had accessed, and process that information into knowledge.

In stating this, for students who were prepared to bring a level of critique to the use of such resources, the availability of online materials offered a new range of exciting information possibilities. Students such as Simon, Zane and Anton who were prepared to engage in the 'cognitive effort' of reading and understanding what they saw on screen, developed not only significant knowledge, but also confidence in being able to benefit positively from their use of these resources. An illustration of this was witnessed when this group, working collaboratively, were undertaking an independent research study on Charles Schultz, the creator of the Peanuts cartoon series. They had self-selected this project as part of a class-wide study on the topic of 'Leisure', and had created some key questions they were researching using the Web. The trio had organised themselves between two computers, with two students researching websites (Simon & Anton), and the third, Zane, shuttling backwards and forwards between them, jotting down on a piece of paper relevant information for later use (case notes, 2003). They changed positions intermittently, so that each had a turn at being the recorder. They had also divided the questions between the two on the web-based computers, so that they could maximise their work efficiency. The following dialogue was recorded using Camtasia, and supplemented with observational case notes (2003).

> **Simon:** ....right O... what's next *(looking at question sheet)...* when he died and how did he die?
> *(Simon clicks on a Schultz biography website – and begins to read).*

Zane: What are you doing Anton?

Anton: I'm just reading this site... d'ya know he died in December '99... that was just a couple of years ago, eh!

Zane: ...three and a bit actually...

Anton: Yeah... says here he died of stomach cancer...
(Zane goes to Anton's computer and begins to read the information on the screen).

Anton: ...gee, poor bugger!

Simon: Hey Zane, I found the answer to number 6! *(the question about when he died and how).*

Zane: What's it say?

Simon: *(Calls out)*...says here he died February 12, 2000 from a heart attack after having colon cancer... *(pause)*... I wonder what your colon is?

Zane: Hey, that's different to Anton's stuff... is it the same Charles Schultz?
(Zane goes to Simon and quickly reads the information from his website, and then back to Anton's computer and re- reads his website).

Zane: Yeah... it's the same guy... someone's lying here... I think we need to get a third opinion... Simon... can you have a look at another site?

Simon: Sure thing boss!
Simon clicks on and searches a third site.

Simon: Here's one... it says here... *(reading from site)* "Charles Schultz, the famous creator of the Peanuts cartoon characters, died at 9.35pm on Saturday, February 13, 2000, of a heart attack, caused by complications resulting from cancer".

Zane: Great... who do we believe here guys... we've got 3 different stories!
(Simon, Anton & Zane, Camtasia clip, 2003)

At this point, Zane made the suggestion that as they appeared to have conflicting stories, they should simply generalise the information.

> **Zane:** I know, let's say we just write that he died of cancer... that seems to be what most of them are saying... then we can put, say, in early 2000. That would probably be accurate enough... what'ya reckon?
> (Simon, Anton & Zane, Camtasia clip, 2003)

The others agreed with this suggestion, and from there they moved on to the next question.

This example is a good indication of the value web-based resources *can* have for student learning, although it has to be acknowledged in this instance, the fact that these students actually discovered and were prepared to respond to an apparent discrepancy in data, was really accidental. If the two students had not been searching for an answer to the same question at the same time, it is likely that they would have missed the discrepancy and accepted the information from the first site they accessed. However, the manner in which Zane responded once a discrepancy had been identified, was a good indication of the type of skills and attitudes students need to be able to maximise the advantage of having access to the range of digital information, such as that provided by the Web. The fact that he was prepared to interact critically with what he saw on the screens of the two researchers' computers, and then had a reasonable strategy for dealing with the discrepancy, showed the beginning of the development of a level of information critique which is needed within the Web environment. The issue in this respect, is that the acquisition of such skills did not appear to be a 'natural' process for the majority of the students in this class.

The final section in this chapter presents and analyses data on a general issue related to all student activity in this environment. This is one that does not neatly 'fit' into the aforementioned categorisations, and relates to the role and influence of 'software diverters' on student practice in the e-classroom.

5.5 'Software Diverters', and their Influence on Student Practice

As introduced earlier, a significant element which influenced the manner in which all students went about their tasks in the e-classroom, related to a concept labelled by the researcher as 'software diversion' (case notes, 2003). For the students in this class, the level of attention to software diverters varied considerably, but it was a phenomenon that was at some stage applicable to all students, irrespective of their work organisational structure. In defining any specific performance as being an example of this phenomenon in action, the researcher needed to differentiate between means-of-working with software features identified as potentially 'diversionary' in nature. This differentiation was made on the basis that the use of such features could be viewed as adding to or enhancing the overall outcome, versus the excessive or inappropriate use of such features, or prolonged periods of time taken to decide on the use of such features – to the extent that they impeded the attainment of learning goals.

The term 'software diverter' was therefore defined as features which are built into many software applications, which:

- may divert the students' attention away from planned learning goals; and
- or may detract from the attainment of these in some way, such as through excessive consumption of student on-task time.
(case notes, 2003)

An example of the former could be illustrated by the earlier detailed instance of Simon's use of hyperlinks on the contents page of his digital portfolio. While the author does not intend to repeat the details of this example (see earlier discussion), advantages for the use of hyperlinks in this case were explained in terms of the need to support easy user navigation, and the ability to link to other work samples embedded in different applications. In this case, it took minimal time to make the decision to use hyperlinks, set them up, determine where links were to be made, the type of transitions to be used, and so on (case notes, 2003). Their use did not appear to take time out of, or detract from Simon's ability to meet the planned outcome, which was the completion of his digital folio (case notes, 2003). Rather, they were used in a manner which clearly enhanced this outcome.

However for many other students, the lure of engaging in the use of 'enhancements' such as animation, hyperlinking, clipart, wordart and the various art tool capacities integrated into many software packages, meant that a high percentage of allocated time was engaged in the use of these. This in turn had implications for the attainment of learning goals. By far the highest level of 'software diversion' occurred when students were engaged in using programs such as Microsoft Powerpoint or 'Inspiration'. These programs have highly developed graphics and interactive capabilities, which are reasonably easy to access and use. In using these applications, activities such as the selection of background colour, headers, fonts, styles and borders, animation formats, paths and sequences, and the application of any imaging resource – often for no apparent benefit in terms of the overall outcome – could take students a considerable amount of time (Camtasia video clips, 2003, case notes, 2003). In some cases, within any single work session, students estimated that most of the time could be spent working with diversionary features of the software, rather than engaging in the specifics of the learning task (student interviews 2, 2003). For example, during the second round of interviews, one student during a pair interview commented in response to a question about how much time they spent using diverters:

> **Rose:** ...they (diverters) take up too much time... that's what I mean.
>
> ***Researcher:*** *Let's think about this a bit... say you are doing a particular task...*
>
> **Rose:** ...like drawing pretty pictures just to write your name on the bottom!
>
> ***Researcher:*** *OK... let's say with the sporting thing you have just been doing... about how much time was taken up fiddling with the pictures... would it have been half the time, quarter of the time?*

Rose: ...maybe 75% of the time.

Researcher: *Playing with the pictures!*

Rose: Me and Cherrie, playing with the pictures.

Researcher: *And at the end of the day, what did you come up with?*

Rose: Two ideas!

Researcher: *After an hour's work?*

Rose: Yeah... that's all!
(Melanie & Rose, interview 2, 2003)

The impact that engagement with diverters had on the attainment of planned learning goals in many cases was significant. In the following example, Kiri, working individually, had been set the task of developing a concept map identifying the animals she was going to research for her self-selected investigation on 'Pets'. She had chosen the mind mapping software 'Inspiration' for this task, and after four minutes sorting out the folders in her individual class file, she entered the program. Upon entering the program, 'Inspiration' provides a blank page with what is known as the 'main idea' in the middle, from which the designer develops linked concepts around a central theme. In Figure 5.29 Kiri has 'customised' the plain oval 'main idea' template using the built in clipart library. She has replaced the original 'bubble' with an image of a dog, and has changed its position from the centre to the top-left corner of the page.

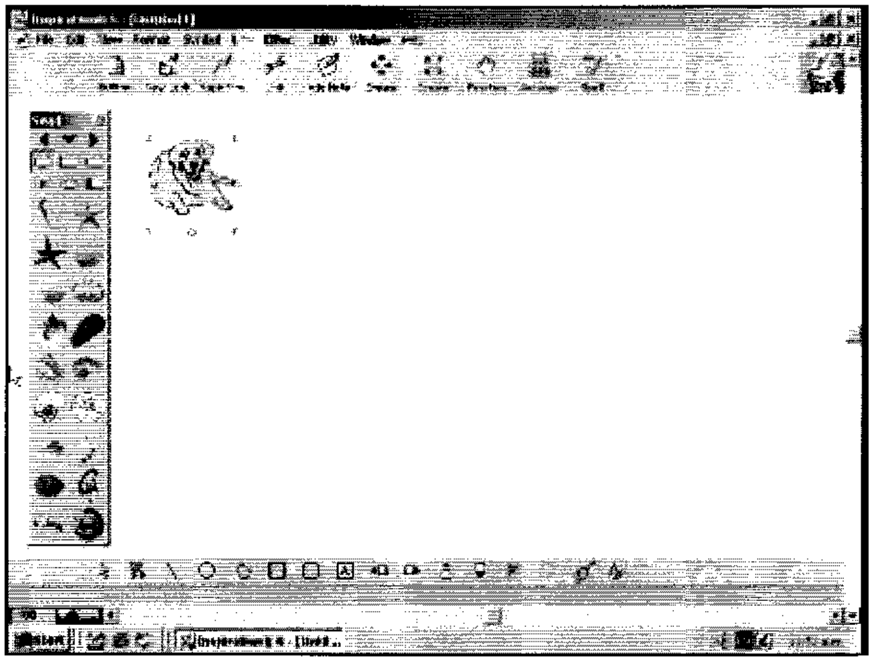


Figure 5.29: Kiri Altered the Shape and Position of 'Main Ideas' Icon

Kiri then proceeded to create a title in a second ideas bubble, and add images to the page consistent with the 'Pets' theme, as required by the task. She had added a rabbit and two cats (Figure 5.30) when she decided to start exploring the clipart libraries, and was diverted away from the set task.

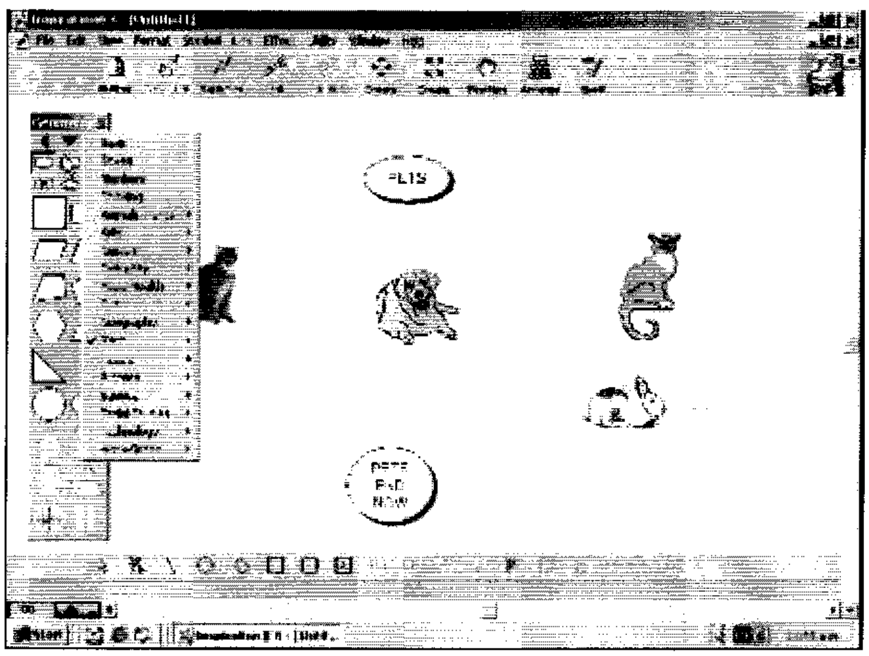


Figure 5.30: Kiri Added Two Cats and a Rabbit to her Concept Map before Opening the Clipart Library

From here she appeared to sort her way through the clipart library, selecting and inserting images seemingly at random, with very few selections being related to the set topic. What is interesting also in this instance, is how, at the end, she started to add to the assigned topic of 'Pets' to include the additional labels of 'Animals', 'Boats' and 'Flowers', to accommodate the additions and changes she had made (Figure 5.31).

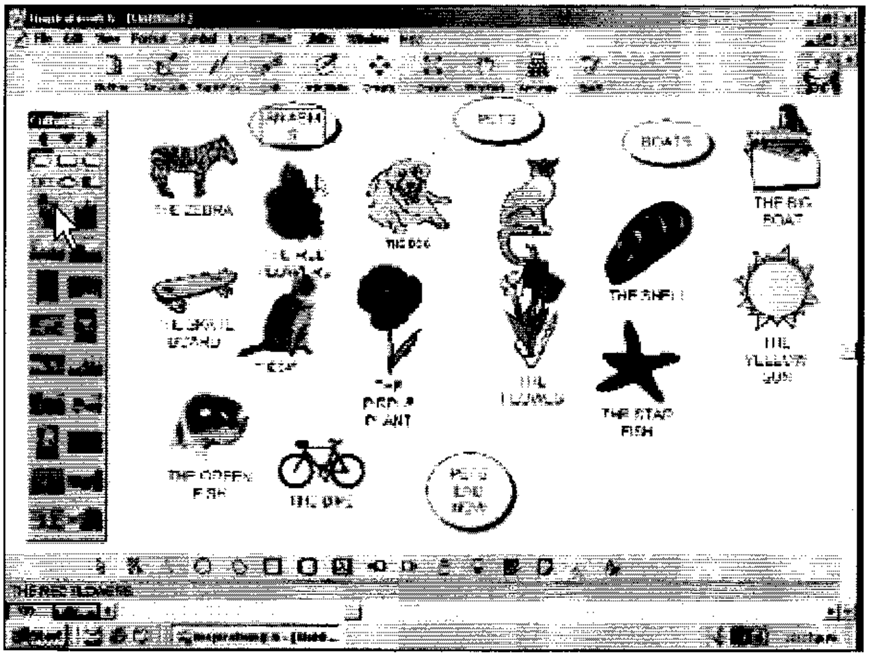


Figure 5.31: Kiri Added Unrelated Images with Title Bubbles to Accommodate her Diversions

From the start to the point at which she saved her file and closed the application (as indicated in Figure 5.31), it took 42 minutes to complete this exercise. Approximately 25 minutes of this was spent in selecting and manipulating images unrelated to the planned theme (Camtasia video clips, 2003).

Many students were aware of the impact that engaging with software diverters had on their overall outcomes, with some expressing a desire to have access to these limited at a system level. They viewed the presence of these as a 'temptation' that they found difficult to resist. These students considered it would be better if access to them was able to be withdrawn or regulated in some way, so they would be able to get on with what they were supposed to be doing.

With regard to this, Simon and Zane commented:

> **Simon:** When we work with Hemi he can't help himself, he spends all the time playing around with the animations, and we say to him, "do the proper work..."
>
> **Zane:** Yeah, and we say to him to stop but he doesn't, and we get really angry with him… he's just a one man team!
>
> ***Researcher:*** *Do you find things on the computer that distract you from what you're supposed to do?*
>
> **Simon:** On Powerpoint, I like doing animations…
>
> **Zane:** …temptation... *(laughs).*
>
> **Simon:** ...and on Inspiration, I want to put pictures on every word… and then I don't and I do and I don't and I do… I can't really make my mind up, and in the end I don't… but by then the time's all gone… *(laughs).*
> (Simon & Zane, interview 2, 2003)

The widespread use of software diverters in this class appeared to be based on the notion that they added to the visual attractiveness of work, and thereby improved, somehow, the quality of that work. The capacity of the computer to make their work 'flasher' is something that many students mentioned (student interviews 2, 2003), and this could be achieved with relative ease using the range of tools available within the software. As Rose and Melanie commented:

> **Rose:** Say if you are using Inspiration… you can move everything around… the computer gives you so many advantages to do like… make all these flash pictures.
>
> ***Researcher:*** *Do you think those sort of things distract you?*
>
> **Rose:** They like to choose all these pretty pictures to write their names in…
>
> **Melanie:** …yeah… one day I was working with Sam and she got all these pictures of animals like tigers and scorpions… and all I wanted to do is get on with my work… but she just wanted to make a page full of pictures!
>
> ***Researcher:*** *Why does this happen?*

Melanie: Because stuff is so flash!

Rose: Yeah... it's all computerised... and you've got all these images and like... you can get them and change them so easily.

Researcher: *Why do you use them?*

Melanie: 'Cos it's fun, and it makes you look smart and cool 'cos you've got all these pictures... but if you were working on paper you wouldn't take all your time drawing cats or pigs or something... you would only do that if you needed a picture or something... it's too easy on the computer.
(Rose & Melanie, interview 2, 2003)

The importance of the aesthetic appearance of work was mentioned by a number of students, and the computer was seen as a way of 'levelling the playing field' for some students who experienced difficulty in maintaining a consistent level of tidiness and layout (student interviews, 2003). However, this was not limited only to the computer's capacity to ensure uniformity of text style and appearance, but also related to its ability to add graphical enhancements which others would think were "cool" (Hemi & Anton, interview 2, 2003). The decision to use these was based on a number of reasons, but one which was mentioned by three student pairs indicated a level of desire to impress an intended audience. In the example below, this was the students' parents, and occurred as part of preparation for a parent interview evening. When asked about the reasons for the use of 'software diverters' in their digital folios, Hemi and Anton commented:

Hemi: ...it depends on who is going to look at it... like if we are doing it for our parents, like for next week, or maybe a story they are going to look at, then we make a good job... we do it fancy and all that.

Researcher: *What do you mean, fancy?*

Anton: Like decorating it... yeah... you can do it in Paint and draw circles and stuff, and then control-c and control-v where you want it to go...

Hemi: ...and there are cool things in the programs you just *have* to try out... but we are supposed to be doing our 'proper' work.

Anton: I just start fiddling around with the pictures and have a little click on them and see what happens… to see what it looks like… and you can make them move!

Researcher: *Do you think those things take your attention away from what you are supposed to be doing?*

Anton: I play with the animations a lot!

Hemi: Yeah… but it's pretty cool with the animations… you can make them go up into the air and make circles and come down and stuff… make your own path… houses and cars and all that stuff…

Anton: …but they take up a lot of time… you do a little bit of work and then spend a lot of time on the animations and don't get it (the work) finished.
(Hemi & Anton, interview 2, 2003)

While a considerable number of students spent a good deal of time 'playing' with visual features such as those detailed above, for a small number of others, they were viewed as an addition which were able to be explored only after they had finished their 'real' work (student interviews 2, 2003). These students did not appear to see their use as an integral component of their work – for example, to aid user navigation, but rather as an 'add-on' used primarily for aesthetics and appeal, or for the entertainment of the viewer. These students did not consume a lot time developing their animation or graphical components at the expense of what they saw as their 'core work'. They simply got on with it, and if there was time left at the end, then they would explore the 'diversionary' elements. However at the same time, they did not seem to understand how facilities such as hyperlinking could be used as an appropriate enhancement either – they simply tended to avoid their use in these ways altogether (student interviews 2, 2003; case notes, 2003).

When asked if they spent much time using software diverters, Sherilee and Susan commented:

Sherilee: No, but sometimes when we have done a whole heap of work and we can't think if anything else, then we just go into things like that (diverters)…

Susan: ...yeah, like in Inspiration we might change the main idea into the main topic, and then change the picture...

Sherilee: ...or we might do some pictures... if we've finished the thing...

Susan: ...like choose a little picture and put it on our name down the bottom.

Researcher: *Have you ever used them in some way to improve or enhance your work, other than say for decoration?*

Susan: Not really... they just make our work look prettier.
(Sherilee & Susan, interview 2, 2003)

Figures 5.32 to 5.34 provide an illustration of the way in which these two students used the imaging capacities of the computer to add what they considered was visual and aesthetic appeal to their work. In this example, Sherilee and Susan had just completed their initial 'Big 6' brainstorm of key questions and concepts related to their self-selected 'Leisure' investigation.

They were to use this plan to undertake a web-based research investigation of the concepts, from which they were to create a multimedia slideshow of their findings for presenting to the rest of the class. They had just inserted a helicopter from the clipart library, and were in the process of designing a skydiver. Figure 5.32 shows the basic images inserted into their Inspiration map from the clipart library.

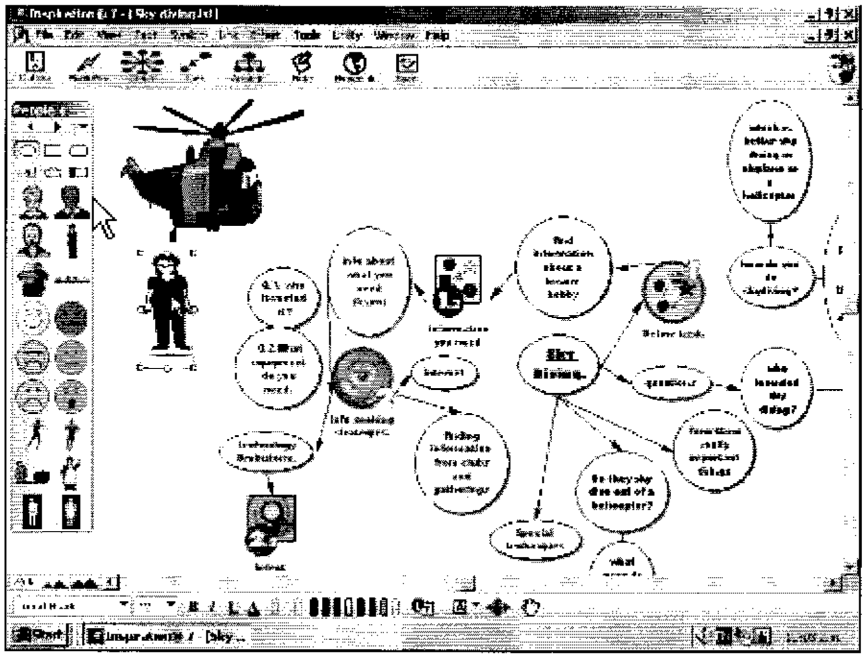


Figure 5.32: Sherilee and Susan Inserted Two Images from the Clipart Library for Visual Appeal

After the two images had been inserted, Sherilee and Susan then proceeded to change the characteristics of the images numerous times, until they arrived at a form that they both agreed upon (Figures 5.33 and 5.34).

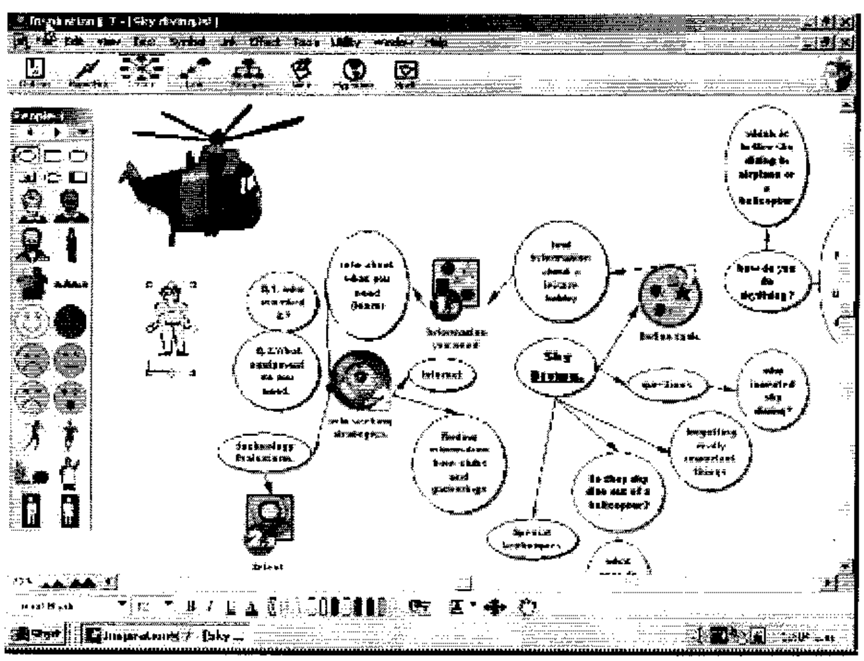


Figure 5.33: Sherilee and Susan Changed the Characteristics of Images Many Times Before Settling on Final Form (Figure 5.34)

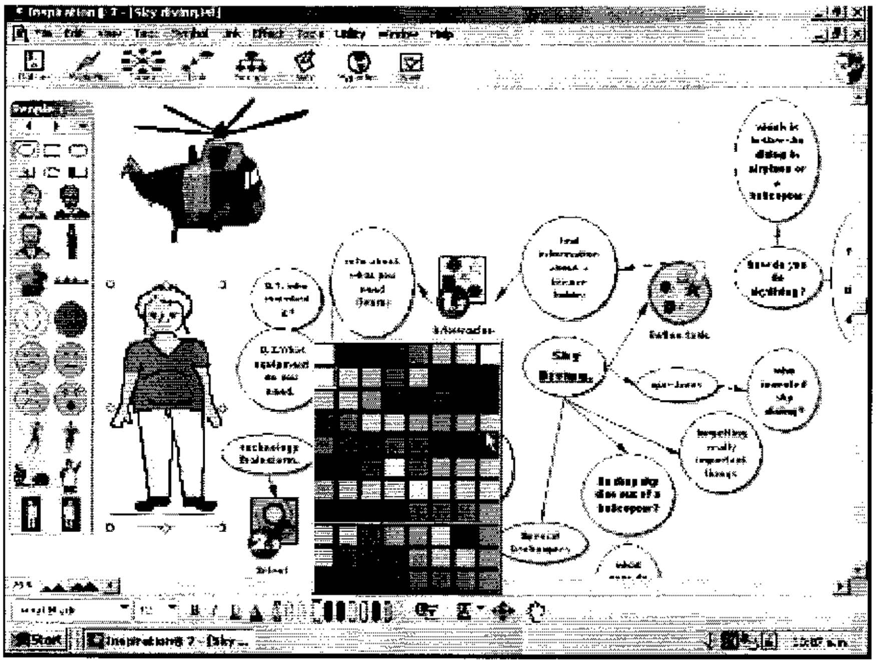


Figure 5.34: Sherilee and Susan Settle on Final Image Design

By the time these students finally settled of a range of clothes colours for this character, the entire image development process had taken approximately 10 minutes (Camtasia video clip, 2003). However, unlike some of their classmates as discussed earlier in this section, these students undertook this exercise only after they considered their 'real' work had been completed.

The use of software diverters in this class did not appear to be related specifically to gender or ethnicity, but there was a tendency for their use more in work groups which were described earlier as being variably or non-collaborative. Unlike the superior quality work practices displayed by collaboratively working groups, variably and non-collaborative groups tended to spend more time on peripheral activities such as software diversion, which was consistent with the generally inefficient approach they adopted to work tasks overall.

5.6 Chapter Summary

This chapter has presented and analysed data on the diverse manner in which students approached their learning tasks in this e-classroom. Whilst it is virtually impossible to separately quantify the individual contribution to student learning of each of the three domains – cognitive, affective and social, there are unique strategies and tactics the students applied to their work from all three. How these interacted and interrelated, ultimately formed the 'strategy set' students applied to any individual learning task. According to the composition of this mix, the capabilities of the computer in terms of acting as a 'learning partner' was, to a greater or lesser degree, able to be mobilised.

This research revealed a very strong relationship between the ways in which students worked in terms of their groupings and levels of collaboration, and their capacity to leverage any learning advantages from computer use. Students who were members of the strong and well-established social structure existing in this room and who worked with their friends in highly collaborative relationships, were readily able to access knowledge and support from each other, and from within the larger social grouping, to sustain their activities relatively independently. However, for others in variably-collaborative relationships, the lack of a stable socially-based structure meant that work practices needed to be re-established repeatedly, often with different students. Much of the work time for these students was consumed with negotiating working parameters, or 'catching up' on what the other student had been doing. Such relationships generally resembled more of a 'resource sharing' arrangement rather than full collaboration, and outcomes, if any were forthcoming, were disjointed and fragmented.

The five students who consistently displayed non-collaborative practices rarely produced any tangible outcomes. Their 'nomadic' and disruptive behaviours did not allow them to establish any working relationship, and if they were unable to secure a computer for themselves, they would simply spend their time moving from group to group, observing or disrupting the work of others. If they did manage to secure a computer, they generally spent their time engaged with software diverters, and very rarely produced anything of significance.

The two students who consistently chose to work alone established a unique relationship with the computer, often 'personifying' it in the absence of a human 'learning partner'. These two students became immersed in their work, the computer enabling them to largely shut out the distractive environmental conditions of the classroom. However, while these students were clearly engaged with their learning tasks, the lack of a peer who could interact with their thinking and assist by prompting and cueing in constructing understanding, was apparent. While the computer provided an environment which sustained these students' activities, very few of these activities resulted in learning. Both of these students needed the frequent and active engagement of the teacher or more capable peer to help them progress knowledge construction. In the absence of this, these students tended to revert to software diversion, or the 'brick wall' non-engagement with learning problems described earlier in this chapter. A significant issue in this respect was that the computer-dominated environment in this classroom was able to 'mask' this non-productive activity effectively. Formative teacher assessment of student work progress was only made on a 'single point in time' basis, usually the result of a visual appraisal of what was happening as she walked around the room. There was no visible pathway or 'working trial' for the teacher to see what had been happening beforehand, and for all she knew, it could have been the third or fourth time the student had reached the same point in their work.

Such an issue was not confined only to students who worked alone. As identified through data in this chapter and as will be discussed in the next chapter, this issue was a major concern for the work practices and progress of all students in this classroom.

Another significant finding from this section related to the very close alignment between the level of conceptual and domain-specific content knowledge held by the students, and their ability and willingness to engage in the cognitive activity of solving learning problems using computers. Students who, for example, had limited knowledge in areas such as spelling, or had restricted strategies for word analysis or identification, gained relatively little from using the built-in software tools. However, for others who had superior capabilities in such areas, these tools assisted considerably in enhancing the quality and accuracy of their work. In some instances where students possessed high levels of content, conceptual, and procedural knowledge related to the task, the computer was able to assist in sustaining work practices on a relatively independent basis (case notes, 2003; Camtasia video clips, 2003). However, where this level of understanding or capability did not exist, students tended to opt out of engaging in the 'cognitive loading' of solving the learning problem, or altered the outcome to accommodate their incapacities.

In some instances, the manner in which the software operated in terms of its ability to support instant and convenient changes to format and content, exacerbated this issue. The resulting strategy for many students facing learning problems they were unable to solve, was the closing of files or applications, and starting again from scratch. Alternatively, they tended to develop 'work around' strategies for problems, so that the outcomes bore little resemblance to that which was intended or defined in learning goals.
The overall impact of the repeated application of such strategies, was that minimal progress was made towards achieving planned goals.

Aligned to findings relating to cognitive elements of student practices in this room, a noteworthy and somewhat disturbing finding related to the preparedness of many students to uncritically accept as correct the outputs of the computer, even when they intuitively felt they were inaccurate. As revealed by the data, several examples of this were seen during this study, with students accepting the incorrect 'digital ouput' provided by the computer without any cross-checking or reference (Camtasia video clips, 2003). Associated with this was the apparent lack in some students of a sufficient level of basic knowledge relating to concepts such as approximation or estimation. Without such knowledge, these students were unable to determine often gross inaccuracies in Mathematics calculations within spreadsheets, or when working with other Mathematically-based programs such as Logo.

With regard to motivation and attitude to work in this room, much of the positive attitude displayed by the students appeared to be closely linked to the type of software being used, and in particular, the 'feature set' which the individual programs contained (Camtasia video clips, 2003; case notes, 2003; student interviews, 2003). Engagement with software diverters was common to all students at some stage, but varied according to the levels of personal interest in the topic being studied, and the composition of work groups. Regardless, for some students engagement with the diversionary features of software could consume considerable amounts of learning time, with very little by way of tangible outcomes being produced.

In concluding this chapter, the data gathered using the Camtasia video capture tool and confirmed via student verification, interviews, and case notes, painted a complex picture of student work in this e-classroom. Interaction between the three critical inputs – cognitive, affective, and social – created unique learning environments for each student in this class. The effectiveness of the computers to support student learning was determined according to the balance and quality of these, and how effectively they could be brought to bear on a learning problem.

The next chapter will provide a comprehensive discussion of the data and analysis from the preceding two chapters, in relation to the overall aim of this study. Implications will be drawn from it in the development of recommendations for changes to the organisational structures in this room, in order to improve student learning potential. It will also be revisited in Chapter 7, through a series of recommendations for schools wishing to undertake similar initiatives.

CHAPTER 6

Discussion of Findings

By discussion and analysis of data gathered in relation to the two research questions identified in Chapter 1 and presented in Chapters 4 and 5, namely:

> Upon what educational vision was the e-classroom environment at Parahaki School established, and what was the nature of the implementation processes associated with this?
>
> How does the e-classroom environment impact upon the cognitive, affective and social development of its students?

this chapter draws together significant findings from this study in relation to the primary aim of this thesis, which was to determine:

> **...the nature of student work practices in an e-classroom environment, and what are the factors which influence this?**

From this it identifies a series of recommendations for improving the performance of this classroom, in responding to the third research question which was:

> In what areas might changes or improvements be made to optimise the learning potential of this e-classroom?

This chapter will argue that the 'blend' which was developed between curriculum design, the range of organisational and teaching strategies which were employed, and the manner in which computers interfaced with these, did not create an environment which optimised learning for many of these students. In addition, whilst for some students it could be reasonably argued that the e-classroom assisted in developing certain social, affective and cognitive outcomes, this was not the case for all. In fact for almost half of the students, with minimal teacher intervention and limited knowledge resources upon which to draw, development in these areas was limited.

To facilitate more managed discussion of data, the chapter has been organised using sub-headings generated from each of the three research questions above. However as stated in Chapter 5, there are significant overlaps within each of these categorisations, particularly in the three focus areas of computer-environment impact on student cognitive, affective and social development. It is therefore important to interpret this discussion holistically, to understand how each aspect interacted with, and to an extent influenced the others, in the establishment of this unique learning environment. This discussion will be presented with reference to relevant literature, as introduced in the literature review.

6.1 The Impact of the e-Classroom Establishment Process on the Resulting Environment

6.1.1 Leadership and Clarity of Purpose

As described in Chapter 4, the primary driving force behind the e-classroom was the vision of the principal, Peter, who identified the potential of ICT to help meet the diverse needs of students in his school. He described this as "enabling them to develop the sort of skills, knowledge and capabilities that will allow them (the students) to function effectively in the future, and become life-long learners" (Peter, interview, 2003).

Such a view is compatible with those expressed by authors such as Page (1999), Thornburg (1999), Roschelle et al. (2001), and McCombs (2000). They state that there needs to be a broadening of the skill-set being developed in schools to better enable students to meet the demands of a rapidly changing, technologically-focused world. While in this study such a view appears to have been *articulated* by the principal, there appeared to be little strategic planning with regards to how such an underpinning philosophy could be translated into achievable goals. That is, no clear goals for the e-classroom were developed, nor success indicators generated that could be used to measure their achievement. The vision statement appeared to be used as a broad justification for the considerable expenditure on the facility, and the 'alternative' nature of the curriculum which was delivered within it.

Such uncertainty as to the nature of outcomes for students from the e-classroom should be viewed within the context of wider issues related to a lack of a clear learning-based rationale for computer-use in schools generally. As commented on by authors such as Brown (1995 & 1997), Capper (2001), Stratford and Brown (2002), Selwood (2002), and Hawker and Capper (1999) in relation to the New Zealand experience, and Harrison et al. (2002), and Wood (2003) internationally, the often confused and sometimes contradictory reasons for computer-inclusion which have been promoted by various agencies, has clouded the development of a clear educationally-based purpose for computers in schools. To an extent it could be argued that the decisions made by Peter at Parahaki School in relation to the e-classroom development, and the huge investment in computer resources generally for what appears to be little apparent student benefit, was a result of such confusion.

Consistent with the study by Selwood (2002), what is very apparent in this study in addition to the lack of specific goals, is that the 'vision' described by Peter did not appear to be shared or understood by many within the school, or from the wider school community. Nor did it seem that the basis upon which resource allocation decisions were made in terms of fulfilling this vision, had been well-established. Indeed there were high levels of skepticism amongst other staff members as to the extent of expenditure on the e-classroom, where it was viewed the money could have been better spent meeting more pressing student social and educational needs in other ways. This situation was further compounded, as very few other staff members were able to identify any significant learning benefit for students involved in the e-classroom programme (case notes, 2003). However, such a situation does not appear to be unique to teachers at this school. As commented upon in the literature review, Cuban (2002) laments that it is the lack of clear evidence in the minds of teachers in relation to the benefits from computer use that is effectively stifling innovation with them in most American schools.

Although as identified earlier, statistical data indicated improved levels of attendance and fewer student stand-downs, this was not *directly* attributed by other teachers to the presence of high numbers of computers in the room (case notes, 2003). Other teachers in the school considered that factors such as Sarah's philosophy and approach in relation to students with social or behavioural issues, meant that she was less inclined than other teachers to take disciplinary action against these students (case notes, 2003). Although a link between computer use and behaviour/attendance was promoted by the principal and the e-class teacher (case notes, 2003), this study did not seek to conclusively determine such a relationship, and any such comments should be viewed as anecdotal and as perceptions only.

The perception of other staff that the e-classroom was simply a large financial 'black hole', meant that it did not receive universal support, and created definite tensions within the school (case notes, 2003). In many ways, it gave the impression of Sarah being in a privileged position by having access to lots of equipment, and the flexibility to use it in any way she wished. This was seen by other staff to take place in an environment where the rest of the school was constrained by financial restrictions, more conventional equipment, systems, and expectations. The cumulative outcome from all of this was a distinct feeling of professional jealously towards Sarah, and a perception that 'it's all right for her with all that gear – how could she fail'? There can be little doubt that this feeling weighed heavily on Sarah, and regularly came to the surface in comments relating to her insecurity in what she was attempting to do, and the loneliness she felt while doing it (Sarah, interview, 2003).

The isolation of Sarah and the e-classroom was exacerbated by the attitude of Peter to the other staff, in relation to establishing additional facilities of this type. He had openly stated that he saw no other staff member display the sort of attributes he considered were necessary to make the most of an e-classroom facility, although he never actually articulated what these attributes were (Peter, interview, 2003; case notes, 2003). To an extent he established a 'catch 22' situation by adopting this attitude, in that he was not prepared to provide a similar level of resourcing to other teachers without first seeing some apparent effort by them, although he never identified what form this effort should take. The other teachers therefore had no known 'course of action', should they have wanted to access a resource of this type.

Criticism of the e-classroom concept was not confined only to within the school. As described in the data, since its early development Peter and Sarah held a strong perception that other schools within the region wanted the initiative to fail, and that these schools were professionally jealous of what they were trying to achieve (Peter & Sarah, interviews, 2003). This created a certain level of almost 'paranoia' in Peter and Sarah, as they felt they needed to constantly 'look over their shoulder' and prove the concept was meeting its goals. As previously discussed, this was a problematic exercise, as these goals were never clearly established. The constant striving for justification contributed to the somewhat defensive attitude adopted by Peter, Sarah, and to an extent, Shirley, in their interactions with others relating to the e-classroom. This served to further isolate Peter, Sarah and Shirley from the rest of the school and the wider education community, and in a way ensured little opportunity to build understanding of the e-classroom in either concept or practice.

While the e-classroom was well established within the school in a physical sense, it was far from secure in terms of being able to deliver on the broad vision under which it was established. The lack of specific goals and a clear rationale for its presence, worked against enhancing any learning advantages which may have been possible. As Parr and Ward (2004) identified in relation to the Digital Opportunities FarNet project, the statement of a vision is insufficient to establish ICT innovations in schools. Like they found in relation to the establishment of FarNet, until a clear statement of *specific goals* is developed relating to what it is this school expects to get from its e-classroom for students, enhanced learning opportunities will continue to be elusive.

In addition, and as introduced earlier by Bolstad (2004) and Parr and Ward (2004), once again in relation to Digital Opportunities, assumptions were made as to what computers were able to achieve within this environment. Although the implementation did not adopt what Capper (2001) and Stratford and Brown (2002) referred to as 'technodumping' in its truest sense, the e-classroom was formed primarily on the assumption that computers would, by their presence, impact positively upon the learning environment for these students. The specific areas of impact were identified by Peter as the enhancement of social, affective and cognitive skills and capacities, although once again these were never defined in more than very general terms (Peter, interview, 2003). This study shows that the positive impact of computers on the learning environment was variable for these students. This variability, and the reasons for it, will be discussed later in this section.

6.1.2 Technical Setup, Infrastructural Design, and Software

The difficult implementation process and the lack of clarity of purpose, also impacted upon decisions made about the physical and technical setup of the environment, which in turn had a 'flow on' effect to the curriculum able to be developed within it. These issues related to limitations brought about by decisions to utilise thin-client technology, to severely limit the range of software applications available, and the general setup and layout of equipment.

Firstly, the decision in the mid 1990's to adopt a "business model" (Peter, interview, 2003) for the design of the network infrastructure and the consequential development of a thin-client, terminal-server network, limited the array of programs able to be used in this classroom. Thin-client technology was developed in response to business needs in having access to a centrally managed and administered network, able to share programs and files using terminal server – client technology. Within the business world such a system works well, where the majority of network use relates to basic productivity programs such as those used for database, spreadsheet, and wordprocessing. However, within a typical primary school environment the use of productivity programs is only one aspect of computer use.

Increasingly, the array of graphically-based software featuring high levels of interactive capability and utilising a wider range of media such as sound and digital video, is finding a place within classroom curriculum (Cleverley, 2004; Winter, 2004). This move acknowledges a more diverse role for the computer, in terms of a broadened understanding of its value beyond what was previously viewed as mainly 'technical' outcomes (Heinecke et al., 1999; McCombs, 2000). The thin-client environment in this e-classroom was never designed to accommodate such uses, and when attempted, led to multiple technical issues and system crashes (case notes, 2004).

As admitted by Peter and documented in Chapter 4, the decision to adopt the "business model" (Peter, interview, 2004) in place of what at the time were viewed as more reliable and suitable network options for schools, could be seen as totally compatible with Peter's philosophy of working 'outside' of, or challenging, conventional systems, in pursuit of what he believed to be the best solution for his school. It could also be reasonably argued that the adoption of thin-client technology which at the time was being promoted as a good network solution for businesses, and the commissioning of a well-known multi-national company to install and configure the network, was an attempt by Peter to add legitimacy to his decisions. This could be a reasonable interpretation, given the level of internal and external skepticism which was targeted towards the initiative at the time. Irrespective of Peter's thinking behind this and acknowledging the rapid technological changes which have occurred over the past few years (Page, 1999), the decision to adopt a thin-client network has tied the school into an infrastructural system which does not appear to effectively meet many teachers' needs, and requires continual high-level maintenance and upkeep.

There was no doubt that the limitations of the thin-client environment in terms of being unable to deliver adequately the multimedia capability of modern software, frustrated both the teacher and the students (Sarah, interview, 2003; student interviews, 2003). It also contributed in a significant way to the somewhat defensive attitude adopted by Shirley, the systems administrator, to network innovations or "enhancements" (Shirley, interview, 2003). Shirley was highly protective of the integrity of the network, and was very reluctant to allow the trial of 'enhancements' that she viewed as being a threat to this integrity. The net impact of this was that many computer-related opportunities teachers saw as being possibilities for their classes, were 'torpedoed' by a combination of network constraints, and a reluctance by Shirley to allow their exploration due to perceived threats to network operation. Once again this generated a 'catch 22' situation, where Sarah was reluctant to offer suggestions in the knowledge that in all likelihood they would not get past the systems administrator, or would not be network compliant. This also served as a significant disincentive for other teachers to engage in computer integration (case notes, 2003).

The restriction in available software had a significantly greater impact on e-classroom curriculum design than did the specified achievement objectives of the curriculum framework (Ministry of Education, 1993). Despite the fact that some software of an open-ended nature was generally available, it did not appear to provide the breadth of capability to fully accommodate the scope of objectives required under the curriculum framework. For example, during the research period of 16 months, activity within the domain of Mathematics comprised basic geometry using Logo, a range of spreadsheet and graphing type activities focused around school-wide programmes such as fitness, and the construction of Mathematics games as part of the school's 'Maths week' programme (case notes, 2003). Additionally, within the Arts learning area, students used the Microsoft 'Paint' application extensively to create images for their work, but little production outside of this application, or using different media, was explored. Science investigations were restricted to student exploration of virtual experiences, such as that described in Chapter 5 when students were investigating concepts related to simple machines.

Simply stated, activities which could be relatively easily accommodated by the software were prevalent in the e-classroom. Those activities which were of a written or visual language orientation which could be facilitated using productivity software, or learning experiences such as mindmapping or the development of 'Thinkers Keys', tended to dominate the curriculum. Other activities or experiences which were not so compliant with the capabilities of the software or the design of the room, were emphasised less.

Limitations to the balance of curriculum were also imposed by the fragile nature of the computers, and the lack of specific areas within the classroom which supported the use of alternative resources. For example, during the time of the research, no activities which involved any practical work such as completing science experiments, or creating murals and so on, was attempted as a class (case notes, 2003). From time to time, small groups would be involved in creating individual paintings or other artwork in a small area of the room allocated for such activities, but this area was unable to cater for more than a few students at a time. The concern in this respect related to possible damage to the computers brought about by accidents such as the spillage of water, and the lack of suitable furniture upon which to carry out practical work (Sarah, interview, 2003).

Evidence of student frustration at this was found, with some commenting that they felt they were unable to achieve the results they were wanting by using software alone, and that they were not receiving a balanced education (student interviews 2, 2003). Eight students interviewed during the final round of interviews picked up on this point, by making specific reference to the fact that they had limited exposure to areas including Drama, Science, Physical Education, Sport, and Art, as a result of being in the e-classroom (student interviews 2, 2003). Students viewed this as a significant issue as they were to move from the primary to the intermediate school the following year (student interview 2, 2003). Some clearly considered they would be at a learning disadvantage in these areas, as a result of spending two years in the e-classroom (Simon & Zane, interview 2, 2003).

The technical infrastructure also compounded difficulties in monitoring student progress towards learning goals. The chaotic manner in which students organised the storage of their files on the server, and how they labelled each file and the directories in which they were placed, did not enable the teacher to easily monitor their work and make an assessment of progress (case notes, 2003). Although each class member had their own folder on the server, how they organised the storage of their work within that folder was really up to them. There were no infrastructural systems established at a technical or procedural level to structure this, and the teacher was generally unable to keep a tab on the whereabouts or quality of student work through informal interactions. In addition, each student was able to access the files of others, and on several occasions files were moved or deleted, sometimes accidentally, and other times deliberately (case notes, 2003). The 'looseness' of processes associated with the storage of student work, both technically and procedurally, appeared at odds with the tight policies related to overall network management. At a classroom level the results of these decisions were very apparent, and made monitoring and assessment of student learning extremely problematic.

Another limitation of the environment identified by five students and related to the storage of their work, were issues regarding receiving feedback and formative input about their progress. The storage of work digitally meant that for most it was unavailable to a wider audience for comment or formative feedback. Restrictions on what students were able to print out due to the high cost of ink cartridges, meant that only limited amounts of work could be taken home, and usually this was restricted to text-based outcomes which were more economic to reproduce. In an effort to overcome this, Sarah got the students to develop 'digital portfolios' of what they considered to be exemplary work, to display to parents at an information evening. These were then collated onto CD Roms available to parents to take away with them, if they so wished. The main issue related to this was that most of the homes these children came from did not have access to either a computer, or the software required to view the portfolio.

Limitations also extended to the impact that completing all work digitally had on the aesthetic appearance of the classroom. Unlike most other rooms in this school, the appearance of the e-classroom in terms of the display of student work, was very barren. Restrictions imposed by the cost of printing out work, the small size and generally black and white nature of any work which was printed out, and the lack of use of alternative mediums as discussed earlier, all contributed to this. Six students commented on this as being a significant limitation of working within the e-classroom (student interview 2, 2003).
Such practical considerations relating to working in these environments have generally not been raised in literature. This may be because the concept of an e-classroom is so recent that little or no research has been undertaken into their functioning or effectiveness. Recent general research on the impact of computers on learning environments such as that undertaken by Bolstad (2004), Parr and Ward (2004), Blackmore et al. (2003), and Pittard et al. (2004), indicate limited positive impacts in specific areas such as student access to a breadth of information resources, and improved student task application. However, as revealed by Parr and Ward (2004) and Bolstad (2004), these gains did not translate into any significant and enduring learning benefits for students. As Parr and Ward (2004) commented, ill-founded 'visions', flawed implementation processes, and gross assumptions made about computers' capabilities to transform educational environments, were fundamental to the failure of other 'digitally-enhanced' school-based projects.

This study is consistent with such conclusions, in determining that the underpinning philosophy and resulting implementation process for the e-classroom were not based on a clear educational purpose, did not involve and were not communicated to key audiences, and were not defined as a set of verifiable goals. Assumptions were made about the potential of having access to computers in large volumes to transform learning for this group of students – assumptions which to a considerable extent have proven to be unfounded. This study shows that the impact of such things as a lack of rationale and the inability to translate a vision into practice, can have long-reaching negative impacts on the success of such initiatives, due to a lack of consideration being given to social, technical, and procedural issues.

6.2 Teacher Philosophy and its Impact on Curriculum Design and Student Work Practices

This section discusses how Sarah understood the overall vision for the e-classroom as earlier identified, and in the lack of clear goals established for its presence, interpreted this understanding into her practice. It will discuss how this interpretation and her teaching philosophy, along with the software issues as discussed, acted as strong determinants in the formation of the curriculum, the selection and application of teaching strategies, and the resulting student work practices in this classroom.

As discussed in the literature review, one of the critical elements associated with optimising the performance of computers in the classroom is the need for teaching to move towards a more student-centred approach (ACOT, 1998; Bialo & Sivin-Kachala, 1996; Blackmore et al., 2003; Capper, 2001; Cleverley, 2004; Falloon, 1999; Heinecke et al., 1999; Hooper, 1992; Iverson, 2001; Johnson & Johnson, 1996; McCombs, 2000; McCombs & Whistler, 1997; NcNabb et al., 1999; Oliver & Hardy, 2002; Page, 1999; Papert, 2002; Pittard et al., 2004; Reeves, 1998; Robertson, 2003; Simonson & Maushak, 1996; Somekh et al., 2002; Steketee et al., 2002; Terrell & Rendulic, 1996; Thornburg, 1999; Yelland, 1995).

From the data analysis, it is apparent that a critical motivation for Peter's implementation of the e-classroom, related to his perception that it would help better meet the unique learning needs of students at the school (Peter, interview, 2003). This strongly student-centred focus permeated through to a classroom level, where the teaching philosophy displayed by Sarah, and the manner in which this was enacted, impacted significantly upon her curriculum design, teaching methodology, and organisational systems. Sarah interpreted the student-centred philosophy promoted by Peter through a range of practices which emphasised 'individualising' learning, by enabling her students the greatest level of freedom and input into the design and direction of the curriculum implemented in the classroom. Some of these practices included allowing students to establish their own learning outcomes within, but often outside of, planned teaching units, showing significant time flexibility to allow students to follow apparent interests, and adopting what was very much a 'hands-off' teacher role in assisting students with learning problems (case notes, 2003). As Sarah stated, "...well, I'm not going to help anyone find an answer if they are able to find it themselves" (Sarah interview, 2003).

While such a stance is meritable, as will be discussed it was actually her interpretation of this student-centred philosophy *to the extreme*, that did not allow her to fully maximise any learning advantages from the e-classroom, for many of her students.

The capacity to 'individualise' learning has been touted as potentially one of the most significant advantages of the digital learning environment (Hooper, 1992; McCombs, 2000; Strommen, 1992; Taylor, 1980). However in this example, Sarah did not appear to understand how such a philosophy should be implemented, to ensure that learning goals were able to be achieved. The manner in which Sarah's student-centred philosophy was implemented, did not provide a sufficiently organised and structured environment for effective student learning to occur. Skerman et al. (2000) states that one of the challenges teachers face in coming to terms with digital learning resources, is how to balance out the use of these at the same time as "retain(ing) the best of current practice" (Skerman et al., 2000, p. 13). By that they refer to the 'art' of teaching – that is, the active engagement of the teacher in structuring a learning environment to enable students to develop sound knowledge of the world around them (Skerman et al., 2000). In this classroom, more active teacher engagement in structuring the learning environment was required.

The 'looseness' of the learning environment in the e-classroom manifested itself in several ways. Sarah's interpretation of student-centredness in allowing her students a considerable level of latitude in establishing learning goals, or departing from goals altogether in some cases, contributed to a situation where it was difficult, if not impossible, to monitor student work. At any one time, groups of students or individuals could be working on several different topics, in pursuit of totally different learning outcomes. While this is not necessarily a bad thing (Compton & Harwood, 2003; Hooper, 1992; McCombs, 2000; Strommen, 1992), Sarah had no adequate assessment or monitoring system in place to 'keep a tab' on student progress towards these multiple outcomes. Revised student goals were only informally arranged, were never recorded, and were often decided on the 'spur of the moment' in response to what appeared to be genuine student interest. It was very apparent that the students understood the way Sarah worked in this respect, and they would deliberately direct the curriculum towards areas of specific interest to them, or via their 'software preference'.

The implication from this was that significant amounts of time were consumed on a very limited array of activities. While this certainly enhanced student motivation and assisted in dealing with some of the behavioural problems which existed in the room, it did so because it effectively *appeased* student wishes. The cumulative effect of this in relation to the curriculum, was that it led to a distortion in programme balance over time (case notes, 2003). When this factor was coupled with the limitations imposed by the environment as described in section one, it was scarcely surprising that mandated coverage of the essential learning areas (Ministry of Education, 1993) was never achieved.

Although it was not the case in all instances, it was apparent that Sarah's willingness to allow her students high levels of input into the direction of classroom curriculum, contributed to a high degree of programme fragmentation. Whilst student involvement in the design and format of curriculum is viewed by many authors as being highly desirable in a technology-supported, student-centered learning environment (Heinecke et al., 1999; Jonassen, 2000; McCombs, 2000; McCombs & Whistler, 1997; McNabb, 1999), the manner in which this was undertaken in this instance was fundamentally flawed. Sarah lacked an effective assessment framework such as that developed by Compton and Harwood (2003) which would have allowed her to validate, monitor, and report on the attainment of the diverse array of learning goals being pursued by the students in her classroom.

Related to this issue was the manner in which Sarah initiated learning experiences. Conventional unit or lesson plans indicating specific learning goals for a programme of study were seldom developed. Instead, Sarah chose to record topics as themes, with a range of headings relating to the areas she wanted to cover within the themes, as her guide. Learning experiences were recorded only as outlines in very general terms, with no specification of desired knowledge or skill outcomes being generated. Sarah stated that she found it difficult to record outcomes when working in an environment such as this (Sarah, interview, 2003). She claimed that if she did this, she would be confining the students in terms of what they would be able to learn through using the computers, by focusing them on predetermined, teacher decided, learning goals (Sarah, interview, 2003). However, what this strategy did was effectively deny each of her teaching units an identified target or 'to be achieved' goal or goals. What tended to happen in the absence of such goals, was that they got made up along the way, usually in response to perceived student interests, or where she felt the most student effort was being applied (case notes, 2003). As previously identified, revised goals were never recorded or assessed, and original unit intentions quickly became dissipated as the curriculum became fragmented. Identifiable student knowledge and skill development within this framework, was negligible in many instances (case notes, 2003; Camtasia video clips, 2003).

Sarah appeared reluctant to engage with students directly in the development of knowledge required to be successful in their learning tasks (case notes, 2003). This can again be attributed to her weak understanding of the role of a teacher in a student-centred, constructivist learning environment. Her view of her role as being largely 'hands off' in terms of directly teaching the content or conceptual knowledge students required, led many students to develop inaccurate understandings, or to stagnate in their work. She seemed instead to make an assumption that the computers would be able to 'teach' such knowledge, if she pointed the students in the right direction, or prompted them by challenging with relevant questions (case notes, 2003; Camtasia video clips, 2003). Students with well-developed knowledge bases upon which to draw, or who possessed competent research capabilities, were generally in a reasonable position to do this. They progressed satisfactorily, and appeared to enjoy the relative freedom afforded by the flexibility of the classroom curriculum.

As previously identified, the knowledge development process was usually more effective in groups where students engaged in collaborative practice, and were able to scaffold each others' learning supported by interactions with the computer. As will be discussed later, it was often the 'rich' conversations these students held when interacting with each other with and through the computer, rather than the computer itself, which facilitated such knowledge development. This finding is consistent with the work of Jonassen (1996 & 2000), Johnson and Johnson (1996), and Rysavy and Sales (1991), who claim that learning benefits exist for students working cooperatively when solving problems with computers, as long as they are prepared to engage with each other, and cognitively with critical content and concepts associated with learning tasks.

For other students who lacked such knowledge and skill, the situation was very different. These students often reached a point in their work where they were unable to progress without significant teacher or 'more capable peer' intervention. They lacked the conceptual, content, or procedural knowledge required to progress, and if they were unable to access this, they had few strategies to apply to solving learning problems. This often resulted in them opting out of the learning experience by applying strategies such as closing the program, diverting to more attractive and familiar features of the programs they were using, or changing the outcome to accommodate their incapacity or error. These students effectively stagnated, and resorted to spending more time 'playing' with graphical features of the software, or engaged in exploratory activities related to the software's operation. As introduced earlier in reference to the work of Jonassen (2000), the inability of these students to "engage in effortful reasoning" (p. 272) created a significant barrier to their learning, which resulted in them "applying their misconceptions" (p. 273) to learning problems.

The point of this discussion is that without very active teacher engagement in assisting students to construct accurate knowledge, computers when used for the type of learning activities represented in this room, were unable to adequately substitute. Although research by Russell and Plati (2002), Stoney and Oliver (2002), Mann, et al. (1999), and Wenglinsky (1998), identify the potential of technology to develop basic 'mechanical' knowledge, the findings of this study indicate that this capacity is limited, and not able to extend to less concrete or conceptually-based understandings.

Another significant impact of Sarah's student-centred philosophy, related to student work practices and organisation. While specifics of student work practices within the class will be discussed in the next section, it is important to understand the rationale for Sarah opting for the 'self-select' group system. As detailed in Chapter 5, Sarah allowed her students to select their own groups when they undertook their learning tasks in the e-classroom. This decision was based on her belief that socially-organised groupings offered the greatest potential for establishing a productive working environment, and was consistent with her philosophy of establishing a student-centred learning community (Sarah, interview, 2003). The manner in which this decision impacted upon student work processes and outcomes will now be discussed.

6.3 Student Work Practices and Outcomes in the e-Classroom

This section discusses the nature of student work practices in the e-classroom, with particular emphasis on the attainment of social, affective and cognitive outcomes. As identified previously, student outcomes in this classroom were strongly influenced by the design of curriculum and the manner in which it was 'planned' and introduced. This provided a highly variable and fragmented framework within which the students were expected to function. As a result, the performance of students in terms of the attainment of ill-defined goals was also highly variable, with success (or otherwise) in achieving outcomes being inextricably linked to the level of collaboration between group members, and the efficiency of their work practices. These will now be discussed in detail.

6.3.1 Collaborative Student Work Practices

As was identified in Chapter 5, collaborative work practices were utilised by approximately half the students in the e-classroom. These practices were by far the most effective in terms of enabling student access to ongoing guidance and support, and encouraging a level of critique and debate in the refinement of ideas and development of content. Students who consistently adopted collaborative work practices generally displayed high levels of mutuality and equality (Hooper, 1992).

The composition of work groups changed little during the course of the study. Irrespective of the task they were required to work on, they were usually made up of socially-generated pairs or threes, with the occasional and temporary addition of other members, usually on a 'consultancy' basis to achieve a specific outcome (case notes, 2003). Collaborative working arrangements were formed by students who were part of the larger well-established social grouping identified earlier, and these arrangements usually had a significant level of social 'history'. That is, they were formed amongst students who generally considered themselves to be friends of some standing, or had out of school relationships, usually through sporting or cultural groups.

Students who displayed consistently high levels of collaboration were able to sustain learning activity relatively independently, through a combination of discussion, debate, and scaffolding, and via feedback from the computer and through the use of cognitive tools (Jonassen, 1996 & 2000). The strong social basis upon which collaborative arrangements were established, meant that for these students the process of organising and undertaking learning tasks was a comparatively simple operation. Unlike others working in less collaborative arrangements or by themselves, these students did not need to spend time finding a workmate, or establishing or re-establishing a variety of work patterns, systems, or processes, each time they needed to undertake a task (case notes, 2003; Camtasia video clips, 2003, student interviews, 2003). The fact that they generally worked with the same person or persons each time irrespective of the task, meant that they were familiar with the way in which their workmates functioned, and the knowledge and skills they were able to contribute to the task. This resulted in greater efficiency in developing their outcomes, and in many instances, the more rapid completion of goals.

Collaboratively-functioning groups held what Johnson and Johnson (1996) earlier referred to as high levels of "positive social interdependence" (p. 1018). That is, they understood that the attainment of work goals could only be achieved if each member of the group was actively engaged by contributing to task, and could see personal reward for themselves in completing the task as a group. For students working in this manner, the task cooperative incentive structure (Slavin, 1983) was well-developed, with high levels of group interdependence being evident, and recognition that the rewards of group effort were also rewards individually, with an individual sense of satisfaction being gained from a job well done (Johnson & Johnson, 1989).

Collaboratively-functioning groups also displayed superior capacity in terms of being able to acknowledge the perspectives and views of group members, and objectively assess the validity of these views in terms of their contribution and relevance to the task (Camtasia video clips, 2003). Unlike other arrangements, personality aspects did not appear to come into their decision-making process (student interviews 2, 2003). Critique of ideas and views was made relative to the task rather than on a personal basis, or the extent to which a workmate was able to impose their views on another, such as was the case in less collaborative arrangements. When one of the group suggested something or made a contribution that the other did not agree with, they would generally debate the suggestion and negotiate a compromise, rather than abandoning the idea, or meeting it with a degree of ridicule (Camtasia video clips, 2003; case notes, 2003). These students actively supported each other in the construction of knowledge, and were more prepared to seek alternative perspectives when there was doubt as to the accuracy of information or work pathways. Such behaviour is consistent with the work of Hooper (1992), whose research found that students working collaboratively held a greater level of vested interest in the performance of their team-mates, and were more prepared to scaffold and support each other's learning thereby generating higher levels of mutuality.

The level of "working talk" (Simone & Hinemoa, interview 2, 2003) exhibited by students functioning collaboratively was also superior to other working arrangements. Verbal interaction was a hallmark of students working in this way, and was generally continuous throughout their work activities, as they 'picked and negotiated' their way through the requirements of a task. As in the Johnson and Johnson (1996) study, these students were more successful in operating software and negotiating understandings relating to tasks.

In all instances in which it was a requirement, collaboratively functioning arrangements produced a single outcome which generally represented a shared and negotiated understanding of what was required (Camtasia video clips, 2003). In situations where separate outcomes were to be produced, they worked together in producing each outcome as a separate entity, with all students making contributions to each others work, when and where required. Time management in such cases varied, with some arrangements opting to work together but choosing to divide 'keyboard time' within each session equally, while others worked together to complete one person's task, before commencing the other's. Regardless of which option was utilised, tasks were nearly always completed within the set time allocation (case notes, 2003).

The availability of computers appeared to support the manner in which collaboratively-functioning student arrangements operated (Johnson &

Johnson, 1996). For example, they utilised the features and capabilities of the software extensively in trialling and recrafting different processes and ideas. They were supported in this by the capacity of the computer to more easily and conveniently facilitate changes and modifications, as they sought to refine their outcomes (Camtasia video clips, 2003). Indeed, as Jonassen (1996 & 2000) had earlier reported, the ability of the computer to remove what might have been termed some of the more laborious components of student work, and 'free them up' to concentrate on solving learning problems, was very apparent in most collaborative arrangements.

Due to their willingness to enter into a dialogue with each other in response to onscreen feedback, these students were able to better analyse outputs, decide on a new or alternative course of action or response, and modify their subsequent inputs accordingly (Camtasia video clips, 2003; case notes, 2003). Their work processes reflected a highly interactive, multi-modal relationship, in which the computer became an 'active partner' in testing, trialing, and refining ideas and concepts, as they moved towards outcomes. The manner in which these groups operated was totally consistent with the type of approaches Johnson and Johnson (1996), and Jonassen (1996 & 2000) identified as being central to the effective use of computers in cooperative learning situations. As Johnson and Johnson (1996) stated, "computers themselves promote cooperative interactions amongst students" (p. 1031) and it was the richness of these interactions with the technology that significantly enhanced these students' learning.

However, two issues became apparent when observing students working in collaborative arrangements (Camtasia video clips, 2003; case notes, 2003). The first of these related to the issue introduced previously, in that even these students, with their peer-supported, computer-facilitated work processes, were often unable to develop new knowledge using this process, without significant, and sometimes direct, teacher intervention. While these students were generally more prepared to engage in the "effortful reasoning" (Jonassen, 2000, p. 272) of solving a problem within their group, there was a limit to which the built-in software features and tools could assist in this respect (Jonassen, 1996 & 2000). Without teacher input, many collaborative arrangements made mistakes or developed incorrect understandings, despite their relatively enhanced capabilities in using each other, electronic information sources, and the software tools (Camtasia video clips, 2003).

The reluctance of Sarah to engage by using more direct teaching methods held implications for the learning of all students. This reluctance was illustrated in Chapter 5 by the comments Sarah made during the Logo work of Justis, and also during her interview, when she commented on what she interpreted as the high levels of "learned dependence" (Sarah, interview, 2003) she had noted in some of the students. Sarah's frequent interpretation of students asking for assistance as 'learned dependence', and her strategies of dealing with such instances through "throwing back questions" (Sarah, interview, 2003) did not assist student learning in many instances (case notes, 2003). It was often the case that the students did not have sufficient capability to construct strategies for responding to the questions, or could not assimilate new information due to there being insufficient existing knowledge upon which to construct accurate understandings. Consistent with the Rysavy and Sales (1991) meta-analysis, higher levels of scaffolded interaction did exist between these students, but on many occasions these were insufficient to support accurate knowledge construction. Some direct teaching in such instances would have more readily facilitated knowledge development.

The second issue related to the fact that collaboratively functioning students often spent a lot of time helping other groups in peer tutoring roles, which meant that they were unable to make a consistent contribution to their own group's work. That is, they often inadvertently displayed low mutuality and equality towards their own workmates (Hooper, 1992). Although this factor did not appear to significantly impede the work of the group to which these students belonged, the generally 'technical' nature of the help they provided to others, meant that often they missed out on developing knowledge related to the context being studied. Often they would return to their own group at the end of a session, when most of the significant knowledge construction had been completed. In stating this, in many instances students working collaboratively who had been involved in peer tutoring, were able to catch up at the next work session, due to the quality of interactions with their workmates (case notes, 2003). The use of peer tutoring is a commonly-used strategy for managing student knowledge and skill development in computer-supported learning environments (Cleverley, 2004). However this study indicates that such strategies should be used in moderation and that peer tutoring duties be distributed more widely, rather than being the sole responsibility of a few.

As identified in Chapter 5, the levels of collaboration displayed by students in this room varied considerably along a continuum from non-collaboration, to full-collaboration. There existed approximately 16 students who did not belong to the stable social structure which underpinned consistently collaborative arrangements, but rather drew their workmates from various combinations of up to 5 or 6 others, or for various reasons, worked alone. Of this group, 10 or 11 students consistently organised themselves in groups which displayed variably-collaborative work practices (case notes, 2003).

Students working in variably-collaborative arrangements did not have a significant social 'history', but tended to choose their workmates more on an 'acquaintance' basis. As a result, the composition of these groups was fluid in nature, but typically comprised 2 or 3 members, with the membership often changing within the same unit of learning. This structure at times exhibited both collaborative and non-collaborative characteristics, with variable levels of mutuality and equality being displayed, often according to the nature and perceived purpose of work tasks (Hooper, 1992).

Collaboration between students existing in such arrangements appeared in a significant way to be linked to task incentive and motivational structures (Hooper, 1992; Slavin, 1983). That is, their assessment of the relative importance or imperative associated with the task influenced the manner in which they worked together. Several examples of this were witnessed during the preparation of the digital portfolios for the parent interview evenings as detailed in Chapter 5. During this task, students existing in variably-collaborative relationships showed high levels of collaboration, due to the task being perceived by them as 'high stakes'. This perspective was also supported by comments made by the students in relation to this task, during the second student interview (student interviews 2, 2003). However, as was illustrated in Chapter 5 in the 'buddy reading' example with Abby and Susan, collaboration could very quickly diminish, when individual agendas took precedence over collaborative activity. These students appeared to adopt what Slavin (1983) earlier termed an intra-group competitive incentive structure, in which the success of one group member came at the expense of the others. Such organisational systems Slavin (1983) viewed as being the least effective in promoting learning, with internal competition for resources and an emphasis on individual rather than group achievement, acting against the formation of truly collaborative structures.

Students working in variably-collaborative arrangements generally displayed higher-quality collaboration on tasks in which there was expected to be a joint or combined outcome, as opposed to tasks where single outcomes were to be produced (Camtasia video clips, 2003; case notes, 2003). Once again, such behaviour was consistent with the research of Slavin (1983), who found that students would adopt individualistic incentive structures when they knew they were going to be graded individually or were expected to produce individual outcomes, even when working as a group.

When working on joint outcomes, the nature of collaboration between members of these groups generally took the form of basic input to the technical accuracy of work such as spelling, grammar and sentence structure, through to, on a few occasions, some collaborative contributions being made to the generation of content (Camtasia video clips, 2003). However, unlike consistently collaborative students working in cooperative incentive structures (Slavin, 1983), students working in these groups showed little consistency in their interactions with their workmates, rather seeming to make decisions on whether or not or how to contribute according to their own, rather than their groups, needs and wishes (Camtasia video clips, 2003; case notes, 2003).

The fluid nature of variably-collaborative arrangements generally impacted negatively upon student performance. This was because students adopting these practices did not have a consistent and stable framework from which to operate, from one work session to the next. Often they were required to reconstitute groupings within the same activity, which held major implications for their progress (case notes, 2003). On each occasion these students needed to re-establish working relationships, usually with different workmates, and then work out where each other was up to with their previous activity. This effectively forced them into a 'computer-sharing' rather than collaborative structure, as they either had to start again from stratch with the new partner/s, or continue with what they had already started. Most opted for the latter, which meant that other group members had to 'sit it out', while only one worked on their outcome (case notes, 2003; Camtasia video clips, 2003). 'Hands on' computer time was usually allocated on an equal time basis, although the better performing of these arrangements did show limited understanding of the benefit of working together to complete one person's work, before applying the same process to the others (case notes, 2003). Students adopting this strategy generally completed more, and the outcomes were closer to cumulative rather than individual efforts.

Hooper et al. in a 1993 study on the effectiveness of computer-based cooperative learning, also found that the stability and composition of groupings greatly influenced student outcomes. Their research showed that where individual levels of accountability were maintained, and attention was paid to the composition of groups and to teaching students skills aimed at improving group processing and interactions, higher quality outcomes were produced (Hooper et al., 1993). Unfortunately in this study, levels of individual accountability were not maintained or monitored by the teacher, and assumptions appear to have been made about students' abilities to work collaboratively. Also, and consistent with the lack of teacher input generally, at no time was there any effort made to teach students the skills needed to work together in a way which could have optimised the potential of this environment.

Variably-collaborative arrangements were generally the domain of 'cruising' students. As detailed in Chapter 5, cruising was the phenomenon displayed by some students who aligned themselves with groups, or were members of groups, but with the primary purpose being the avoidance of work. Some students working in variably-collaborative arrangements would establish at the outset of a session, just who the person in the cruising role was to be for that session (Camtasia video clips, 2003; student interviews, 2003). They would then organise their behaviour, so that the nominated person would be able to 'ply their trade' with the minimal chance of detection. Over time, these groups endeavoured to ensure that the cruising opportunity was evenly distributed amongst all members. Alternatively, if the cruiser was not a member of an arrangement, they would attempt to attach themselves to one, with the objective being the same.

The strategies cruisers applied to avoiding detection in many cases were quite sophisticated, and in all cases, cleverly orchestrated. The most prevalent strategy used by cruisers was upon detection of teacher presence, they would gain access to an input device, and momentarily give the appearance of interacting with the onscreen content (case notes, 2003; Camtasia video clip, 2003). The moment the teacher turned away, they continued with their non-productive activity as before. Generally they were able to persist with this, as it was very difficult for Sarah to be able to determine accurately at any point in time, the level of input each group member had contributed to an outcome (Sarah interview, 2003). This difficulty was further compounded by the fact that the role of cruiser changed between the members of these groups, and between groups. Therefore, it was not the same person who was cruising each time (case notes, 2003). Irrespective of how the decision on cruisers was made, the cumulative input from these students to the attainment of outcomes, was at best negligible.

In the literature review the early work of Latane et al. (1979), Kerr (1983), and Kerr and Bruun (1983) was referenced in relation to the phenomenon of 'social loafing'. The cruising strategies displayed by some students in this class appear to be a variation on the broad concept of social loafing. While both phenomena are socially-based and result in variable levels of individual input to a collective task, 'social loafing' is perception-based, while cruising was very much an organised and negotiated strategy between group members to avoid work. Whilst the net outcome of both phenomena was similar, the level of planning, motivation, and conscious understanding of what was going on, was quite different.

6.3.2 Non-Collaborative Student Work Practices

Students who consistently exhibited non-collaborative work practices were the most dysfunctional of all the working arrangements in the e-classroom, and exhibited virtually no mutuality and equality (Hooper, 1992), and no "positive social interdependence" (Johnson & Johnson, 1996, p. 1018). Like those in variably-collaborative arrangements, non-collaborative students were not part of the 'social hierarchy' existing in the classroom, but were the same five students who were consistently 'left over' after all other work arrangements had been settled upon (case notes, 2003). They were not the students who consistently chose to work alone by choice, but sometimes 'worked' alone or on other occasions when all the computers had been taken, they worked with each other or attempted to join other groups. If they were part of a group, they made it their mission to try to dominate proceedings by denying their workmates access to the keyboard or mouse, or at the very least, ensuring they got the 'lion's share' of access (case notes, 2003). These students formed highly competitive and individualistic incentive structures (Slavin, 1983), in which personal agendas and desires took precedence over any notions of collaborative endeavour.

In more extreme examples of non-collaborative practice, students adopted a range of aggressive strategies to ensure that priority was given to their cause. These strategies ranged from the use of physical 'stand over' tactics, such as forcibly removing the other person from viewing the screen by pushing their roller chair out of the way, to verbal intimidation designed to distract their workmate/s from their task (case notes, 2003). Other strategies included the positioning of input devices such as the keyboard and the mouse out of reach of their workmate, or 'shouldering in' and taking control of one of the input devices to such an extent, that the others were unable to continue working.

Although the number of students in this class who adopted such 'bullying' tactics was relatively small, their impact upon other class members was significant. Non-collaborative students often 'migrated' from one group to another, sometimes within, but usually between sessions. The extent to which these 'bullies' were able to impact upon the work of the other groups was very much determined by the capacity of individuals to ignore the bullying, or to withstand it to the point that the bully would move away and try somewhere else (case notes, 2003). Most students were able to do this adequately, and after an initial period of intimidation, they were able to get on with their work. However others did not fare so well, and generally chose to opt out of the situation by letting the bully get their way, and abandoning their own attempts to get anything done. Some of these displaced students attached themselves to other groups and occasionally became a 'cruiser' or an inactive observer of the work of the 'hosts'. Others chose to 'sit out' the session, or to commence an equivalent activity using pen and paper (case notes, 2003). Whatever the response, non-collaborative students within a group impacted negatively upon outcomes. Any outcomes which were produced within such arrangements were generally solo efforts, incomplete, unrelated to the topic being studied, or of low quality (case notes, 2003).

Interestingly, students who regularly displayed non-collaborative practices did not appear in any way to influence the work of students in strongly collaborative arrangements (case notes, 2003). This was not because these individuals were able to withstand the unwanted inputs of the bullies better than others, it was simply that they were never subjected to it. That is, the bullies chose not 'ply their trade' in their direction. While the reasons for this were not explored, it may have been that the strength of the social relationship which existed between students working collaboratively was in some way acknowledged and respected by the bullies. The fact that these students were generally popular and well-considered members of the class, may have acted as a disincentive. Such a conclusion appears to be consistent with Hooper's (1992) work which identified the resilience and improved performance of groups displaying high levels of equality and mutuality. Alternatively, their decision to target only those who may be viewed as the most vulnerable – that is, those outside of the well-established social structure, is consistent with bullying behaviour generally.

Sarah's reluctance to engage in proactive management of these students appeared to be linked to her and Peter's philosophy of not denying educational opportunities to any student, as discussed in Chapter 4. While this is a meritable stance, failing to deal with the non-collaborative individuals in this class effectively denied learning opportunities to others. That is, through the time-consuming and reactive management strategies Sarah adopted, and the sheer amount of time these individuals consumed through their bad behaviour, valuable teaching time was taken away from other students, the majority of whom were motivated and keen to learn (case notes, 2003).

6.3.3 Students Working Individually

The final working arrangement utilised by members of the e-classroom was students working as individuals. Whilst this arrangement was adopted consistently by only two students, the role of the computers in both cases was significant. In these cases, both students opted to work alone by choice, with the computers helping to facilitate this process by sustaining their work, generally at its present level, in the absence of other external inputs from the teacher or a peer. With the help of the computer, these students created a learning 'micro-environment', almost appearing to 'personify' the computer by giving it a name, or holding 'working conversations' with it, in the absence of other students (Camtasia clip, 2003). Both of these students seemed to construct what Jonassen (2000) earlier described as a learning partnership, where the computer appeared to act in support of a learner's cognitive and social operation by "functioning as intellectual partners" (p. 9).

As revealed on a Camtasia clip, one of these students, Wendy, appeared to use the computer as something of a reflective device, holding a basic analytical conversation with it, as she orally queried its responses to her inputs. Whilst in the strictest sense of the terms these individuals did not display any level of equality and mutuality (Hooper, 1992), in another way the computer acted as a substitute group member, and served as a 'reflective device' as these students refined their thinking and developed their outcomes. When interpreted in this way, the computer became an important player in the process of learning for these students, engaging with the students (ie: displaying mutuality) as they progressed their learning tasks (Jonassen, 2000).

However, these individuals did not appear to be able to progress their work significantly by using computer outputs alone. In fact, the absence of input from a 'real' partner or the teacher to solving learning problems, or by providing direction in terms of the technical operation of software or clarifying the requirements of tasks, greatly inhibited their progress. Unlike students working collaboratively who were able to use each other to test ideas and theories, and in the process receive formative feedback and guidance that assisted in moving them on, these individuals tended to stagnate when they came across a problem they were unable to solve (Camtasia video clips, 2003; case notes, 2003). Alternatively they went off on tangents, such as engagement with software diverters, or changed their outcome to accommodate their mistakes or incapacities, in a manner that was illustrated by Wendy in Chapter 5 when constructing her chequerboard Mathematics game.

Their apparent reluctance to ask for help, or often the unwillingness of others to provide it, did not appear to be able to be substituted for by the formative tools embedded within, or the content or operation of the software (Camtasia video clips, 2003). In addition, the computer was unable to provide or develop in these students the knowledge that was required to support and extend their learning within many learning tasks, beyond its present level. Although research such as that completed by Cox et al. (2003), Reeves (1998), and Weglinsky (1998) indicate some potential for using computers to assist in the construction of basic knowledge, this study indicates that for this class such a capacity did not extend to hierarchical understandings.

Additionally, by sanctioning these students' individual work processes, this arrangement effectively gave them a 'way out' of having to engage with others in the class, thereby further reinforcing their isolate status. Whilst depending on the performance of these students this may not necessarily be a bad thing, it tends to undermine any social objectives that may be in place for such facilities as e-classrooms.

6.4 Affective Processes and Outcomes

As discussed in the literature review, considerable attention has been paid to the role of computers in enhancing student attitudes to learning (Bialo & Sivin-Kachala, 1996; Bolstad, 2004; Kulik, 1994; Panitz, 1999; Parr & Ward, 2004; Pittard et al., 2004; Small, 1997; Somekh et al., 2002; Terrell & Rendulic, 1996; Wenglinsky, 1998). While the findings of this study were generally consistent with these studies, there were a number of issues which arose relating to the extent of the motivational impact, how it was formed, and how enduring it was. These aspects will now be discussed.

Firstly, it needs to be acknowledged that initially at least, all students enjoyed working in the e-classroom. They found being able to access and work with the computers preferable to working in a 'conventional' classroom, and were generally happy with the outcomes they produced (student interviews 1 & 2, 2003). However, this enjoyment appeared in part to be based on a perception that the work they were doing on the computers was more akin to 'play' than 'real' work (student interviews 1 & 2, 2003). It was also aligned to specific features of the software they enjoyed using, rather than any perceived learning benefits from using the computers (student interviews 1 & 2, 2003). It was apparent that these two elements were linked, and displayed themselves through student attitudes to the various software packages that were used, and engagement with what were earlier termed 'software diverters'. This is what Simonson and Maushak (1996) refer to as the students' "affective response" (p. 986) to the technology, and was based on little more than an emotive reaction to the surface features of the software.

As previously mentioned, it was generally software of a graphical or interactive nature which gained the most favour. Programs such as Powerpoint, Publisher, or Inspiration, featured strongly in software preference (student interviews 1 & 2, 2003). Multimedia functions such as animation, the ability to incorporate sound and moving images, and attractive header and border-art options, were identified as features of these programs which held greatest appeal (student interviews, 1 & 2, 2003). In this class, student "affective response" (Simonson & Maushak, 1996, p. 986) to the prospect of using specific software packages which contained such features was instrumental in the establishment of their "behavioural component" (Simonson & Maushak, 1996, p. 986). That is, student attitude to the software to be used (most often determined by the feature-set it contained), impacted significantly upon the way in which they used it in their work.

All students at some time during the research engaged in interaction with software features in a manner earlier defined as 'diversionary'. This behaviour was not confined to any particular grouping composition, but tended to be utilised more by students who were struggling with a task, or were not prepared to engage in the effort of solving a learning problem (Jonassen, 2000). In at least four observed instances during the course of this study, it was apparent that students were deliberately applying greater effort to work which involved the use of appealing 'diverters' (case notes, 2003). That is, their behavioural response (Simonson & Maushak, 1996) to this software was one of heightened engagement, which Sarah interpreted as enhanced interest in the topic. She then 'legitimised' the diversionary activity by extending the work period allocated to the task (case notes, 2003).

The cumulative result of prolonged engagement with software 'diverters' was the non-attainment of learning outcomes, and significant time-wastage. This finding appears to be consistent with the results of the Wenglinsky (1998) study where continual or high levels of computer use actually led to a decrease in work efficiency in terms of the attainment of goals, and an increase in the computers' use for non-productive purposes.

In addition, some students' attitudes relating to participation in the e-classroom did not appear to have an enduring "behavioural component" (Simonson and Maushak, 1996, p. 986). For example, eight students showed some reversal in their attitudes relating to the use of the computers for learning between the first and the second interviews. All students in the initial interviews (Appendix 1), indicated a strong preference for using the computers as much as possible to complete their tasks. However, by the time of the final interviews at the end of the school year (Appendix 2), this had changed somewhat. Although still finding high levels of satisfaction and enjoyment from using computers in their work, after using them continually for the year, eight students (25% of the class) indicated a preference for a more balanced approach, one which allowed them to utilise a wider range of media in the production of their outcomes. It would appear from this finding that for some students, any 'novelty' effect from the computers diminished with continual use over time.

The formation of the attitude of some students was also influenced by the extent to which they perceived the e-classroom programme adequately met their learning needs (student interviews 2, 2003). Approximately a quarter of the students indicated some concern with the heavy emphasis placed on the use of computers for all learning experiences. They either commented that they felt they may be at a disadvantage when they left the e-classroom and went to another school – in this instance an Intermediate (year 7 and 8) school – or that their progress had suffered in other areas such as handwriting or spelling (student interviews 2, 2003). Two students commented that they undertook additional 'lessons' in their own time at home, so that what they saw as essential basic skills and knowledge such as their Mathematics facts or spelling accuracy, could be maintained (Simon & Zane, interview 2, 2003).
Others commented that they enjoyed working in books or on paper as an alternative option. They felt that the number of computers in the classroom

should be reduced, with the students being 'rotated' to them, or given the opportunity to balance onscreen with paper-based activity (Sherilee & Susan, interview 2, 2003). Still others commented that they found using the computer for all learning tasks restrictive, in that they were unable to achieve the results they were wanting by using software alone (student interviews 2, 2003).

What Simonson and Maushak (1996) refer to the 'cognitive component' of attitude formation was also displayed by this group of eight. They felt that their lack of technical skill in using the software was a major obstacle which did not allow them to take full advantage of the capabilities of the computer. Others considered they did not possess the level of physical coordination or dexterity to allow them to use the mouse well enough to create quality drawings or diagrams (Simon & Zane, interview 2, 2003). While these students indicated that they saw learning to use the computer as valuable at a technical level, they considered that other presentation formats should be more actively explored and promoted.

As indicated in the literature review, the way in which students perceive the learning environment can have a significant influence on their attitude towards it, and the level of benefit they can gain from being a part of it (Nair & Fisher, 2000). As in the Nair and Fisher (2000) science course study in relation to environmental factors, what appeared apparent for at least these eight students, was the level of concern they possessed about the balance of the programme in the e-classroom, and the almost exclusive emphasis on using computers for all their work. While this study did not attempt to quantify the impact that this concern had on student attitude formation, it is certainly of worthy note.

This study indicates the difficulty in making assumptions about any universal or enduring motivational impact from computers in classrooms. Whilst acknowledging that attitude formation is the product of multiple inputs (Bolstad, 2004; Simonson & Maushak, 1996), as identified above, sufficient evidence was found in this study to suggest that the presence of computers *alone* within this e-classroom, did not have an *enduring* impact on motivation and attitude formation, or led to improved outcomes for a significant number of students. Additionally, any affective component was based on little more than an "affective response" (Simonson & Maushak, 1996, p. 986) to specific features of the software, which students found enjoyable to use. While this finding may appear to directly challenge other research in this area (ACOT, 2002; Lepper & Hodell, 1989; Warschauer, 1996; Wishart; 2000) it needs to be remembered that attitude formation is intimately linked to environmental and social context. As has been discussed above, in this example both of these factors displayed, at best, only variable levels of functionality.

6.5 Cognitive Processes and Outcomes

As revealed in the data, students in this classroom displayed diverse cognitive strategies and responses to learning problems. The level of 'preparedness' to engage in solving learning problems naturally held significant implications for the progress students made in this room. Student responses to learning problems could be interpreted on a continuum – ranging from at one end, non-engagement and either diversion or reversion – to at the other end, active engagement and work continuance. As illustrated by the data, significant numbers of students were unwilling to apply any 'cognitive effort' to solving learning problems. As also illustrated, to an extent the manner in which computers functioned supported their responses in 'bailing out' of a difficult cognitive situation, or altering the outcome to accommodate their lack of knowledge. The 'easy edit' capability of software, and the fact that it was quick and convenient to close down applications and start again if the going got tough, did not support students, if they themselves were not prepared to exert any effort to solve the problem in the first place. The behavioural response (Simonson & Maushak, 1996) many of these students applied to problems they could not solve or were not prepared to engage with, was to either 'divert' to activities they could cope with technically or intellectually, or engage in non-productive activity such as the use of 'software diverters'.

Due to limited teacher intervention and monitoring of work in this class, students were able to 'get away' with this for prolonged periods of time.

Such characteristics as those described above, according to Salomon and Globerson (1987) and more recently Jonassen (2000) with reference to the American experience, are symptomatic of what Jonassen (2000) describes as "a diminution (amongst students) in the ability and willingness to think" (p. 272). It appeared that some students in this study used the software in a manner which avoided the necessity of engaging in "effortful reasoning" (Jonassen, 2000, p. 272), choosing instead to adopt a quick-fix solution to a problem they were unable to immediately solve (Salomon & Globerson, 1987). Unfortunately the manner in which software operates in being able to easily 'mask' this 'bailing out' behaviour, and the fact that when students work on computers they do not leave a visible 'work trail', did not assist the teacher in monitoring and dealing with this lack of engagement. In stating this, the apparent acceptance and on occasions encouragement by the teacher to use such strategies – as illustrated earlier by reference to Justis and his Logo work – did not help. Such responses appeared to support what Salomon and Globerson (1987) pointed to as a general decline in the level of expectation, and the acceptance of this by teachers, parents, and society.

At the other end of the scale, students who were prepared to exert cognitive effort by interacting critically with data, information, and learning problems, were able to gain significant advantages from the computers. The computer environment, in particular the software capabilities as described previously, provided these students with useful resources which they used effectively in modifying and refining their outcomes (case notes, 2003; Camtasia video clips, 2003). It was clear that these students brought to the learning task more knowledge and skill than their classmates, and they were able to apply this using an array of strategies ranging from direct application, to experimentation. To a considerable extent, the performance of these students was also enhanced by the collaborative working frameworks they adopted (Hooper et al., 1993; Johnson & Johnson, 1996).

For many of these groups the foundation to work effectiveness was socially-based. It was the strength of the relationship developed between group members, and the fact that they had a good understanding of how each other thought and worked, that allowed more effective use to be made of the computers (case notes, 2003; Camtasia video clips, 2003). Not only were these groups prepared to engage with the problem, they had more 'unified cognitive resource' which could be brought to bear on it, and better strategies for independently sourcing and working with information where deficits were identified. It was very much a case of "two (or three) heads are better than one" (Simon & Zane, interview 2, 2003).

Almost without exception, students working collaboratively appeared to have available to them a much wider array of options related to solving learning problems (case notes, 2003, Camtasia video clips, 2003). Consistent with the Johnson and Johnson (1996) and Hooper et al. (1993) studies, it was these students who persevered longer at problems, sought and analysed more rigorously multiple information sources in reaching a decision, and held more detailed and analytical conversations relating to problem solving options (case notes, 2003; Camtasia screen capture, 2003; student interviews 1 & 2, 2003). As noted by Jonassen (2000), the ability to apply complex thinking skills to a learning problem is a vital characteristic for successful use of computers as cognitive tools. In this study, students who were prepared to exert mental efforts by applying such complex thinking processes, and then reflect critically on the results, were able to gain some significant advantages from using the computers.

A good example of this was illustrated in the previous chapter in reference to the group working on their 'Charles Schultz' study. As theorised by Jonassen (2000) and earlier by Norman (1993), it was apparent for these students that the computer environment to an extent supported their joint cognitive processes. Compliant with their theories, the willingness and ability of this group to reflect upon and respond to a discrepancy in information, and then to use the computer efficiently to seek clarification, was a good example of using technology to "reflect on what they have done, what needs to be done, and what else they need to do and know" (Jonassen, 2000, p. 13).

In the literature review, Jonassen (1996 & 2000) discussed the power of computers when used as cognitive tools in supporting higher order thought processes. He identified the need for students when using computers for such purposes to have engaged with, and hold a deeper understanding of the content material being investigated (Jonassen, 1996). It was apparent in this study that deep engagement with content was not a natural process for many of these students, and as a result, the use of software-based cognitive tools for many, did not realise such theoretically-possible gains. The conclusion in this respect is that if students *are* to benefit from the availability of software-based cognitive tools, they must be prepared to exert the cognitive effort involved in engaging with critical concepts and content. The assumption that through the *use* of cognitive tools alone higher order capabilities will be developed, is at best dubious. This assumption appears to have been made by the teacher in this study.

In summarising this section, the issues relating to the effectiveness of this e-classroom in supporting student cognitive, affective, and social development can be traced back to the manner in which the project was conceived and implemented in its earliest stages. The lack of a shared and educationally-sound purpose reflected in specific and identifiable student outcomes, should be interpreted within the wider framework of more general confusion relating to the overall place of computers in curriculum (Brown, 1995 & 1997; Capper, 2001; Stratford & Brown, 2002). In many ways the flawed establishment process for this e-classroom merely mirrored this.

This lack of clarity of purpose reflected in confusion and unsurity about the nature of teacher role in computer-dominated environments, with respect to the balance that needs to be struck between student-centred approaches and more teacher-organised or structured learning strategies. The adoption of strategies which prioritised student interests and preferences above the mandatory objectives of the New Zealand Curriculum Framework (1993), contributed to distortion in curriculum coverage. When this was combined with limitations imposed by the design of the classroom, the restrictive technical infrastructure, and the limited range of available software, the breadth of learning experiences these students were exposed to was limited. Such limitations did not go unnoticed by several students, and appeared to contribute to a diminishment over time in the favourable attitudes some held towards their work in the room.

As discussed, the extent to which students were able to secure any learning opportunities in this environment was closely aligned to the extent to which they adopted collaborative work structures, which were able to generate high levels of mutuality and equality (Hooper, 1992). In the absence of frequent and engaging formative teacher input, such structures provided many students with the type of framework needed to sustain work independently. However, as identified, there were limits to the effectiveness of even these structures in supporting hierarchical knowledge construction. Additionally, the reluctance of many students to engage in the cognitive effort required to solve learning problems could not be compensated for by the technology.

Finally, in responding to the aim of this study in describing student work processes in the e-classroom and the factors which influenced this, this thesis argues that the presence of computers within this particular environment offered few significant learning advantages for a considerable number of students. That is not to say however, that the potential for this was not present. Rather, it was the nature of the environment in which the computers were embedded which actively mitigated against any prospects of enhanced outcomes.

6.6 Recommendations Arising from the Findings

The last section of this chapter, the recommendations, responds to the final research question:

> **In what areas might changes or improvements be made to optimise the learning potential of this classroom?**

It must be reiterated that it is not the purpose of this thesis to 'pass judgment' on the effectiveness or otherwise of computers when used in this manner, or within this particular school. It needs to be accepted that computers and other electronic technologies are, and will continue to be, an integral component of education. As outlined in the methodology chapter, these recommendations are intended to help inform the sort of framework within which the best use of this technology can be made *in this classroom,* rather than necessarily be generalisable to all like contexts.

Consistent with the previous discussion, these recommendations are organised under the following headings and are listed in numbered-point format, with a brief description of each.

1. The establishment process;
2. E-classroom environment;
3. Curriculum design and monitoring;
4. Teacher understandings, work and role; and
5. Student work processes.

6.6.1 The Establishment Process

Many limitations in the performance of this e-classroom can be attributed to its initial planning and implementation processes. The following recommendations are made in relation to re-establishing and clarifying its purpose in the school:

1. Revisiting the broad vision for establishing the e-classroom, and defining this into a set of specific goals for students ie: skills, knowledge, competencies, attitudes (etc.) across social, affective and cognitive domains;
2. The generation of specific measures or criteria against these goals, that could be used as indicators of progression towards goal attainment;
3. The articulation of the vision, goals, and performance indicators to the whole staff, and the wider school community. This should include explanation of expenditure, and anticipated benefits from this in terms of (1) and (2) above;
4. A clarification for other staff of various possible avenues for their participation in the project, and the provision of support to do so;
5. The provision of regular updates to staff and the wider school community on the progress of the e-classroom in relation to achieving goals, and the valuing of the professional knowledge of other staff in improving its performance; and
6. A clearer definition of the role and responsibilities of the Systems Administrator, and how she is expected to interface in meeting the needs of teachers.

6.6.2 The e-Classroom Environment

Changes should be considered to the physical layout of the classroom and the technical network setup. This is to allow for a wider array of software to be used, and a greater variety of media to be explored by the students in developing outcomes (see also *Curriculum Design and Monitoring*). The following recommendations are made in this respect:

1. If the thin-client technology is unable to be totally replaced, options should be explored which will allow for the integration of multimedia capability.

These options should enable the use of digital video, cameras and other imaging technologies (etc.) at an individual computer level;

2. The redesign and redevelopment of the physical layout of the classroom, to include safe 'wet' areas, and sufficient space for large groups of students or preferably the whole class, to engage in creative or experimental work using alternative media;
3. The provision of a wider array of software, more capable of supporting the diverse learning needs of these students, and mandatory curriculum objectives;
4. Changing the configuration of the network to ensure students cannot interfere with the files of others, or to add to shared resources such as spelling dictionaries;
5. Changing the configuration of the network to allow the teacher to sort and access student files by date and/or time created. This is essential for formative and summative assessment, and student work-monitoring purposes; and
6. The addition of a wider array of cost-effective printing options, so students may, if desired, print out their work for sharing with others.

6.6.3 Curriculum Design and Monitoring

The design of curriculum in the e-classroom was very tightly aligned with teacher philosophy and associated teaching strategies (see also *Teacher Understandings, Work, and Role*). The following recommendations are made in this respect:

1. Improved planning processes, to better ensure a balanced coverage of the mandatory achievement objectives from the New Zealand Curriculum Framework (Ministry of Education, 1993);
2. Clearer specification of learning outcomes, and the identification of teaching 'pathways' towards their attainment;

3. More teacher direction and input to the generation of learning outcomes, and less teacher responsiveness to 'errant' student divergence in generating these;
4. If the present integrated theme or topic-based curriculum is to be maintained, the adoption of an assessment framework such as that developed by Compton and Harwood (2003) should be considered. This allows for a balance of teacher-determined and student-negotiated learning outcomes, whilst providing a structure for formal recording and verification of these; and
5. Consideration may be given to reducing the number of computers in the room, thereby requiring students to engage in the use of alternative media. At the very least, the emphasis on using computers for virtually all learning tasks, should be relaxed.

6.6.4 Teacher Understandings, Work, and Role

This research has clearly identified the absolutely critical role the teacher has to play within a computer-supported learning environment. This should not be interpreted as a return to didactic or transmissive methodologies, but rather the practice and enhancement of essential skills that make up good teaching, irrespective of the presence of computers. Recommendations in this respect are:

1. A revisiting and clarification of the role of the teacher in a student-centred, constructivist learning environment. This will require a reassessment to be made of the *radical* nature of present teacher-held interpretations of 'student-centredness';
2. Assuming a stronger leadership role within the classroom, for decisions relating to overall student learning and curriculum design;
3. The clear identification of the extent of prior knowledge or skill held by students in relation to tasks or topics, and the active and direct engagement by the teacher, where needed, to bridge any

deficits. This should include content, conceptual, and technical knowledge, and skill or strategy aspects such as solving problems or working with and using information;

4. *Assumptions* about the capability of computers alone to facilitate significant outcomes for students independent of teacher input, should be interrogated;
5. More rigorous and regular formative and summative assessment of student work through the checking and evaluation of student outputs;
6. More vigilant monitoring of the class and their work patterns, particularly the presence and operation of 'cruisers';
7. More teacher input by way of teaching skills needed to work effectively in collaboration with others;
8. More proactive management of students exhibiting extreme non-collaborative practices; and
9. Increased concentration on ways of using the computers to enhance student outcomes, rather than for student 'edutainment', placation, or management.

6.6.5 Student Work Processes

The group organisational structures utilised by the students had a significant impact upon their performance. Clearly those organised in structures adopting collaborative practices were in the best position to take advantage of any independent learning potential presented by the computers.

Therefore, within this classroom, consideration in this respect should be given to:

1. Establishing where possible, socially-based and stable collaborative groupings, and maintaining the composition of these for the course of the year;
2. Allocating groups a computer to be used for the course of the year, or a term at the very least. This would assist in tracking

student work patterns and alleviate issues associated with students 'scrambling' to access machines;

3. Encouraging 'isolate' students to work within, rather than outside of the grouping structure, if social objectives are established for the e-classroom; and
4. Using peer tutoring in a more organised and equitable manner. Care should be taken not to use the same student tutor each time, as this potentially impacts negatively upon their learning.

The final chapter concludes this thesis by extrapolating key understandings, in identifying a set of considerations or guidelines schools should consider if undertaking similar initiatives. It also identifies strengths and limitations of the research, and areas for further investigation into the effectiveness of using computers in this manner.

CHAPTER 7

Conclusion

This final chapter concludes the thesis by identifying a range of considerations and guidelines, generated from the previous discussion, which could be used by other schools considering similar initiatives. The guidelines have been written as general principles, and should be interpreted in conjunction with the specific recommendations for changes to this e-classroom as detailed in Chapter 6, which in many ways illustrate how the principles can be implemented at a practical level.

The principles detailed below should be considered as providing guidance only, rather than acting as a set of 'hard and fast' rules generalisable to any situation. As explained in Chapter 3, the emphasis in this study was on "particularisability" (Erickson, 1996, p. 130) rather than generalisability, and the reader should interpret its findings accordingly. In this way, this case study may inform practices with computers across a range of situations.

This chapter also identifies strengths and limitations of the research, and suggests areas for further investigation. It closes with a concluding statement relating to the importance of examining the place and future of computers in classrooms, and how the role of the teacher will continue to be pivotal in enabling any learning potential inherent in them, to be realised.

7.1 Considerations and Guidelines for Schools Considering Similar Initiatives

7.1.1 Planning, Infrastructure and Environment

Of central importance to the successful development of innovations such as e-classrooms, is the establishment process. There needs to be a clearly articulated and shared purpose for the existence of any such facility, based on a sound educational rationale and taking into account broad cognitive, affective, and social goals (Heinecke, 1999; McCombs, 2000). These goals need to be specified as identifiable outcomes for students, which are revised and updated regularly to reflect new potentials which may be revealed, as more knowledge is developed about any learning advantages presented by the technology. Where possible, the establishment process should take place in conjunction with all staff at the school, so that a sense of 'collective ownership' is developed, rather than the facility being viewed as the exclusive domain of a few. The involvement of other staff members will also ensure that a broader base of professional expertise is made available to assist in project goal-setting and evaluation. The role of the principal in leading and managing this process is critical, and needs to be supported by a deep understanding of the theoretical underpinnings for computer use in schools. Without a depth of leadership knowledge in this area, there exists the possibility that decisions will be made based at a shallow and reactive level, rather than using soundly-based theoretical perspectives.

Additionally, it needs to be kept firmly in mind that the core objectives and outcomes as mandated by relevant legal documents such as curriculum frameworks, should form the basis of any programme operating in a classroom, whether it be digitally-enhanced or not. Whilst the advent of computers may be viewed as an alternative way of implementing the curriculum, *basing* the curriculum on the capabilities (and limitations) of hardware and software is not recommended.

As demonstrated by this study, any tendency to do this can lead to distortion and narrowing of programmes provided to students, and an imbalance in curriculum coverage.

With regard to the physical and technical setup and design of e-classroom spaces, this study concluded that establishing such facilities within existing classrooms is not recommended. Where possible, if a decision is made to implement an e-classroom, the physical space should be custom designed and built. New designs should include multiple areas or work spaces, so students are readily able to undertake practical work and explore a range of media, including, but not limited to digital resources. Consideration should also be given to the establishment of 'digitally-supported' rather than 'digitally-dominated' learning environments. This may mean a lessening in the ratio of computers to students, so that computers become one option amongst others for students to undertake and present their work.

The technical infrastructure of e-classrooms needs to support access to, and reliable use of, a range of electronic and digital media. For this reason, technical systems such as thin-client networks are not recommended due to their inherent complexity and inability to easily support multiple media formats at a desktop level. Students should also have ready access from their desktops to a printer for reproducing work samples in a more readily accessible format. Any costs associated with this need to be factored into the operational expenses associated with operating such a facility, and planned for in advance. Whatever the technical system adopted, it needs to be secured against intentional or unintentional interference by students, and support easy and organised teacher access to student work for formative and summative assessment purposes.

7.1.2 Identification and Training of the e-Class Teacher

The role of the e-class teacher is complex and demanding. In identifying a suitable teacher to fulfill such a role, it should not be assumed that any or all teachers want to, or are capable of, teaching in such an environment. Suitable teachers must possess the depth of understanding and theoretical knowledge relating to the role of computers in education in much the same manner as the principal. However more than this, they need to understand how such theoretical perspectives are able to be enacted within the classroom. Specifically, they must understand the blend of student-centred with teacher-determined strategies, which must be developed to ensure that student knowledge and capability across social, affective, and cognitive domains is progressed (McCombs & Whisler, 1997; McNabb et al., 1999).

Furthermore, teachers teaching in e-classroom environments need to be expert professionals. They should possess indepth knowledge of learning theory, curriculum and unit-related concepts and content, technical know-how relating to software and hardware, and learning management strategies, which will enable them to successfully coordinate simultaneous multiple learning activities across a range of knowledge domains. As Skerman et al. (2000) explain, they need to be able to "use educational technologies to support a range of higher order cognitive, metacognitive, affective and social skills, while retaining the best of current practice" (p. 13). The importance of ongoing professional development for the e-class teacher in the areas mentioned above, cannot be ignored. As is the case with teachers generally, it should not be assumed that an 'expert e-class practitioner' has mastered all they need to know in relation to the art of teaching in an e-classroom. This is particularly relevant where both technological advances, and increasing knowledge of the manner in which students work in such environments, is rapidly changing the basis upon which computer use in schools is founded. Knowledge of computer-enhanced learning is evolving rapidly, and e-classroom teachers need to be at the forefront in both developing this knowledge, and benefiting from it.

With regard to the selection process for the e-class teacher, it is recommended that this process be as 'transparent' as possible, whilst at the same time clearly stating the desired attributes of any successful candidate in terms of the characteristics and understandings described above. If an appointment is to be made from within the school, the selection of a suitable candidate should be made against identified criteria, and be the joint responsibility of the principal and possibly a representative/s from the staff. Care should be taken to ensure that 'shoulder tapping' is not the basis upon which a decision to appoint is made, as this may contribute to divisions within the staff, such as those which were clearly evident in this school.

As with any professional activity, a system of performance monitoring needs to be put in place to ensure that the goals for the e-classroom are being met, and that teacher performance and accountability within the environment is maintained. Such a process should not be seen to be unduly harsh, punitive, or outside of established school performance monitoring systems. It should however, reflect the 'cutting-edge' nature of such initiatives and acknowledge their evolutionary nature, by offering a framework which allows for serendipitous findings and is supportive of innovation, while at the same time providing an accountability structure. A careful balance needs to be developed between these two objectives.

7.1.3 Curriculum Design

The capacity of computers to support student hierarchical knowledge construction independent of teacher input, should not be assumed. Although some research has indicated limited benefits from using computers to enhance basic knowledge development (for example, Cox et al., 2003; Mann et al., 1999; Weglinsky, 1998), this study indicated significant limitations of computers when knowledge requirements were more complex or were conceptually-based. In designing and implementing the curriculum for an e-classroom, it must be kept firmly in mind that the principal purpose of using technology must be to enhance student learning, and a vital element of that learning remains the construction of knowledge. Care needs to be taken to ensure that what is valued as outcomes from computer-based activities is more than that which is represented by aesthetic enhancements, or the use of 'whiz-bang' features of software. If this is not the case we run the risk of 'dumbing down' student learning, by prioritising surface features of outcomes over the quality of knowledge and understanding they represent.

The role of the teacher in this respect is critical, and relates back to the previous section on the required characteristics and understandings of teachers working within these environments. The importance of teacher scaffolding, and where necessary, direct involvement in assisting in the construction of student knowledge, must be clearly understood and acted upon. Also, teachers need to ensure that formal planning practices are maintained, so that units of learning have identified targets or outcomes, which provide a working structure for teacher and student activity. As previously discussed, these should be balanced and enable fulfillment of mandatory curriculum requirements.

As theorised as early as the 1980's by Taylor (1980), computers have long been viewed as offering unprecedented potential to transform learning from a teacher-dominated to a more responsive, student-centred process. While authors have generally viewed this as positive (for example, Bialo & Sivin-Kachala, 1996; Hooper, 1992; Hooper et al., 1993; Iverson, 2001; McCombs, 2000), the move towards the delivery of a more diverse and responsive curriculum as is possible using technology, requires a rethink of traditional student assessment and work monitoring processes. If teachers are to optimise the benefit from access to high levels of technology, and within the parameters of mandatory documents design more flexible learning programmes, the employment of more individualised assessment schemes such as Compton and Harwood's (2003) Technology Assessment Framework (TAF), is essential. Like the TAF, such schemes need to be formative and summative in nature, and validate both teacher-determined and student-negotiated learning outcomes in the development of specific learning pathways, which can take into account the divergent learning opportunities presented by computer access. The adoption of such frameworks could assist teachers working in e-classrooms to better manage student work, and keep track of their progress towards learning goals.

Finally, consideration needs to be given to ensuring that outcomes from student work in digital environments are accessible to parents or caregivers, and others who may hold a vested interest in student progress. This study revealed the importance to many students of being able to share what they have achieved, and receive appropriate reinforcement for it. The school in which this study was undertaken served a very low socio-economic community with minimal computer access, and the development of digital portfolios on CD Roms and work samples stored on the school's network, meant may parents and caregivers were unable to readily input or comment on their children's work. While this may be different for schools in other socio-economic contexts, thought should be given to a mechanism for ensuring the accessibility of student work to other audiences.

7.2 Strengths of the Research

This research had many strengths related to its focus and methods. Firstly, the context and situation in which the research took place was distinctive in that it was the only e-classroom in the Northland educational region, and one of very few similar facilities in New Zealand. The advent of the e-classroom concept is a very recent phenomenon, as is evidenced by the lack of specific research and documentation associated with them, both in New Zealand and internationally.

Secondly, the unique data collection tool Camtasia (Techsmith, 2002), also assisted greatly in this study, by providing exceptional insights into how students worked, thought, and interacted with each other and the software. This tool revealed clearly the complexity of practices and interactions between members of this class and the computers, and how these impacted ultimately upon student performance. It also revealed a significant amount of information relating to how effective students' use was of software tools such as the spelling and grammar checkers, and how they used these to greater or lesser benefit in their work. The impact and operation of 'software diverters' was also revealed, and in other instances, Camtasia was able to capture the nature of teacher-student interactions, and the consequential impact these had on student decisions. This was able to be recorded without explicit 'by instance' student or teacher knowledge of this happening, enabling 'true and natural' data to be gathered. Without the use of this exceptional tool, it is doubtful that the collection of such rich and accurate data related to what was happening 'behind the scenes' would have been possible. It was the richness of this data that enabled insights to be gained into social, affective and cognitive achievements, or the lack of them. Researcher observation and interviews alone would have missed much of the complexity of student interactions in this room.

A further strength of this research related to the relationship the researcher forged with the students in the classroom. As was identified by the teacher and discussed in Chapter 3, it was critical that the researcher was seen to be an integral part of the learning environment, and was not viewed by the students with suspicion or as a threat. The significant number of students in this class with behavioural, social, or personal issues, meant that a level of trust needed to be developed in relation to the researcher. If this was not established, it was considered that true and accurate accounts of student practice would be unattainable (Sarah, interview, 2003). It is considered that such a relationship was developed between the researcher and the students in this class in order for research objectives to be achieved. The use of a case study methodology, and the ability to adopt roles ranging from non-participant observer to participant-researcher according to the needs of the study, were instrumental in ensuring successful data acquisition. Additionally, the duration of the study over 16 months allowed insight to be gained into the consistency of patterns of students' interactions with the computers, as they worked. The researcher is still in active contact with the students and teacher involved in the study, both electronically and in person.

Formative and summative feedback from the study was provided to the principal and teacher, resulting in several changes being made to the organisational systems and curriculum design in this e-classroom. Examples of this include the recent provision of a 'Multimedia Unit' within the classroom, with the addition of computers capable of working-in with the thin-client network but offering digital imaging, photography, and video capabilities. Presently, research is being completed to identify a solution to video streaming difficulties with thin-clients, and several options are expected to be trialed soon. Additionally, Sarah has this year trialed the use of more teacher influenced, structured, and stable student work arrangements, reporting higher levels of on-task time and greater collaboratively developed output. She has also increased her attention to planning, with particular emphasis on her role in developing specific student knowledge, when required. She has commented positively on the effects these changes have had on student outcomes, and the level of satisfaction she gains from her work. Additionally, the researcher has been requested to assist in the further refocusing and reorganisation of the e-classroom along the lines of the recommendations in Chapter 6, in order to enhance student outcomes.

Whilst impossible to summarise in a short paragraph, for the researcher, undertaking this study has alerted me to the incredible complexities of teaching and learning in such environments, and challenged my thinking relating to a number of previously-held assumptions about the role of computers in student learning. It has raised a significant number of issues in my mind regarding the vital role a teacher plays in such environments, and the impact that their philosophy and theoretical understanding of the manner in which children learn can have on the formation of digitally-supported learning environments. It has also encouraged me to reflect critically upon the importance of knowledge construction when learning in the 'digital age', in particular the need to maintain a clear focus on what (and if) students are *really* learning as they are engaged with the technology. It has displayed to me clearly what appears to be a significant 'engagement – learning' gap in some students' practices, which can easily be missed by the teacher, or 'glossed over' through an interpretation of learning as aesthetically pleasant or entertaining outcomes. It has also illustrated that learning is, and will continue to be, a social process. The role of peers in this classroom in scaffolding and supporting each other's learning through socially-based collaborative structures was very apparent. Whilst the computers helped facilitate this, it was the strength and quality of interactions within these structures that facilitated the most significant learning.

7.3 Limitations of the Research

A number of limitations of this study can be identified resulting from the research design and the personalities of key participants. Firstly, the study took place only in one classroom in one school, and therefore by design did not attempt to compare or generalise across samples of a like type. The nature of such outcomes are generally consistent with case study research (Burns, 1997; Cohen & Manion, 1994; Erickson, 1986; Stake, 2000). In stating this however, as outlined in section 7.1, this study did reveal significant understandings that *may* assist schools considering similar initiatives, in making decisions about such things as establishment processes, infrastructure and technical design, teacher selection and teaching methodologies, curriculum structure (etc.).

Secondly, the students in this class could not be described as 'typical' in relation to a New Zealand national sample. The vast majority were Maori students from very poor home environments, many of whom had significant social, health and emotional issues. While this did not *necessarily* manifest itself in the classroom through misbehaviour, in some cases it did, and significant amounts of time were spent by the teacher in using the computers to placate these students' wishes. This could be interpreted as a 'survival' strategy the teacher had developed to manage the behaviour of these students. However, her use of this strategy took a lot of 'teacher time' away from others in the class, and as teacher input has been identified in this study as absolutely critical in such environments, this would have impacted negatively on the progress of students. The limitation in terms of this study is that these circumstances may have resulted in a situation where the true learning potential of the computers was 'clouded'.

Thirdly, due to the critique which had been leveled at the e-classroom through its development stages, Peter, Sarah, and Shirley had developed highly defensive attitudes to anyone who appeared to be criticising it. Because of this, the researcher had to take great care in reporting back findings from the study, and to present the data in an objective and professional manner. While this should be the case in any research, it was difficult to assess at the time what impact this had on Sarah, and whether or not it caused any 'staged' changes in the way she behaved or responded, in my presence. The same could be stated for Sarah's response to knowing that her interactions with students were being recorded by Camtasia. She was aware of how this software operated on the two research computers, and was able to detect its operation due to the change in colour of the Camtasia icon in

Window's icon tray. The extent to which these two factors impacted on her practices cannot be calculated.

Fourthly, although every effort was made to encourage all students to use the Camtasia-equipped research computers relatively evenly over the 16 months of the study, some students chose to use them more than others. This led to video captures of some students being made more often, although over the research period all students at some time were recorded across a range of tasks. Care has been taken to reflect this balance as much as possible in the findings, although it is important that this factor is acknowledged.

Fifthly, limited literature was revealed relating to using computers in classrooms in this manner, possibly due to the e-classroom concept being very recent with no known research studies having as yet been undertaken. Additionally, relatively few authors have written about using computers in classrooms for social and affective purposes, and in the manner described here as 'cognitive tools'. Further research needs to be undertaken to identify the usefulness of using computers to achieve such outcomes.

Sixthly, it was not possible to track the impact on these students beyond the period of time they spent in the e-classroom. As half left the school at the end of the study (ie: the end of the school year), it was not possible to determine whether any of the concerns voiced by students during the study about getting behind in 'core' work, held any foundation in terms of their future schooling. Such an aspect would be fertile ground for future investigation.

Finally, a research presentation issue was noted as limiting in terms of the ability of the researcher to communicate the richness of the data. Presenting the findings in paper format did not allow the full benefit of having access to the Camtasia video clips to be realised. Although the researcher managed to clip a number of 'stills' from the Camtasia recordings and incorporate them in the data chapters, a more complete understanding of student interactions and events would have been enabled, had there been some mechanism to incorporate Camtasia excerpts 'live' and play them within the text, via hyperlinking. This would have meant, however, that the thesis would have had to been presented on a CD Rom or DVD, and possibly evaluated directly on a personal computer. As new generation digital research tools such as Camtasia are becoming available, consideration should be given to alternative presentation modes.

7.4 Recommendations for Further Research

As with any research, this study posed a significant number of additional questions and areas for possible future investigation. These include:

- tracking the progress of students from this study as they enter their intermediate year, to determine whether the perceptions some held in relation to limitations from their time in the e-classroom, held any foundation. Alternatively, gaining insights into how they considered their time in the e-classroom better equipped them for intermediate school (or beyond);
- the undertaking of a formal interventionist action-research study into how the recommendations of this research, if implemented, could impact upon this e-classroom and enhance student outcomes;
- the undertaking of similar studies in other 'e' or digital-classroom environments in New Zealand;
- research into the formation of alternative evaluative frameworks encompassing social, affective, and cognitive goals for computers in classrooms;
- using the guiding framework for establishing e-classrooms as identified in this study, to research the development of a new initiative of this nature, built from the 'ground up'; and
- more specific research into the efficacy of various student work arrangements, as identified in this study. This should examine traditional assumptions made about the effectiveness of cooperative groupings in technology-supported environments.

7.5 Concluding Statement

The aim of this thesis was stated as:

> **What is the nature of student work practices in an e-classroom environment, and what are the factors which influence this?**

This study has revealed that establishing the nature of student work practices in an e-classroom is an extremely complex and variable process. It demanded close examination of key influencing factors identified as the establishment process, the attitude, philosophy, and strategies applied by the classroom teacher to her curriculum and her students, and the students' interactions with each other and the computers.

The primary conclusion the researcher has made from this study, is that there needs to be a sound, educationally focused rationale for including an 'e' classroom in a school. Within any such environment, there also needs to be developed a delicate balance of teacher-student involvement in curriculum design, organisational structures, and responsibility for learning. The teacher must take the lead responsibility for facilitation of this, with computers being seen as ***one*** 'enabler' in providing students with potentially powerful learning opportunities. However, assumptions should not be made relating to computers alone as providing such opportunities. Computers have an important, ***but not exclusive*** role in educating students – acknowledgement of this will be the deciding factor in their successful implementation in our classrooms.

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APPENDIX 1

Individual Interview Schedule

(September 2002)

Brief introduction and chat to see how they have been going etc... 'break the ice...'

Starter questions only (elaborate and deviate as necessary):

1. Can you please tell me your name and your age.

2. How long have you been at this school?

3. Do you have a computer at home?
(if yes) What sort of things do you use the computer for at home?

4. What sort of things have you used the computer for at your school this year?

5. What was the *best* thing you think you did with the computers in your class this year? Why was this so good?

6. Did you work mostly by yourself on the computer this year, or in groups?
Which did you like the best? Why?

7. Do you think that the computer helps you to learn? Why do you think this?

8. Of all the activities that you used the computer for this year, tell me about the activity you think you learnt the most from? *(prompt)*

9. Do you think you have learnt better by being in the computer class than you would have if you had been in a 'normal' class? Why or why not? In what areas? *(prompt)*

10. What did you like/dislike the most about being in the computer class?
(prompt, reverse)

11. Do you think that being in the computer class this year made you feel any different about being at school? In what way?

12. If you could change anything about the computer classroom or your work in it, what might that be, and why would you like to make these changes?

Other questions arising from the interview?

Thank you.

APPENDIX 2

Pair Interview Schedule

(October, 2003)

Starter questions only *(elaborate and deviate if necessary)*

Break the ice – talk briefly about the fact that I have noticed that they often work together when they are doing their work etc...

1. Why do you chose to often work with *xxxx* when you do your work in room one?

2. Do you find any advantages or benefits from working with *xxxx* in room one? What are these?

3. When you strike a problem with the software or whatever the task is that you have to do on the computer, what do you do? *(Can you think of a problem of this type that you have had, and can you step me through the process by which you went about solving it?)*

4. Do you consider that you produce more or better work when working with someone else, or when working by yourself? Why?

5. Would you rather work with the same person each time you do a project or work on the computers, or someone different? Why?

6. Do you always complete whatever it is you are doing on the computer, or do you sometimes leave things incomplete? Why is this?

7. Do you find that sometimes you get distracted by others in the class when you are working together on something? How does that make you feel about your work?

8. Are there any other things you are aware of that distract you or draws your attention away or takes time from what you are supposed to be doing?

9. Are you generally happy with the work you produce using the computers? Why or why not?

10. Is there any way you can think of that might help improve the work you produce?

11. Are there any advantages you can think of to using the computers for your work? What are these?

12. Are there any disadvantages to using the computers for your work? What are these?

13. Do you experience any problems when working in Room 1 – what are these, and why do you see them as problems?

14. Do you think it is important to be learning about using the computer now, and why or why not?

Other questions arising from the interview?

Thank you.

APPENDIX 3

Interview Schedule – Sarah, Classroom Teacher

(March 2003)

Starter Questions:

Background:

1. Can you please describe your level of teaching experience?

    a. History
    b. Service
    c. Schools etc

2. What made you decide to become a teacher?

3. How would you describe the core set of beliefs that guide your teaching practice?

4. In what ways *(at a practical level)* do you try to implement these with your children? eg: What sort of strategies and attitudes, for example, do you employ that would reflect these beliefs?

5. Have these beliefs changed over time? In what ways? *(if so or not...have the strategies or methods you have used to implement them changed...?)*

Early use of computers:

6. How long have you been using computers in your teaching? Describe the early use of computers in your classes.

7. Why did you decide to explore the use of computers with your children? What 'attracted' you to using them with your classes?

8. In these early days, what were some of the issues you experienced when using the computers in your classes?

Present:

Spend a little time describing the present position in terms of the Digital Classroom environment....

9. Why do you feel as a teacher in this school, you were identified as the person who would be most suited to teaching in this *(the e-classroom)* environment?

10. Has having access to an environment such as the digital classroom impacted in any way upon:

a. The way you teach?
b. The design of your programme? *(eg: choice of topics, content of topics, ways of managing curriculum etc)*
c. The way you manage the class?
d. The way you organise or plan the school day?
e. In any other way?

11. Using your vast experience as a classroom teacher as a guide *(acknowledging you have not always had access to an environment such as this!)*, do you feel that the digital classroom environment you are presently working in has impacted in any way upon your students?

a. How?
b. Where – in what areas?
c. To what degree?

12. Do you consider the e-classroom environment affords any specific learning advantages for your students, and if so, in what areas, and how do you know this?

13. Are there any specific issues related to your work in the e-classroom that you have become aware of in the time that you have been working in there? How have these impacted upon your activities in this environment?

14. From observations to date, you appear to be making extensive use of programs which might be labelled cognitive tools (such as Inspiration and Logo). Why is there such a heavy emphasis on the use of these types of programs in your curriculum? Are you using any particularly theoretical framework as a guide or basis to using these? (eg: DeBono)

Follow up questions arising from responses to the above.

Thank you.

APPENDIX 4

Interview Schedule – Peter: Principal, Parahaki School

(February 2003)

Starter Questions *(elaborate and deviate where needed)*

1. Can you please give me an indication of your experience in school management or leadership? How long have you been in the teaching profession as a teacher or principal?

2. Which aspects of your role as principal do you find most rewarding? Why do you find these aspects so rewarding? How would you describe your leadership style?

3. Can you please provide a short summary of your initiatives to date with ICT?

    a. Why did you make a conscious decision so early on to develop ICT so extensively as part of your school programme?
    b. What was the rationale and philosophy behind such a move?

4. Were there any issues you experienced in those 'pioneering' days, and how did these impact upon the decisions that you made?

5. What was the motivation behind the establishment of the digital (e) classroom? Why did you decide on this option?

6. Are you aware of any significant differences between the type of programme operating in room one and other classes in the school, or in your overall experience of teaching programmes? What do you consider might be contributing factors to these differences?

7. Why did you select Sarah Wilson as the teacher most appropriate to teach in this room? What qualities does she possesses, that in your opinion, make her compatible with such an environment?

8. Do you consider there are any learning (or other) advantages for the children in Room 1, from being in the computer-supported environment? What do you consider these to be?

9. How does the computer-supported learning environment in Room 1 fit in with the overall philosophy you are trying to develop within the school?

10. Have you had any feedback from parents of children in Room 1 regarding their child being a part of this programme? What has been the nature of this feedback?

Follow up questions arising from the above

Thank you.

APPENDIX 5

Interview Schedule – Shirley: Systems Administrator

(April 2003)

Starter questions *(elaborate and deviate if necessary)*

1. Can you please describe your role at this school?

2. Can you tell me how long you have been working at this school, and detail any changes in your role since you commenced?

3. Have you had any professional training or education to assist you in this role?

4. Can you relate what your understanding is of the overall vision for ICT use at Parahaki School?

5. How do you see your role as contributing to the overall vision of the school in relation to the use of ICT? *(Prompt in particular towards understandings in relation to personal contributions (direct or indirect) to student 'development' through the use of ICT...)*

6. Are there any issues you are aware of in relation to achieving this overall vision – and if so, can you please describe these.

7. What is your understanding as to the reasons why the school is investing so much money and resource into ICT development?

8. To what extent do you have input into the strategic decisions and direction in relation to developments with ICT at the school? Can you describe how this process works? *(Follow up: upon what basis are decisions, for example in relation to what software is used or who has access to it, made?)*

9. Can you describe for me one of the most satisfying incidents to date in relation to your work in this role at the school?

10. Where would you like to see the development of ICT in this school moving towards, say, over the next 3 years?

Follow up questions arising from the above

Thank you.

APPENDIX 6

Parent or Caregiver Permission Letter

Dear Parent or Caregiver,

I would like to take this opportunity to introduce myself to you, and let you know a little of what I am hoping to achieve in your child's class this year.

My name is Garry Falloon, and I am a Senior Lecturer in Information and Communications Technology at the Tai Tokerau Campus of the Auckland College of Education. I am presently undertaking educational research at Parahaki Primary School, looking at the 'Digital Classroom' environment in Room 1, in an effort to determine what opportunities or advantages such an environment enables for both the children and Mrs. Wilson, the classroom teacher.

During the course of the year I will be spending time in the classroom working with the children, and I am hoping to interview them about their work, and their thoughts and opinions on using the computers for their daily activities. I will also from time to time be using computer-based video software and other recording equipment to record their thoughts, ideas and activities. This data will be used later to help me in my analysis, and as a means of presenting information for my research project. Any videos, still images or audio recordings taken of the children during the course of the research will be for research purposes only, and will be kept strictly confidential. In the event of any of this material being used for purposes other than in the compilation of the research report, specific informed consent will be sought from the parents or caregivers concerned to do so.

As mentioned earlier, this research project is important in that its aim is to assess where and how computer environments such as that in Room 1 at Parahaki Primary School, impact upon children's learning, and teachers' teaching practice. It is hoped that this research will feed into national policy and strategies relating to the use of computers in schools, so that more effective use can be made of this teaching and learning tool.

Later on in the year I may contact you, with a view to holding a short interview or completing a brief questionnaire to determine your thoughts and opinions on how your child is functioning in the computer classroom. Once again, this data will be kept strictly confidential.

If for some reason you would not like your child to be involved in the research, or would not like to be contacted for an interview or questionnaire, could you please fill in and return to school the slip below.

If you have any questions or concerns about the research, please do not hesitate to contact me at the College of Education on 470-1012 or in the evenings at home on 430-8564.

Kind regards,
Garry Falloon

Child's name:

I **DO NOT** wish my child to be included in the Digital Classroom research ☐

I **DO NOT** wish to be contacted for an interview or questionnaire ☐

Please tick

Signed: ______________________________