

2016

Journeys towards expertise in technology-supported teaching

Lorraine H. Kershaw
Edith Cowan University

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**Journeys towards expertise
in
technology-supported teaching**

This thesis is presented for the degree of

Doctor of Philosophy

Lorraine Helen Kershaw

Edith Cowan University

School of Education

2016

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The Use of Thesis statement is not included in this version of the thesis.

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This journey for me began as a result of a shared interest and passion with Chris Brook for understanding teacher quality in using technology and his belief in my capabilities. This led to the fulfilment of a long-held desire, encouraged and supported by Jan Gray and Mark Hackling. Without doubt, my supervisors, Jeremy Pagram and Paul Newhouse, despite the geographic distances between us for a number of years, have been patient with my delays and re-invigorated me with their speedy responses to all my queries. Thank you Jeremy for your wonderful humour and positive feedback. Thank you Paul for your critical analysis and suggestions which always stimulated and guided my pathway.

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For

Colin P. Kershaw

ABSTRACT

Expertise in technology-supported teaching needs to be understood from multi-dimensional perspectives and influences, if raising teacher quality is a desired goal of education services. This study aimed to uncover the interactive influences of teachers' pedagogical practices, learning experiences and personal characteristics and how their decisions impacted upon their growth in expert technology-supported teaching. A mixed methods approach incorporated case study techniques, use of quantitative and qualitative data and was *informed* by grounded theory. Five female primary teachers participated in this research which was conducted during one year over two data collection stages in a technology-supportive independent Australian girls' school.

Variations of expertise were most evident in teachers' pedagogical practices, attributable to their technological, pedagogical and content knowledge and beliefs about student learning. These were apparent in the design, delivery and management of student learning activities, with and without digital resources and tools. Common to all was the strength of performance self-efficacy beliefs, desire for excellence and the motivational challenges afforded by technologies to practices and approaches to learning.

Particular experiences and influences on learning were perceived by teachers as significant in their journeys of growth, namely 1) accessing the knowledge and modelling strategies of a dedicated curriculum resource teacher, 2) engaging in collaborative activities and feeling part of a team, 3) observing colleagues at work, and 4) being committed to staying abreast of new ideas by spending time alone to play and learn in the non-threatening environment of technology. A distinctive feature of their professional agency was illustrated by

pro-active attitudes to change and taking ownership for decisions. These deliberate choices made to advance professional growth over time were epitomised by changes in professional roles, changes within school systems and changes to practices, incorporating risk-taking actions.

Expert practices with technology need to be sustained through perseverance and dedication to learning and practice. When the extent of a teacher's expertise is distinguished by referring to descriptors along continuum pathways, this is an encouragement to all teachers to pursue excellence in technology-supported teaching practices.

Keywords: expert teaching, technology, pedagogical practices, learning experiences, characteristics, influences, descriptors, pathways, continuum

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ABBREVIATIONS

ACARA	Australian Curriculum, Assessment and Reporting Authority
ACOT	Apple Classrooms of Tomorrow
AITSL	Australian Institute for Teaching and School Leadership
Becta	British Educational Communications and Technology Agency
CSaLT	Centre for Schooling and Learning Technologies
DEST	Department of Education, Science and Training
DETYA	Department of Education, Training and Youth Affairs
ECAWA	Association of Western Australia
ESL	English as a Second Language
ICT	Information Communication Technologies
IWB	Interactive Whiteboard
ISTE	International Society for Technology in Education
MCEECDYA	Ministerial Council for Education, Early Childhood Development and Youth Affairs
MCEETYA	Ministerial Council on Education, Employment, Training and Youth Affairs
MMS	Multimedia Messaging Service
NBPTS	National Board for Professional Teaching Standards
NCREL	North Central Regional Educational Laboratory
OECD	Organisation for Economic Cooperation and Development
PACE	Providing Academic Excellence for Everyone

SR	Stimulated Recall
TPACK	Technological Pedagogical Content Knowledge
UNESCO	United Nations Educational, Scientific and Cultural Organization
USA	United States of America
USB	Universal Serial Bus

DEFINITION OF TERMS

Data unit	Descriptive label given to a feature of a domain.
Domain	A term used to label categories of teaching.
Feature	A term used to describe aspects or concepts within a domain.
Information Communication Technologies	ICT is defined in this study as electronic technologies (such as computers, computing applications, IWBs and software, Web 2.0 resources) used by teachers to create and structure learning environments and by students to construct and provide evidence of their learning.
<i>Informed by</i> grounded theory	Research design <i>based</i> on grounded theory and without adhering to all stages of this methodology.
Journey	This term in this study refers to the development of teachers' professional practices, professional learning and the influences of experiences over time.
Mininote	Small laptop computer without DVD function.
Visual Literacy	This is defined in the ACARA v.8.1 (2015) Curriculum: Literacy Key Ideas as "students understanding how visual information contributes to the meanings created in learning area texts."

CHAPTER ONE

INTRODUCTION

The growth of expert teaching qualities within a technology-supported environment is central to this qualitative study. Within this context, the intention of the study was to discover features of these qualities, which would assist our understanding of how and why expertise in teachers' practices could be attained. Distinguishing features of teachers' pedagogical practices, learning experiences and personal characteristics were explored, described and considered as inter-related dimensions. A holistic approach aimed to uncover the scope of these dimensions and their influences on the decisions teachers made about progressing their professional growth of expertise. This chapter provides an overview of the rationale, significance and purpose for the study leading to its research question, design and context, concluding with an outline of the thesis structure.

Background

It has been asserted that excellence in teaching and the delivery of a technology-supported curriculum would transform practices and raise the quality of education (DEST, 2002; Hargreaves, 2003; Kozma, 2011a). The responsibility for incepting these changes and meeting these goals rests with teachers, who as Hattie (2003) maintained, are powerful influences on student achievement. Indications of the attainment of exemplary practices have been described as levels within competency frameworks, labelled stages and standards indicating professional growth (AITSL, 2012b; Hine, 2011; ISTE, 2008). Rather than rely largely on descriptive labels and stages to explain

progressive change in technology-supported environments, uncovering reasons why and how teachers choose to advance their growth and seek excellence would contribute to our knowledge about supporting changes demanded of pedagogical practices. The aim of this study was to investigate whether particular learning experiences and personal characteristics are critical in influencing the development of teachers' expertise in pedagogical, technological and curriculum knowledge, reflected in their classroom practices.

Rationale and significance

Changes to the school curriculum have been significantly affected by the demands of the information age, in the belief that teaching with technologies would enhance student learning, particularly by promoting student-centred learning (Cuban, 2002; Fullan, 1998; Hargreaves, 1998). Expectations are that teachers will acquire the relevant pedagogical strategies and knowledge to design authentic learning activities which reflect their understanding of how students learn and live in this technological world (UNESCO, 2011). At the same time, there are also calls for excellence in teaching to improve standards in education (AITSL, 2012b). If continued progress in the attainment of these goals is to be made, then the results of this study could be both informative and constructive in adding to our understanding of how to advance the pursuit of excellence culminating in the accrued benefits to education quality.

There has been limited use of the term expert in an educational technology context, perhaps due to the complexities of teaching itself and complicated further by the pedagogical changes expected through adoption of technologies into teaching practices. Often it would seem that evidence of expertise is more readily apparent and more easily measured in other

professions or human fields of endeavour, than in the teaching profession. More recently, however, research on outstanding teachers and exemplary teaching practices with technology have been emerging and highlighting facets of expertise (Ertmer, Ottenbreit -Leftwich, & York, 2006-2007; Goodwyn, Protopsaltis, & Fuller, 2009). This study considered these facets and integrated personal characteristic descriptors of experts and expert teachers as part of its rationale to make a contribution to the accumulation of knowledge about the intricacies of expertise and its influences.

Understanding influences, such as teachers' curriculum and technological knowledge (Koehler & Mishra, 2009), and their pedagogical goals and beliefs are connected with other aspects of teachers' practices (Prestridge, 2012). A detailed knowledge of teaching strategies can be valuable in recognising aspects of practices where there is potential for growth or change. Observations of teaching strategies, illuminated by teachers' reflections on those strategies, are sources of knowledge to promote expertise (Schleicher, 2012). As Schleicher (2012) said, "teachers need to reflect on their practices in order to learn from their experiences" (p.38). Uncovering the detail of teaching strategies, coupled with teachers' self-reflective capabilities, were therefore deemed by this study to be significant in ascertaining the reasons behind their choices of strategies.

Learning through reflection is one avenue for teachers to evaluate their knowledge and skills to determine their own needs. Professional development courses and in-school opportunities with colleagues are often sources in which these needs can be met (Hughes, 2005). Yet it is likely that other avenues or experiences are influential in changes teachers make about their practices. For

this study the focus is again in this respect upon the teacher, for there appears to be a paucity of literature about the significant events or experiences which teachers believe have influenced their growth of expertise in a technology-supported environment. Related to these perceptions are those they hold about themselves as teachers and their quality of expertise. Understanding these perceptions and their motivating power can advance our knowledge about technology-influenced expertise in teaching.

Benefits to teachers and schools are envisaged. Teachers could have a heightened awareness of the features of expert teaching in the delivery of a technology-inclusive curriculum. This would provide them with not only a wide range of descriptive expert qualities upon which to base their learning, but also the motivation to strive for excellence. Schools would be in possession of further knowledge to support and foster teachers in these aims.

Purpose of the study

The purpose of this study was to gain a deep understanding of the distinguishing features and influences on expert teaching with Information Communication Technologies (ICT), other than by assigning explanatory labels, levels and career stages (AITSL, 2012b; Schibeci et al., 2008), as finite objectives to explain progress of growth in expertise. From this perspective, growth of expertise could be seen as an ongoing journey, accessible to all teachers, regardless of career aspirations, but with a focus on improvement or change in pedagogical practices.

An exploration of teacher expertise with technologies could have considered only uses of state-of-the art digital resources and tools. It did not. This approach would have been limiting in both the selection of participants and

in the applicability of the findings to the majority of teachers, who are likely not to have access to sophisticated technologies. By placing the teacher at the centre, rather than the technology (Brantley-Dias & Ertmer, 2013; Ertmer & Ottenbreit-Leftwich, 2013), the extent and adaption of pedagogical strategies in the uses of technologies, beginning with the simplest digital tools and resources, can be explored. This infers that as a teacher continues to learn, then technological knowledge would increase and its scope widen. This perspective suited the purpose of this study to distinguish qualities of expertise across a raft of dimensions.

This study did not aim to connect expert pedagogical practices in technology-supported environments with the effectiveness of teaching practices by measuring student achievements. By focussing only on the teacher, the study was able to examine the detail of pedagogical practices and their complex influences, in order to build comprehensive and descriptive pathways along a continuum about the growth of expertise. Further studies could embrace the impact of expert teaching with technology on student performance.

In considering influences on the integration of technologies within the curriculum, barriers have been found indicating why success has not been achieved (Ertmer, 1999). However, by perceiving these in positive terms, studies on support factors influencing successful integration, such as school characteristics and the goals and beliefs teachers hold about student learning with technology, have been conducted (Judson, 2006; Prestridge, 2012; Tondeur, Devos, Van Houtte, van Braak, & Valcke, 2009). It would seem reasonable to conclude that this approach, with a focus on success, could also assist in illustrating qualities of expertise. As the purpose of this study was to

view expertise in a technology-supported environment in a holistic way, it also drew upon these support and influencing factors to construct its research framework.

In addition, embedded within the aims of this study, was its response to earlier comprehensive reports on the integration of ICT, recommending further research into expert qualities and positive influences on practices (Cox et al., 2003; Goodwyn et al., 2009). They advocated research into teacher characteristics, these influences and those of colleagues on practice, and teachers' preparation and planning in connection with their reasoned decision-making and pedagogical knowledge. All of these features of teachers' practices were pertinent to the purpose of this study about expertise.

Research question

The aim of this study was to investigate influences on the growth of expert teachers' pedagogical practices and knowledge in their delivery of a technology-supported curriculum. The study was concerned with the influences on teachers' decisions, which impacted upon their practices and directed their learning experiences, and on their personal characteristics, which motivated their desire for excellence. In addition, their curriculum and technological knowledge, their professional and teaching goals, and their beliefs about student learning, with and without technology, were considered. Of particular interest, were their perceptions of themselves and those significant experiences that they believed had the most influence on their journeys of professional growth and the extent of their current pedagogical knowledge. Therefore, this study asked a research question that embraced all these aspects, as follows:

What are the features of teachers' journeys to expertise in their technology-supported practices?

Integral to this central question was an investigation of the inter-related influences on teachers' decisions about their practices, namely,

- Structural and cultural characteristics of the school,
- Teachers' pedagogical practices,
- Teachers' learning experiences, and
- Teachers' personal characteristics.

Design of the study

In the design of this qualitative study and in the creation of the instruments for sourcing and analysing data a mixed methods approach was used. This approach incorporated multiple case studies, a cross-case analysis and was *informed* by grounded theory (Corbin & Strauss, 2008; Glaser & Strauss, 1967; Yin, 2009). Formal and informal observations of teachers at work, complemented by a series of interviews, were conducted over two data collection stages within one year. Two kinds of interviews were conducted, namely, stimulated-recall and semi-structured. Stimulated-recall interviews with teacher and researcher access to lesson video and audio records were used to uncover the reasons underlying the decisions teachers made about their teaching strategies and use of technology. Semi-structured interviews focused on teachers' beliefs about student learning, their perceptions about using technology, their pedagogical and professional goals, and the influences they believed had impacted upon their growth of knowledge and skills. A self-report questionnaire accompanied by verbal explanations captured further evidence of teachers' technology skills.

From the observed lessons, the teaching strategies, questioning strategies and strategies employed by teachers to engage students were analysed. Instruments for the analysis of these strategies consisted of itemised descriptors which were constructed from the literature and expanded with observational data. Further descriptive items were created from the interview data and the questionnaire results, again with reference to the literature but augmented in part by analysis of teachers' responses. These findings were synthesised in the analysis process and are presented as teacher case studies. A cross-case analysis then draws comparisons and inferences to make judgements about the multi-dimensional features and scope along a continuum of differentiated teaching expertise in a technology-supported context.

Context of the study

This study was undertaken in an Australian independent girls' school where the influence of a supportive environment was perceived as necessary to the research design. The junior school was known for its long history of ICT usage, its policy of integrating technology within the curriculum through an enquiry approach to learning, and its levels of ICT curriculum and technical support. Five female teachers were nominated by the school leadership team to participate in the study. They were recognised by the school as confident, competent and frequent users of technology in the design and delivery of cross-curricula learning activities for students, as well as for their abilities to reflect upon their practices. There were four classroom teachers and an ICT curriculum resource teacher, who was acknowledged by national professional organisations for the quality of her teaching with technology. The students, who were all girls in Years 4-6, ranged in age from 9-12 years.

Organisation of thesis

There are ten chapters in this thesis. Its beginning has been introduced in chapter one, *Introduction*, which provided an overview of the study purpose and significance, the research question, the design and context. In chapter two, *Literature Review*, references are made to other research studies, documents and reports on education and technology, and relevant literature, as a basis for the development of the study concept. Background to views on pedagogy, teacher learning experiences and expertise with technology through to the derivation of the research question are explored in detail, culminating in an explanation of the conceptual framework. Chapter three, *Methodology*, provides information on the sample selection, a comprehensive description of the data collection instruments, their administration procedures and data analysis processes.

Four chapters are devoted to case studies of five teachers, namely, chapter four, *Case Study 1: An ICT Curriculum Leader*, chapter five, *Case Study 2: A Teacher with Varied Contextual Experiences*, chapter six, *Case Study 3: A Teacher Focused on Goals and Student Needs*, and chapter seven, *Case Study 4, Two Teachers Working as a Collaborative Team*. From data on lesson observations and interviews, each case study describes and interprets the inter-connected dimensions and influences of pedagogical practices, learning experiences and personal characteristics on teacher's decisions about their growth of expertise in technology-supported teaching. Chapter seven follows this process in comparing the similarities and differences in two teachers. Chapter eight, *Cross-case Analysis*, draws together the findings of the

case studies and makes judgements about the extent of each teacher's expertise along a series of continuum pathways.

Three themes are discussed in chapter nine, *Discussion*. These revolve around 1) patterns in teachers' construction and delivery of learning activities, 2) adaptive strategies adopted by teachers to manage their learning experiences, and 3) teachers' attitudes to change, challenges and risk-taking. Chapter ten, *Conclusions and Recommendations*, includes an overview of the study and a response to the research question. The recommendations make suggestions for schools, teachers and further research about the advancement of expertise in the delivery of a technology- inclusive curriculum.

CHAPTER TWO

LITERATURE REVIEW

This chapter opens with perspectives on the influence and value of ICT to society and education, and an explanation of current views on standards of excellence in teaching. These are followed by an interpretation of ICT integration and influences upon teachers' pedagogy and practices. Descriptions of experts, expert teachers and characteristics of teachers deemed to be expert in the integration of ICT are reviewed and their differing learning experiences examined. In the concluding sections of the chapter the research design is explained and how it is *informed* by grounded theory, as part of a mixed methods approach linking to the creation of multiple case studies. An explanation of the conceptual framework, developed from a review of the literature, is provided. The framework focuses on the influences and inter-dependence of teachers' pedagogical practices, learning experiences and personal characteristics supported by school characteristics. These centre on subsequent decisions teachers make about their journeys towards the growth of their expertise in a technology-supported environment.

Value of ICT, excellence and integration

The global economy, the knowledge economy, the information society, the technology age, the digital age and the knowledge creation age are terms used by society to label the era in which we live and work today (Cuban, 2002; Hargreaves, 2003; Kozma, 2011a). Some powerful features of this information age which affect us are the speed of our communications and the mediums by which knowledge is created and used, as we grasp the opportunities afforded

us by an escalating rate of technological innovation. An impact of this exponential growth in technology knowledge can be seen globally in the reforms and changes of the economic, political and intellectual agendas of world organisations and countries concerned with the welfare and future of nations and their peoples (MCEETYA, 2008; Schleicher, 2012; UNESCO, 2008). These values are also evident in the agendas of government bodies through to parent groups and educators as expressions of their beliefs that technology knowledge would transform education and thus benefit society (Cuban, 2002; Kozma, 2011b).

Value of ICT

The promise of the benefits that ICT would deliver to education can be traced back to the 1970s when social democracies were very much concerned with equity in education (Sully & Young, 1990). They believed that all students should have opportunities to develop skills and knowledge to a level commensurate with their abilities and required for their chosen vocations (D. L. Smith & Lovat, 2003). It was here that the belief arose that computers could be useful tools to aid individualized learning. Computer-assisted learning programs were developed for students to undertake self-paced teacher-independent activities which were highly structured and sequenced generally in linear form (Sully & Young, 1990).

However, as rapid advances in technology were made, a more broad-ranging view of technology's value to education was taken and "a compelling rationale for using ICT in schools (was seen as) its potentially catalytic effect in transforming the teaching and learning process" (according to Hawkrigde in Webb & Cox, p.240). With a focus now on changing the education process from

knowledge acquisition to knowledge creation (Kozma, 2011a), a constant change in technological innovations and a global view of the needs of societies, a technology-inclusive curriculum is being demanded (Hine, 2011), in the view that it offers possibilities for increased educational benefits. In broad terms the value then of ICT is seen as its perceived capability of fostering collaboration across communities in pursuit of advancing their development and facilitating learning processes (Kozma, 2011a).

The environment referred to here has its foundations in a constructivist approach to learning: that is, student-centred and enquiry or discovery, which emanated from the views of philosophers and psychologists such as Bruner (1962) Dewey (1966), Piaget (1970), Vygotsky (1978), and von Glaserfeld (Howard, McGee, Schwartz, & Purcell, 2000; Kaya, 2008; Schuh, 2003). Constructivists' theories of learning place emphasis on the student as the constructor of knowledge where the learning environment provides for critical thinking and active, social engagement in authentic settings. The learning environment afforded by ICT aligns with these viewpoints, for example, when decisions are made in the selection and use of resources and employment of pertinent teaching practices. Students are able to engage in authentic activities suited to their needs, work collaboratively and encounter problem solving situations which challenge them to think analytically (Newhouse, 2002).

These approaches to teaching and learning embody the principles of proponents for reform in education. They suggest that a significant benefit of ICT is in its potential to change the processes and outcomes of education in a curriculum more suited to students' differing needs of today (Condie, Munro, Seagraves, & Kenesson, 2007; Kozma, 2011a). The enabling power of ICT is

seen as facilitating the delivery of a differentiated curriculum. Maker's model of curriculum differentiation, also known as differentiated instruction or multilevel instruction considers curriculum elements of content, process, product and environment; the student traits of readiness levels, interests, learning styles and affect; as well as instructional and management strategies (Minott, 2009; G. Smith, E. & Throne, 2008; Trefz, 1996; van Kraayenoord, 1997). Elements of this model of curriculum differentiation are reflected in an ICT integrated environment, which incorporates constructivist's views of learning as mentioned above. As an example, Maker's model can be viewed in two ways. Firstly, teachers are able to construct learning activities which afford different student outcomes from the same task using the same ICT tool or resource. Secondly, differentiation can occur when the task is modified, allowing students to utilise a range of ICT tools and resources suited to each individual.

For teachers and their teaching practices, their perceived value of ICT is varied and depends often upon their use as a personal productivity tool or as an integral part of their practice. For example, teachers find ICT particularly beneficial for their day-to-day administrative work, their lesson planning and topic research (European & Schoolnet, 2013). Many also utilise ICT as a tool for enabling their continuing professional learning, for example, the riches of the internet as a source of ideas and the collaborative opportunities available through video conferencing and online communities (Comber, 2010). Teachers' beliefs about the value of ICT to the learning environment, on the other hand, influence their teaching practices of how learning can be promoted and facilitated (Ottenbreit -Leftwich, Glazewski, Newby, & Ertmer, 2010). The choices teachers make about incorporating ICT into learning activities are

dependent on their beliefs about the value that this resource would add to the facilitation and promotion of student learning (Cuban, 2002; European & Schoolnet, 2013; Hargreaves, 1998; Ottenbreit -Leftwich et al., 2010; Prestridge, 2012; Zhao, Pugh, Sheldon, & Byers, 2002). For example, in a study of a small group of 4 teachers, their creative use of technologies perceptions appeared to be influenced by their pedagogic knowledge associated with their perceptions of the value of ICT to student learning (Hughes, 2005). In turn, the depth of teachers' content-specific professional knowledge and their past experiences impacted upon those practices. The Ottenbreit et al. (2010) study of 8 primary teachers, through interviews, observations and documentation analysis, found that the teachers valued technology for promoting higher-order thinking skills, for engaging and motivating students and in preparing students for participation in the world of adulthood.

Parents too believe that ICT have much to offer in providing learning opportunities for students to develop appropriate skills and knowledge in preparation for their adult life in this technology age (Clark, Demont-Heinrich, & Webber, 2006). Dependent on the school organisation and administration, technology can provide the means by which parents can feel more involved with the education of their children. Ease and immediacy of communication with teachers through email about student progress, for example, and an awareness of the specific requirements of learning tasks set by teachers through online access to the school's website are just some of the ways which parents are able to make judgments about the value of an ICT learning environment (Schnellert & Keengwe, 2012).

Despite apparent strong reasons why ICT should be an integral part of the education process, evidence of its benefits to learning in terms of student outcomes is sparse and measurement problematic (Kozma, 2011b; Newhouse, 2002). Kozma (2011b), in a review of the literature on student achievement in relation to ICT use, concluded that even though some positive results on increased student achievement have emerged from some meta-analyses, the issue is complex as causal effects are not easily isolated and students were often measured in traditional subjects in traditional ways. These conclusions only confirmed what Newhouse (2002) had stated earlier. He asserted that it was far more important for teachers to ascertain needs of students in relation to their achievements and to plan learning activities accordingly. Nevertheless, there is an expectation that learning environments of today will be supported by ICT.

It is not only ICT which has influenced education agendas but also a perceived decline in the quality of education and a belief that quality in the teaching profession is critical to reversing this situation (Schleicher, 2012; UNESCO, 2008). The following section discusses the standards of excellence which teachers are expected to attain in their general teaching and in ICT integration, standards which imply current unsatisfactory levels of quality and a need for change.

Demands for excellence

As a consequence of the desire for reform in education, attention has turned universally to teaching excellence as a key to raising the quality of education in schools (Caldwell & Harris, 2008; MCEETYA, 2008; Schleicher, 2012). Reports and research recommendations from organisations, such as the

Organisation for Economic Co-operation and Development (OECD), responsible for advising governments on their economic, social and educational policies attest to this.

Comments made by Christopher Pyne, Australian Federal Minister for Education (February 18, 2014), illustrate the desire of governments to improving education standards when he said “The quality of our teaching and quality of our teachers is seen as one of the important, if not most important, determinants affecting education performance”.

This statement is a reflection of recommendations and policies of advisory bodies to governments around the world in publications on professional standards for teachers and programs promoting the pursuit of excellence (Department for Education, 2012; Department of Education, 2012; Hine, 2011; MCEECDYA, 2011). These documents set out a series of objectives which are aimed at the improvement of teachers’ practices and their progress through career stages. The views of the Australian government, for example, on teacher excellence are stated in documents published by the Australian Institute for Teachers and School Leadership (AITSL, 2011, 2012a, 2012b). Standards for teacher performance are described in terms of professional knowledge, practice and engagement. The development of exemplary performance is mapped through four stages of teacher growth, namely, Graduate, Proficient, Highly Accomplished and Lead Teacher.

Prior to these kinds of expectations about teacher excellence being clearly stated and defined, global educational concerns with technology innovations and teaching practices were apparent in government policies (MCEETYA, 1999). These set out goals for the 21st century education of

students in schools with particular emphasis on ICT literacy. Teachers and students alike were expected to attain satisfactory literacy levels in ICT, defined by the International ICT Literacy Panel as “ the ability to use digital technology, communication tools, and/or networks to access, manage, integrate, evaluate, and create information in order to function in a knowledge society” (NCREL, 2002).

This document also aligns with the four broad categories of skills necessary for the 21st century as documented in the OECD Summit report (2012). These are ways of thinking, ways of working, tools for working and skills for living in the world (Schleicher, 2012). The tools for working are identified as ICT and information literacy. The task of providing a learning environment, in which students are able to develop these skills, rests with teachers. Thus the demands placed on teachers are twofold. They are expected to strive for excellence in their general teaching practice and possess the necessary professional knowledge and ICT competencies to deliver quality education.

Standards which incorporate these expectations of teachers using digital tools and resources have been set out by the International Society for Technology in Education (ISTE) in its document titled ISTE Standards: Teachers (ISTE, 2008). Five themes are stated. Explanations are in the form of indicators of teachers’ performances in the teaching / learning environment. Broadly, the standards summarise teaching practices and strategies which emphasise creativity, innovation, collaboration, modelling, communication and depth of professional learning as evidence of teachers’ skill and knowledge in designing and managing authentic learning environments. Standards about

teachers' ethical responsibilities and their leadership roles within the school and wider communities are included.

These expectations of teacher performance have been unified in a document published in 2011 by the United Nations Educational, Scientific and Cultural Organization (UNESCO). It sets out an ICT Competency Framework 2011 in terms of three developmental approaches to competency explained in modular form (Department for Education, 2012; UNESCO, 2011). The three stages of teacher development are described as technology literacy, knowledge deepening and knowledge creation. The stages are encapsulated within a framework of understanding ICT in education, curriculum and assessment, pedagogy, ICT, organisation and administration, and teacher professional learning. Teachers are deemed to be using the knowledge creation approach when they support and create policy innovation, deliver programs that incorporate student acquisition of skills needed in our knowledge society, build a learning environment where teachers not only model the learning but promote continuous learning with their students, whilst employing a range of technology devices.

The AITSL document on standards expected of Highly Accomplished and Lead teachers makes particular reference to ICT (AITSL, 2012a). For example, within Professional Knowledge Standard 2 on "Know content and how to teach it", a Highly Accomplished teacher is expected to support colleagues in their progressive use of ICT and model superior strategies. A Lead teacher should show evidence of using "ICT with effective teaching strategies to expand learning opportunities and content knowledge for all students" (p.16). A similar document at the Graduate teacher level has also recognised the need to

endorse the comprehensive use of ICT across all focus areas of its seven Standards of expected teacher competency levels (AITSL, 2012b).

Teachers then are expected to reach a high standard in teaching excellence and in their use of ICT. These professional standards and career stages describe progressive goals to which teachers can aspire or are expected to attain. Pertinent to an increase in their experience and knowledge are factors influencing the realisation of these high-end career stages, particularly teachers' "critical experiences, beliefs, and practices "(Ertmer et al., 2006-2007, p.58). Multiple aspects within each of these three domains present avenues for in-depth investigations. Furthermore, an exploration of the connections among these and the interrelated impact on practice would benefit further our understanding of how excellence in teaching is reached. In addition, useful knowledge could emerge of how best to encourage teachers desirous of growth and improvement. These avenues formed the foundation of this research study.

This outline has drawn attention to the challenges teachers face in managing the demands of a curriculum influenced by technology to suit our knowledge creation society. Beliefs about the potential of ICT to transform educational practices and make a major contribution to the quality of education put an emphasis on pedagogy in relation to ICT integration. To understand this relationship, the following sections provide a review of teaching and learning pedagogic perspectives. They aim to arrive at a meaning of ICT integration relevant to this study and the implications for changes in teachers' practices to accommodate student learning in this context.

Pedagogy, ICT integration and technology-supported teaching

In the past, principal objectives of the curriculum were concerned with students acquiring content knowledge, rules and facts through teacher-directed activities (Fullan, 1998). Changes in society and its needs now place an emphasis on a student-centred approach within a technology-inclusive curriculum (ISTE, 2008). Curriculum goals have become concerned with the development of a different set of students' skills, understandings, processes, beliefs and values (AITSL, 2012b). This aim has major implications for teachers in their efforts to adopt appropriate pedagogical practices which will provide for the development of students' creative and critical thinking, problem solving processes, collaborative work and confidence (Larson & Miller, 2011). Teachers' knowledge of these practices would be evident in the decisions they make about the design of learning activities and therefore the pedagogic approaches they employ. According to McCaughtry (2005) this pedagogic content knowledge would encompass "the interconnectedness of knowing subject matter, pedagogy, curriculum and students" (p.379).

Pedagogic content knowledge however, is but one facet of the intricate structure of pedagogy. A more detailed view of pedagogy has been explained in a review of the research literature on ICT and pedagogy supported by findings from a range of case studies (Cox et al., 2003). They summarise a number of theories on pedagogy and practice and cite Alexander's framework for educational practice. His framework includes pedagogy as one element of many interrelated aspects of teaching practice, such as teacher content knowledge, management of the learning environment as a complex entity and knowing about how students learn. Knowledge of pedagogical contexts and content,

effective resources and educational goals are the focus of Shulman's model of pedagogical reasoning (Shulman, 1987). This model emphasises the knowledge which the teacher must possess in order to integrate content within the management processes of planning, delivering and evaluating learning activities for the differing needs of all students. In an ICT context Cox et al. (2003) suggest that collaborative learning, lesson preparation and teacher responsiveness to student learning are emerging themes. In their framework for ICT and pedagogy these are described in terms of affordances, which are provided by ICT, the teacher, through the students, the resources and the interactions of these affordances. This learning environment is dependent upon the teacher's comprehensive pedagogical knowledge which includes pedagogical reasoning, the beliefs and values about learning held by teachers and students, and the actions of all these participants in this context.

There are however some elements of other theories on teaching and learning which are relevant to pedagogy, ICT integration and strategies employed by teachers, for example, those found in the work of four other researchers - Bandura, Bruner, Engelmann and Ausubel (Miller, 2008). Miller's summary of their work will be referred to briefly by selecting those aspects which have implications in an ICT context.

Bandura's research focused on modelling, where students learn by observing others at work, and on motivation to succeed, where students receive feedback on performance. In an ICT context this would be interpreted as the way the teacher constructs the learning environment and the selection of ICT resources. For example, learning through modelling can occur when students work at a computer in a group and watch the work of one another as a task is

undertaken. Feedback on performance has the potential to be immediate when the design and use of a computer program tracks and displays student responses.

The learning environment and the form of instruction, emanating from Bruner's work on inquiry and discovery learning, could also be considered relevant to an ICT context. Based on this pedagogical approach, teachers aim to promote students' understandings and knowledge structures through experiential learning. ICT is particularly suited to simulations and authentic settings which can provide opportunities for teachers to create problem-based learning environments.

Active engagement of students, the importance of constant assessment and feedback were the hallmarks of Engelmann's Direct Instruction method of teaching. Although this method has been criticised, nevertheless the essential elements are pertinent in an ICT context. For example, functions within a computing application can provide the student with constant in-built feedback on performance.

Features of expository teaching and the use of scaffolding, stemming from Ausubel's research, are also possible in an ICT context. Examples of expository teaching are when lesson objectives are stated, examples are provided and concepts are reviewed. This is evident when the teacher uses a laptop and data projector, for example, to demonstrate a procedure or a topic concept, and questions about these are asked of students. Scaffolding is a related process in this example, where students are assisted to recall known understandings or concepts and use this knowledge to link to, and build, new knowledge.

A comprehensive explanation of pedagogy and ICT integration, however, is found in a framework devised by Koehler & Mishra (2009). They devised a model where technological knowledge, pedagogical knowledge and content knowledge (TPACK) interact to form a body of knowledge used in “deeply skilled teaching” (Koehler & Mishra, 2009). In their model, content knowledge refers to teachers’ thorough understanding of the scope of the subject matter. The breadth and depth of teachers’ pedagogical knowledge is evident in the ways they deliver the content and monitor students’ learning. Technological knowledge is seen, of necessity, as changing constantly. Thus teachers must have an understanding of the processes and facilities afforded by technology in their choice of resources and use in presentation of the subject content. Teachers’ technological pedagogical knowledge is described as opening up opportunities for them to change practices, that is, to recognise the ways technology can contribute to student learning if pedagogical approaches are adapted to maximize affordances.

While acknowledging the benefits of the TPACK model to identify the intricate domains of technology integration, a criticism has been made of the inherent difficulties faced in endeavouring to measure these multifaceted bodies of TPACK knowledge and skills (Brantley-Dias & Ertmer, 2013). These researchers suggest a move away from technology holding centre stage in the TPACK model, to a focus on student learning, by referring to technology-enabled learning and not technology integration. In their view, this perspective would highlight the importance of the teacher’s content-based pedagogy being supported by appropriately selected resources to facilitate student learning.

Nevertheless, it is argued that in the context of this current research study its perspective on technology integration or pedagogy and ICT integration needed to be made clear. The next section, firstly, outlines researchers' different viewpoints on what is meant by ICT integration. It concludes with an interpretation of technology-supported teaching, as a consequence, and explains the position which this research study has taken in its design framework.

A context for ICT integration and technology-supported teaching

Integration is referred to frequently in research on ICT and the curriculum, yet there are few definitions of its meaning and even these are varied (Lloyd, 2005). In her paper presented to the Australian Association for Research in Education Lloyd draws upon the limited number of researcher viewpoints and studies defining ICT integration. As she points out, educational reform has been linked to the introduction of ICT into classrooms and seen as an integral part of this process. One viewpoint she refers to is that of Fluck (in Lloyd, 2005), who suggested ICT integration can be defined as the seamless inclusion of ICT in the teaching/learning environment, inferring there is an invisibility about it. She cites yet another definition, which distinguishes between the content and context for learning, and is premised on a belief that ICT integration is a process. This particular viewpoint is further corroborated by the Welliver Instructional Transformation Model, which defines integration as the essential use of technology to achieve the educational goals of the classroom (Trinidad, Newhouse, & Clarkson, 2004).

Successful integration is another phrase used to describe ICT integration when resources, school leadership and teaching are incorporated (Wang,

2008). Models of successful integration can be found, such as that suggested by Wang (2008), who described integration in terms of interactions among content, the learner and the technology. This is similar to the way effective technology integration was referred to by Schnellert and Keengwe (2012). They focused on some common threads in their review of the research literature in this area and of the 1:1 laptop programs in American public schools. Their emphasis was on school planning and allocation of resources, teachers' instructional strategies in their use of technology as teaching tools, for student learning and increased achievement levels.

It is acknowledged that ICT integration is "a complex and multi-layered phenomenon and can encompass both process and outcome" (Lloyd, 2005, p.7). For the purpose of this research, ICT integration is viewed as technology-supported teaching. It is a process by which teachers make decisions about their selection and use of digital tools and resources to incorporate in their practices. These reasoned choices are based on their content, pedagogical and technological knowledge with the aim of facilitating and enhancing student learning activities. The process of structuring, delivering and managing student learning activities blends their pedagogical knowledge of content, their technological knowledge and teaching strategies, which demonstrate understanding of how students learn. This definition of technology-supported teaching does not take into account the effectiveness of teachers' skills relating to student performance. Although an investigation of teacher excellence correlated with teacher effectiveness through the measurement of outcomes or student achievement would be a fruitful study, it is beyond the scope of this

research. It is limited to an exploration of the growth of only teaching excellence in an ICT context.

Therefore, in this framework of pedagogy and technology-supported teaching, the one constant, central to discussion and investigation, is the teacher. Investigating further the intricacies of teachers' pedagogical practices, not necessarily through measurement of domains, but rather through rich descriptions of domains, can add to our understanding of the teacher in action. It is for this reason that one aspect of this particular study aimed to explore teachers' range of teaching strategies using ICT and how or why particular influences, such as pedagogical beliefs about student learning, affected their practices.

Student-centred teaching implications

Reference to current theories about learning and the development of student knowledge provide a background to the implications of student-centred teaching in relation to teachers' pedagogies and ICT (Howard et al., 2000; Kaya, 2008; Schuh, 2003). The views of philosophers and psychologists such as Dewey, Vygotsky, Piaget and von Glaserfeld, leading to constructivism as a way of explaining the complexities of the learning process, are pertinent to this research as mentioned previously (Miller, 2008). Constructivists' theories of learning centre on learners developing their own knowledge, rather than knowing a universal truth, through their unique construction of meaning connected with their experiences and prior knowledge base (Kaya, 2008).

One of the aspects of constructivism relevant to a technology-influenced curriculum is the social construction of knowledge and the implications for teachers to have a greater understanding of the ways in which students also

learn outside of the classroom (Norton & Wiburg, 2003). For example, teachers need to be aware of students' social interactions and ways of communicating with others using chosen technology mediums, and their desires to take responsibility for their own learning. It follows that teachers need to take account not only of the impact of technology-supported teaching in the design of learning experiences, but also of students' individual styles of learning. Hence it is expected teachers will plan authentic experiences which investigate reality and engage students actively, provide for students' construction of their own knowledge, encourage collaboration and cooperation, and incorporate processes promoting continuous learning, higher order thinking and problem solving skills (Hartnell-Young, 2003).

As discussed previously, however, constructivist theories on teaching and learning are not the only foundation for teaching strategies in a technology-supported environment. The choice of teaching strategies can also be derived from theories about modelling, inquiry and discovery learning, and expository teaching (Ritchie & Baylor, 1997; Woodbridge, 2004). Of particular relevance here are two studies about teaching with technology and technology integration. The Ritchie and Baylor (1997) study concerned student teachers who were engaged in learning about technology integration. Course instructors found that a combination of teaching strategies based on behaviourism, cognitive perspectives and constructivism was more successful in enhancing student learning than a previous course which had been based solely on constructivist principles. On the other hand, the Woodbridge (2004) study observed and interviewed teachers to ascertain what strategies they were employing to integrate technology. Results of the observations indicated that only 50% of the

teachers had been successful in using a constructivist approach, by creating active, cooperative, reflective and authentic learning environments.

It is apparent that successful teaching strategies in an ICT integrated context need not be limited to a constructivist approach and changes in pedagogy can draw upon a multitude of theories. The underlying aim is to put the focus of learning and active, social and meaningful knowledge construction on the student. The learning environment facilitated by the teacher is an enabling process of putting theory into practice. Teachers' choices of pedagogical approaches are therefore critical to this process and are determined and influenced by their perceptions and beliefs of how students learn in a particular context.

Although the use of ICT has been advocated to support the achievement of such aims, research has shown pedagogic practices have remained largely static in relation to ICT (Balanskat, Blamire, & Kefala, 2006; European & Schoolnet, 2013; Jones, 2002), or teachers have required students to use technology "primarily as a delivery tool" (Ertmer & Ottenbreit-Leftwich, 2013, p.176). These literature reviews and research studies reported that teachers were more likely to adhere to their familiar pedagogic practices of directing learning activities for students, rather than exploring the flexibilities of computing technologies in innovative ways to facilitate student-centred learning. This has been despite concerted efforts by systems and schools in the past to support teachers' development of skills and strategies in their desire to change practices through professional development programs (Cuban, 2002; Fullan, 1998). Now, rather than having a choice to change, which was not obligatory, teachers are being pressured to do so. Government policies make that clear. Standards of

excellence in teaching are demanded (AITSL, 2012b; UNESCO, 2011). The adoption of pedagogical practices to accommodate the impact of ICT as a mediator in a student-centred learning environment, is seen as an important part of the change process.

Identifying those factors which have been instrumental in changing practice is therefore critical to part of this process. The next section summarises known influences on successful integration, including the significance of teachers' goals and beliefs on their practices.

Factors influencing successful integration

Within a school context, program evaluation studies have identified a range of factors contributing to successful integration of ICT (Condie et al., 2007; Schnellert & Keengwe, 2012; Tondeur et al., 2009; Tondeur, van Keer, van Braak, & Valcke, 2008). These include 1) the culture, policies and priorities of a school, 2) leadership commitment to ICT curriculum support within the school, 3) capacity of resources and sustainability of the infrastructure, 4) technology access, 5) available funding and time for training of specialists and teachers, and 6) levels of teacher skills and attitudes, complemented by involvement of the whole school community of teachers, students and parents. Ample evidence also exists of support factors, such as technical and human infrastructure resources, as well as teachers' ICT skills and competencies, which contribute to successful ICT integration by teachers (Condie et al., 2007; Tondeur et al., 2009; Zhao et al., 2002).

The survey study of Tondeur et al (2009) assigned many of the above factors to two dimensions of a school's characteristics and referred to them as structural and cultural. Structural characteristics referred to a school's capacity

and effectiveness to integrate ICT successfully through its ICT goals and documentation, levels of support for teachers and the quality and robustness of its infrastructure. Cultural characteristics focused on the school staff. The three variables investigated were 1) the degree of teacher innovativeness and positive attitudes, 2) the shared goals of the teaching program and 3) the support and quality of leadership. Their findings revealed that these two dimensions of school structure and culture were interconnected. For example, where a school scored highly in its structural characteristics, indicating a high degree of successful integration, it also had a high score for its cultural characteristics.

Fu (2013), in a review of the literature, refers to school culture as a shared vision of school leaders and teachers evident in the school goals and objectives of its plans for ICT integration. This review concluded that plans should be derived through shared decision-making processes and underpinned by common values which reflect the school community beliefs in the value of ICT to support and enhance curriculum delivery. Similar work by other researchers, for example, (Divaharan & Lim, 2010; Fu, 2013; Tezci, 2011), has found that this basis of sharing forms part of a school culture which can influence successful integration.

These influencing factors stem from an analyses of the perceived or known impediments which had prevented teachers from successful integration of ICT and have been categorised as first and second order barriers (Ertmer, 1999). Ertmer classified first order barriers as extrinsic, that is, as personnel and hardware resources, access and maintenance. Not so easily classified were second order barriers attributed to a raft of teacher beliefs and attitudes about

teaching and learning. It was Ertmer's contention that individual teachers would attach differing levels of importance to each of the barrier domains, that is, instances would impact upon one another across and within barriers. For teachers to achieve success, Ertmer recommended they use three broad strategies, namely, 1) observe role models, 2) reflect on teaching practices and 3) collaborate with peers. In addition, she suggested some practical classroom strategies. These encompassed acquiring knowledge of the curriculum to determine the selection of resources, their management in the classroom and assessment of student learning.

It is in the area of these second order barriers that the goals and beliefs of teachers about technology-supported teaching can impinge upon successful teaching practices. Goals and beliefs are powerful motivating factors. The goals teachers set in their teaching program and their choice of teaching strategies, their beliefs about student learning, the goals they have for themselves as teaching professionals and the beliefs they have about the value of their own experiences are just some aspects of their emotions and feelings impacting upon practice (Cuban, 2002; Hargreaves, 1998; Hermans, Tondeur, van Braak, & Valcke, 2008; Judson, 2006; Pajares, 1992).

Differing systems and structures of beliefs have been discussed, examined and summarised by Pajares (1992) in his research findings on teachers' beliefs. Educational beliefs, their connections to knowledge and the influences of beliefs were just one facet of his comprehensive analysis. He argued that fruitful research of educational beliefs should investigate the "relationship between beliefs, on the one hand, and teacher practices, teacher knowledge, and student outcomes on the other" (Pajares, 1992, p.327).

Building knowledge about the factors influencing the successful integration of ICT by teachers and the impact of their goals and beliefs on their practices reveals the complexities of change. Discussion earlier in this review has highlighted pressures upon teachers to change their pedagogical practices informed by technology-supported teaching approaches, in addition to striving for excellence in their work. In order to support the realisation of these goals, learning more about expert teachers through rich descriptions of their practices and their influences has been the concern of many educators (Goodwyn et al., 2009).

Literature about expertise in general is prolific. It is not the intention here to discuss this in detail, rather to provide some background appropriate to the context of this research. Therefore, the following section begins with an outline of characteristics of experts, expert teachers and experts in integration ICT. It concludes with descriptions of suggested stages which lead towards levels of expertise in pedagogical practices and professional learning.

Journeys towards expertise

Expert ICT teaching, integration and teacher growth are central issues in this study. The context for technology-supported teaching has been explained previously (see section on *Pedagogy, ICT integration and technology-supported teaching*). Reference to the literature on expert ICT teaching and related aspects of teacher growth now follows. Firstly, some qualities of experts are illustrated, followed by contexts and terms used to describe practices and personal characteristics of expert teachers. Secondly, some categories of ICT competencies and capabilities are noted. Thirdly, terms and descriptors used by researchers to explain stages of development relating to the growth of teachers

expertise in technology-supported teaching are explained. This concludes with a brief review of the strategies these expert teachers use to advance their learning.

Describing an expert

The term expert is not easily defined yet its use is common in all facets of our lives. Expert chefs, on television, in a proliferation of books and magazines, show how to prepare and serve all kinds of appealing food. The demonstrations imply that the skills needed for the task are easily acquired by the novitiate through observations and explanations. Expert sport and life coaches, on the other hand, aim to improve the performance of their clients, because of their superior knowledge gained over a long period of time in that context. Yet another group of experts includes professionals, for example, in business, the humanities, the law and those engaged in the physical, emotional and mental well-being of the populace. All of these individuals are recognised by society as possessing superior knowledge in their particular field of endeavour. Their talents are visible to their peers and to others through the wider dissemination of their accomplishments. The role of many of these experts is to assist, support and guide those in need of advice or to direct the activities of others in their sphere of work. In many instances, acquisition of their special knowledge and skill has occurred through a commitment to learning and a desire to be the best in their field. Again progress towards expertise has usually taken time and often required prolonged periods of practice, for example, in the case of experts in chess and sporting activities (Berliner, 2004).

It has been asserted that deliberate prolonged practice is a significant feature of expert performance (Ericsson, 2008). In his many investigations on

the characteristics of experts, most particularly in the field of medicine, he found that experts had a high degree of concentration, their knowledge was situated in a specific domain and they had distinctive strategies for storing and retrieving information from memory. Reflection on performance through critical analysis and feedback was a continual process and contributed to their improvement. Attributes such as these have relevance for teachers considered to be experts.

Expert teachers

Excellence in teaching practice has been explained through standards and career stages, referred to earlier in this literature review (AITSL, 2012a; Department for Education, 2012; Department of Education, 2012; MCEECDYA, 2011). These documents provide comprehensive descriptors about the quality of teachers' professional knowledge and practices with an aim of delineating a rewarding career path for teachers to follow. Progression through career stages is but one way to ascertain quality teaching. In an effort to understand the qualities which would explain exemplary teaching, considerable research has given importance to distinguishing the attributes of experienced, novice, expert and non-expert teachers (Berliner, 2004; Dreyfus & Dreyfus, 1986; Hattie, 2003; Schempp & Johnson, 2006; Stough, Palmer, & Sharp, 2001; Tsui, 2009; Webster & Schempp, 2008).

Distinctions between novice and expert teachers, similar to career stages, have been made to describe expertise stages, namely, novice, advanced beginner, competent, proficient and expert (Dreyfus & Dreyfus, 1986). Two large studies undertaken by Berliner (2001) and Hattie (2003), with different sets of features and measures, both found that expert teachers 1) set challenging tasks for students, 2) provided multiple representations of concepts

and 3) gave feedback and monitored student performance. In both studies the researchers drew upon teacher participants who had undergone testing through the National Board for Professional Teaching Standards (NBPTS) in the United States of America (USA).

Assessing a theoretical model of teaching expertise, which had been derived from the Dreyfus and Dreyfus (1986) stages of expert teaching was Berliner's aim (2001). He created a set of 13 prototypic features, which in broad terms related to teacher actions, knowledge and skills. He contended that novices, for example, abide by a set of rules and procedures, know about and teach particular content while using general teaching strategies. Typical features of expert teachers on the other hand, according to Berliner (2001), included deep knowledge of context, diversity of strategies to meet task demands, opportunistic responses to changes in the learning environment and incorporation of routine practices that appear to occur without planning.

On the other hand, Hattie's aim (2003) was to compile a profile of expert teaching by comparing their attributes with those of experienced teachers. From his review of the literature, Hattie (2003) proposed a set of dimensions and associated attributes. Features of this profile included the central role of contextual knowledge, cross-curricula knowledge and flexibility in the delivery of lesson pathways. Equally important were teachers' respect for students, the engagement and knowledge of students and their needs, and the management of the learning environment. For example, according to Hattie (2003), expert teachers were more likely to set challenging goals for their students requiring high levels of engagement and to be more flexible in responding to students' needs as individuals. Experienced teachers, on the other hand, spent a good

deal of their time talking while students listened and tended to use feedback information as it related to the whole class.

While not employing the quantitative and qualitative analysis approaches of the Berliner (2001) and Hattie (2003) studies, case study research work has contributed to an analysis of expert teaching (Gipps, McCallum, & Hargreaves, 2000; Tsui, 2009; Webster & Schempp, 2008). In a small case study of 4 English as a Second Language (ESL) teachers in Hong Kong, Tsui (2009) made distinctions between expert and experienced non-expert teachers. These differences were demonstrated by expert teachers in the ways they linked their breadth of knowledge about context and pedagogy, the depth and scope of their contextual responses in teaching and the extent of their reflective practices on their performance. According to Webster and Schempp (2008), in the context of sport, the use of self-monitoring strategies is a feature of expert teachers' performance. It was their contention that expert teachers aimed to understand and improve their instructional skills. In addition they found that experts had a passion for the acquisition of knowledge about students and content and were aware of their personal characteristics which impacted upon the quality of their teaching. Dimensions of teaching strategies have also served to explain the qualities of expert teachers (Gipps et al., 2000). The findings of their study revealed that successful classroom strategies of expert primary teachers were evident in their flexible modes of delivery according to content and knowledge requirements. Teachers used strategies of explaining, demonstrating, suggesting, constant monitoring, observations and feedback together with an array of scaffolding techniques throughout lessons.

In summary, one way of describing and assessing a teacher's expertise is through the creation of profiles and measures to establish progressive stages of teacher development from novice through to expert. Another is to delineate aspects of their characteristics, such as performance self-efficacy. Yet another is to examine the breadth of their pedagogical practices. Gaining experience can influence development, yet teaching experience alone however, is not necessarily a determinant of expertise (Goodwyn et al., 2009; Hattie, 2003). As Berliner (2001) posited, "would it not have been nice to learn of their life histories and about the role of context, practice and ability in their development" (p.471). The creation of richly descriptive, multi-dimensional profiles incorporating these themes, that is, the pedagogical practices and influences of learning experiences and personal characteristics, in an ICT context as proposed in this study, will add to the depth of our understanding about the complexities of expert teaching.

Exemplary characteristics in technology-supported teaching

There is a paucity of literature using the term expert with reference to teachers' practices in the context of technology-supported teaching. Terms more often used are *successful / unsuccessful teaching*, *effective teaching* or *good practice* (Carbone, Mannila, & Fitzgerald, December 2007; Haydn, 2014; Ingram, 2003; Tondeur, Kershaw, Vanderlinde, & Van Braak, 2013; Trinidad et al., 2004; Webb & Cox, 2004). These categories connect quality teaching with student performance - a complex domain in which to determine and measure variables, as referred to previously in this review of the literature. It is contended that this research on expert teaching which excludes analysis of student achievement and focuses only on the teacher can yield rich and useful

knowledge of teachers' practices, growth and determinants of their decision-making.

Teachers' expertise in an ICT context has been classified using progressive stages and dimensions of practice (Schibeci et al., 2008). Educators and researchers concerned with pedagogic change in ICT environments have used criteria-based labels to determine the progressive stages of a teacher's development (Cuban, 2002; Dwyer, Ringstaff, & Haymore Sandholz, 1990; Jones, 2002; Noss & Pachler, 1999; Trinidad et al., 2004). Excellence in teaching with technology has also been determined by ascertaining teachers' competency levels of skill and capacities (DEST, 2002; ISTE, 2000, 2000b).

Competency in computer applications and equipment refers to skill levels, for example, in word processing, use of email, databases and spreadsheets, digital photography and image editing (ISTE, 2000b). However, competency alone in these skills does not necessarily mean that successful teaching practices will ensue (Haydn, 2014). Capacity as a broader label is more relevant. Capacity scales or stages, imply not only progressive change, but have led to attribute descriptors of teachers considered to be experts in the integration of ICT in the curriculum (Noss & Pachler, 1999). Capacities are usually illustrated by the scope and depth of professional practice use, pedagogical knowledge of ICT integrated planning, delivery of student-centred authentic learning experiences incorporating problem solving and higher order thinking skills, and knowledge about social and ethical issues (DEST, 2002; ISTE, 2000).

Early research into stages of development in teacher practices highlighted different phases of progress towards expertise, namely, entry, adoption, adaption, appropriation and invention (Dwyer et al., 1990). This was a five-year longitudinal study by Apple Classrooms of Tomorrow (ACOT), when interest was centred on the introduction of technology into the classroom. The first phase described practices of teachers who were inexperienced in its uses and traditional in their approaches to student learning, that is, knowledge was organised and imparted by the teacher. Although no teacher had reached the latter phase of invention, it was envisaged as one where the learning environment had changed significantly as a consequence of teachers' beliefs in the potential of the technology to transform the educative process.

The ACOT study was a useful model in beginning to understand how teachers' practices and professional knowledge might develop as the result of the introduction of computing technology into classrooms. When access to digital tools and resources became commonplace more than two decades later, attention had focused on the exploration of teachers' technological, pedagogical and content knowledge as a means of understanding, facilitating and encouraging successful technology-supported teaching (Anderson, 2010; Cuban, 2002; Jones, 2002). Similar stages, that is, emerging, applying, integrating/infusing and transforming, to those of the ACOT model, help in explaining the growth of teachers' practices and in assisting schools to identify their levels of progress (Anderson, 2010). For example, teachers at the emerging stage are those whose use is limited to the skills of using the tools for professional purposes in their planning and preparation. Teachers are deemed to be at the transformative stage when their practices show that technology is

an integrative part of the teaching/learning process. Teachers then would use the technology to create and manage innovative and authentic learning experiences, which are student-centred and aim at enhancing their learning. In this model school leadership would demonstrate vision in their plans for technology integration within the curriculum. While this model also provides teachers with information on performance indicators as a means of encouraging, inspiring and directing their professional growth, these are insufficient to encompass other indicators of expert technology-supported teaching.

According to Pierson (2001), in order to be identified as exemplary in technology integration, teachers would need appropriate levels of “technological-pedagogical-content knowledge”. This type of knowledge would be evident in the depth of their content knowledge, the scope of their technology knowledge and how they embedded these in their pedagogical knowledge as a benefit to student learning. Koehler and Mishra (2009) asserted that “expert teachers bring TPACK into play any time they teach (when they integrate) technology, pedagogy and content” (p.66).

When using technology to deliver the curriculum, exemplary teachers have been described by their practices and characteristics (Cuban, 2002; Hargreaves, 1998; Lopate, Miller, & Miller, 2003; Norton & Wiburg, 2003; Noss & Pachler, 1999; Schempp & Johnson, 2006). Their practices would show their understanding of how students learn, take into account their prior experiences and the technological world in which they live. A wide range of teaching strategies and their recognition of affordances for the use of digital tools and resources would be reflected in their innovative and flexible practices. Their

characteristics would indicate their motivation, commitment to continuous learning a willingness to change in practices. Ertmer (2007) defined “exemplary technology-using teachers ... as those who employ technology in learner-centred, constructivist environments as opposed to traditional teacher-directed environments” (p.55). While she acknowledged the limitations of selecting her research cohort of award winning technology-using teachers across regions and the survey instrument, findings resonate with these and other studies on expert teachers (Tsui, 2009; Webster & Schempp, 2008). For example, in Ertmer’s study (2007) reflection on beliefs, working in a collaborative environment and sharing with peers were ranked highly by participants. In addition, experienced exemplary teachers ranked confidence, time and technology support as important contributors to the quality of their practice.

These examples have served to illustrate the attributes of teachers considered to be exemplary in their pedagogical practices within a technology-supported environment. Professional growth is implicit. To progress their growth teachers must choose their learning pathways, yet many use technology only for preparation purposes and have not attained standards which call for student-centred pedagogical practices (Caldwell & Harris, 2008; Ertmer & Ottenbreit - Leftwich, 2013; European & Schoolnet, 2013). There is concern also, about the pedagogical shift required in expert teaching approaches which incorporate ICT (Kozma, 2011a). If we knew more about these aspects of teacher excellence within working classrooms then the practical face of professional standards could be more visible and attainable. Knowledge about pathways to excellence and learning experiences could assist non-expert teachers in understanding how to reach expected levels of expertise (Bandura, 1991).

Learning experiences

Strategies for learning how to teach in a technology-supported environment vary. Engaging in professional development activities may be one approach teachers choose to advance their own learning, or have imposed upon them as part of school policies. Characteristics of experts and expert teachers tend to influence their particular learning strategies which contribute to their growth, changes in their practices or maintain their levels of expertise (Berliner, 2001, 2004; Brown & Johnson, 2008; Ericsson, 2002; Schempp & Johnson, 2006; Tsui, 2009). The following paragraphs refer to the success and relevance of professional learning activities associated with change, influences on change over time and how expert teachers progress their learning.

The terms professional development and professional learning are not synonymous and a distinction needs to be made for the purpose of this research (Mayer & Lloyd, 2011). In their detailed review of the literature on these two terms, the broad view of Mayer and Lloyd (2011) on professional development was that it involved activities which could be both formal and informal. Professional learning, on the other hand, specifically encompassed change. They concluded that “professional learning could involve changes in one’s capacity for practice (i.e., changes in professionally relevant thinking, knowledge, skills, and habits of mind) and/or changes in practice itself (enacting the new knowledge and skills in one’s daily work)” (p.3). It is this latter definition and its focus on change that is most applicable to this current study, though some initial reference is made to the historical background of professional development.

Professional development models and school implementation strategies have endeavoured progressively to meet the perceived needs of teachers as knowledge has been gained from the findings of many program evaluations aimed at teaching with technology (Hayes, 2004). As a consequence, the scope of professional development programs has been evolving constantly, from an initial focus on computing skill competencies and knowledge of what the technologies could offer, to the design and management of learning activities, use of effective teaching strategies and the inclusion of curriculum support throughout this process (Chambers & Tromp, 2002; McCarney, 2004).

A positive effect of some professional development programs has been the improvement of teachers' confidence and operational skills (Balanskat et al., 2006). Yet it has been asserted that the majority of teachers have not made significant changes to their pedagogical knowledge, beliefs or practices when using technology in student learning environments (Balanskat et al., 2006; Hayes, 2004; Ottenbreit-Leftwich et al., 2010). Much of their use has tended to focus on technology as a management tool, for communication purposes or teacher-led instruction rather than employing student-centred approaches in their teaching (Ertmer & Ottenbreit-Leftwich, 2010).

According to Ertmer & Ottenbreit-Leftwich (2010), a range of professional learning strategies could effect change in pedagogy and beliefs, which would influence teaching knowledge and practices with technology. Many of these rely on school culture and leadership. Creating a cooperative environment where teachers feel they are part of the decision-making process of achieving and setting goals was one example given. The provision of opportunities for teachers to share and observe successful practices, the encouragement of risk-

takers and innovative ideas were some other recommendations made by Ertmer and Ottenbreit-Leftwich (2010). They asserted that it was important to design professional learning strategies which acknowledged teachers' specific needs and scaffolded their learning from their known knowledge bases and pedagogical beliefs.

Similar views were held by Orlando (2014) about the advancement of professional learning and change of pedagogical practices in a technology context. Her 5 year longitudinal study followed changes made by a small group of teachers as they used digital resources and tools in their practice. One of her contentions was that learning environments needed to account for teachers' unique pedagogical knowledge, their personal developmental goals and encourage self-reflection as part of this learning process.

Collegial and critical discussion, which embody self-reflection, is another approach used by teachers who select particular mediums to aid their professional learning (Prestridge, 2009). Prestridge explored the changing practices of primary school teachers (Years 1-7) from 8 Australian schools through their participation in a research project on professional development. Analysis of background data on teachers' beliefs and ICT practices provided four sets of factor descriptors. These were foundational, developing, skill-based and digital pedagogical. She found that by sharing their pedagogical beliefs and practices in face-to-face situations, teachers were able to build relationships and a sense of community. Alternatively, participation in online environments promoted critical discussion of issues related to pedagogical practices. Changes to practices, she believed, would be enhanced by a combination of these two forms of professional development.

Engagement in one or more forms of these learning experiences can contribute to the development of expertise. The decision to do so lies with the teacher. Strong motivation to become an expert, and maintain that standard, is a critical factor (Berliner, 2001). It is not a natural process, rather one that requires commitment to 1) achieving high standards of performance, 2) time spent in learning and repeated practice, 3) continuous learning to maintain standards, and 4) a willingness to address challenges and take risks in unknown teaching/learning environments (Berliner, 2001, 2004; Hattie, 2003; Schempp & Johnson, 2006; Tsui, 2009).

This literature review has served to provide a background to the development of our understanding about expert technology-supported teaching. It segmented features of teachers' pedagogical practices, their learning experiences and their characteristics in an endeavour to uncover their many known influences. This study sought to continue this investigative pathway by analysing these features as interdependent dimensions, thus contributing to our knowledge needed to advance teaching excellence within an ICT integrated environment.

Research design

The purpose of this study was to investigate the learning journeys of teachers through an analysis of factors which had contributed to, and influenced, the growth and quality of their expert practices in a technology-supported curriculum. Within this context it explored affective influences such as their goals and beliefs about teaching and learning, the influences of significant learning experiences and subsequent decision-making strategies on changes to practice, which led to their current expertise. Therefore, the overarching research question of this study asked:

What are the features of primary teachers' journeys to expertise in their technology-supported practices?

This question was explored within the structural and cultural characteristics of a school setting in terms of the relationships and influences amongst teachers':

- Pedagogical practices,
- Learning experiences, and
- Personal characteristics.

These three domains were derived from this literature review and elaborated upon in Appendices M and N, and Table 3.14.

Conceptual framework

A review of the literature informed the creation and construction of the conceptual framework where teachers' expert pedagogical practices, their learning experiences and their personal characteristics are viewed as interdependent – see

That is, the effect of a particular practice may stem from its causal base of a specific teacher experience or characteristic. The inverse may also be inferred. The circular, not linear, interconnectedness of practices, experiences and characteristics was therefore critical to gaining a rich and meaningful understanding of these dimensions and their influences upon one another.

The interactions of the structural and cultural characteristics of a school (Tondeur et al., 2009) are perceived as providing a supportive environment for growth or change in the dimensions of teachers' practices, learning experiences and characteristics. Teachers' reasoned decisions (Shulman, 1987) are considered to be based upon their comprehensive content and pedagogical knowledge (Koehler & Mishra, 2009), their beliefs about learning and their interactions with students. The conceptual framework suggests that the success of the teachers' decision-making may rely not only on the support and quality of a school's characteristics, but on the influences of their practices, learning experiences and characteristics. Dependent upon the outcomes of their decisions, teachers may choose to improve or change aspects of these dimensions. That is, reasoned decisions and the three domains are conceived as impacting upon one another, thereby having an influence on the growth of teachers' journeys towards expertise in technology-supported teaching.

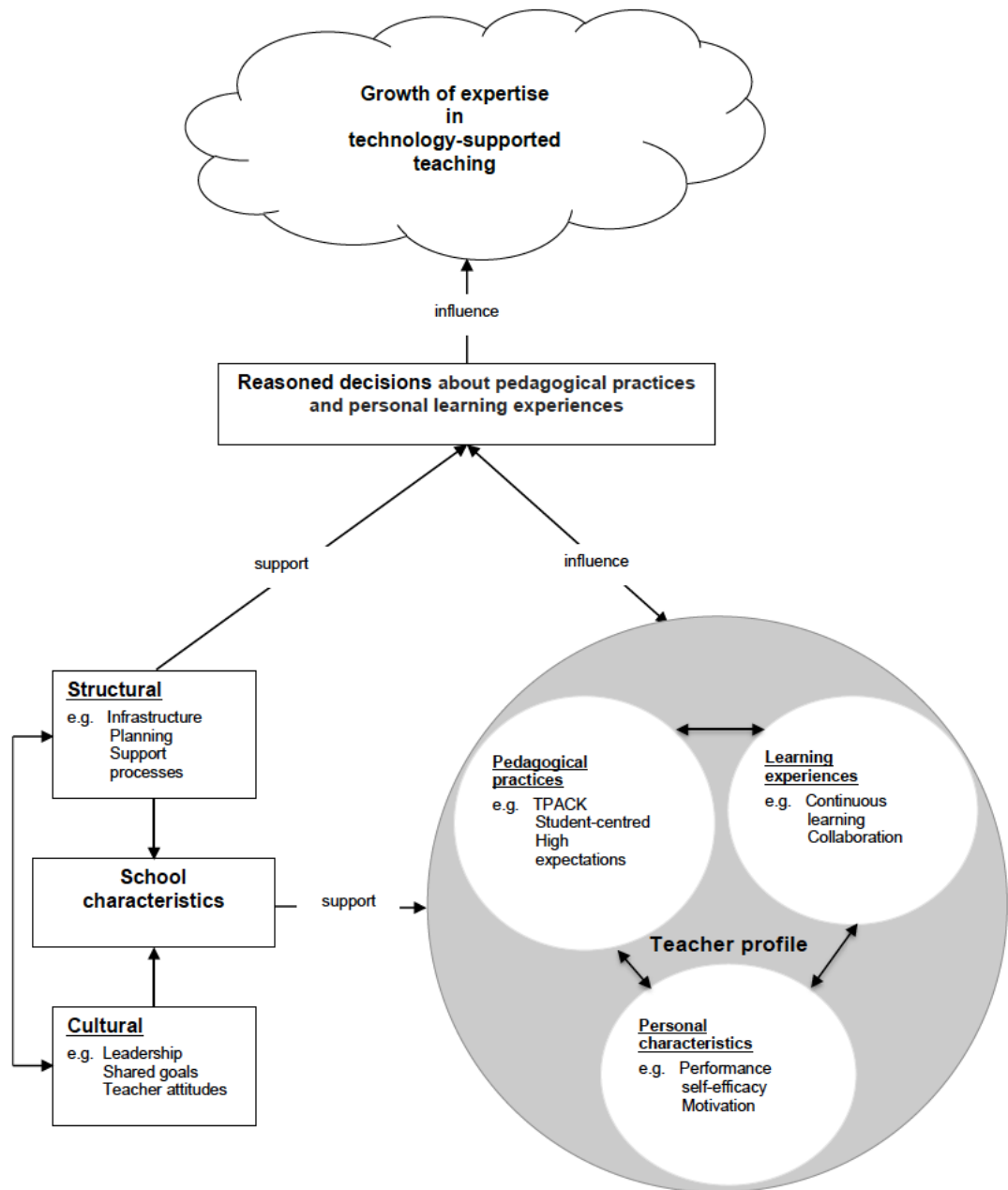


Figure 2.1 A schematic diagram representing the conceptual framework for the study

It has been asserted that the domains represented in the conceptual framework are interdependent. This concept of interconnectedness provided a basis for the research design framework. The methods of data collection (observation, interview and documentation) not only informed teacher pedagogical practices, experiences and characteristics in a school environment,

but they also were informed by, and guided, the data collection processes from these sources.

The context for the theoretical framework of this study was expert technology-supported teaching within working classrooms. In shaping ideas to inform themes and domains of practice, a set of descriptors, developed from a pool of constructed knowledge about influences and relationships, was used in conjunction with some of the descriptors about experts and expert teaching. This was an interactive and almost cyclical process enabling categories and relationships about practices and capacities to emerge through the use of classification and analytical strategies. In this way, it could be said that grounded theory *informed* the theoretical design, rather than forming the basis for its design (Glaser & Strauss, 1967).

The design of this study was not only *informed* by grounded theory, but used both quantitative and qualitative techniques to collect, analyse and present data in the form of multiple case studies, followed by a cross-case analysis. Thus, a mixed methods research design (Yin, 2009) was deemed appropriate for an investigation of the complex domains in this study. As Yin (2014) stated a mixed method “allows researchers to address more complicated research questions and collect a richer and stronger array of evidence” (p.66).

Summary

This chapter has provided a detailed background from the literature to explain the reasons underlying the development of the research topic and an exploration of other research in the key areas of interest to this study about expertise in technology-supported teaching. A range of pedagogical perspectives, particularly learning theories, and factors influencing the success

of delivering a technology-inclusive curriculum, such as school characteristics and the goals and beliefs of teachers, have been examined. Qualities of expertise were considered by reviewing the literature which described experts, expert teachers and exemplary practitioners using digital tools and resources. This included an outline of the learning strategies and personal characteristics which have influenced and motivated teachers to continually seek excellence in their practices. It concluded with an overview of the research design as a conceptual framework. The schematic diagram illustrated the flow of the study's investigation into teachers' growth as journeys towards expertise in technology-supported teaching and the decisions they made about their practices. Links to be investigated were shown as supportive school characteristics and influences of pedagogical practices, learning experiences and personal characteristics.

The following *Methodology* chapter explains the details of the sample setting, the selection of participants and construction of the data collection sources. It includes the derivation processes and the classification of units used to analyse teaching and questioning strategies and student engagement modes. The chapter concludes with the creation and construction of explanatory descriptors of teachers' perceived influences on their practices. In addition, it synthesises data from the data sources with the literature on teachers' pedagogical practices, learning experiences and personal characteristics, extrapolated to include that of experts, expert teachers and teachers expert in technology-supported teaching.

CHAPTER THREE

METHODOLOGY

A mixed methods approach was found to be suitable for this research design (Yin, 2009). Techniques in this approach combined case study design, the use of multiple case studies, a cross-case analysis, quantitative and qualitative data, in addition to being *informed* by grounded theory (Corbin & Strauss, 2008; Glaser & Strauss, 1967). A multiple-case design was seen as most appropriate to account for the analytical investigation of a small group of teachers, and subsequently to draw cross-case conclusions (Yin, 2009). This form of research aims to gain deep and meaningful insights into the particular practices of a small group (Patton, 1990). Individual participants' practices and experiences are viewed as rich sources from which to obtain considerable descriptive data for analysis and interpretation. In this study, the contexts for analysis were pedagogy and technology-supported teaching while the contributing components or influences upon teachers' journeys towards expertise were their goals, beliefs, learning experiences and strategies, and teaching practices

It was expected that expert teachers would be found in schools where support for technical and human infrastructure resources, in addition to teachers' ICT skills and competencies, were well embedded (Tondeur et al., 2009). It sourced primary teachers from only one school where the integration of ICT was school-wide, had been in place more than 10 years and was fundamental to the delivery of the curriculum, according to the school policy documents. By choosing teachers from only one school many variables remained constant, such as known stable and consistent factors for successful

integration (Condie et al., 2007; Schnellert & Keengwe, 2012; Tondeur et al., 2008). This research was then able to focus clearly on the themes of teacher dynamics and their journeys of change towards their degree of expertise, without needing to account for differences in school characteristics and consequent possible different influences.

The decision to select teachers from a primary school was based on factors believed to enhance the quality of the research outcomes. In well-resourced primary schools, classrooms are likely to have easy access to multiple computers or laptops (Tondeur et al., 2009). Thus the physical environment is conducive to their point-of-need use by students throughout their engagement in curriculum activities. Primary teachers generally are responsible for at least core curriculum subjects and many teach just the one class in all learning areas; a range of subject knowledge can provide scope for cross-curricula learning activities and a range of pedagogical practices (Loveless, 2003; Savage, 2011; Smeets, 2005). The timetable for subject activities is not restricted like secondary schools where subjects are scheduled separately and conducted by specialist teachers. This compartmentalisation of subjects is likely to reflect subject-dominated pedagogies. This is not a feature of primary classrooms where teachers have the flexibility to exhibit a range of pedagogies if they implement teaching/learning activities around a theme, to incorporate many subjects in a cross-curricula approach.

Sample setting

The data collection for this research study was carried out in the junior school (primary) of an independent girl's school which is located in an affluent area of a city in Australia. The school was known by the Educational Computing

Association of Western Australia (ECAWA), and the Centre for Schooling and Learning Technologies (CSaLT) at Edith Cowan University (ECU) for its length of ICT use, good level of resourcing and infrastructure availability, its goal of embedding ICT within the curriculum, its quality of staff and its leadership structure. The director of CSaLT had recommended the junior school to the researcher, who had no previous knowledge of the school. Formal approval for permission to conduct the research in the school was given by the principal of the senior school, before the principal of the junior school was approached. The junior school principal advised that no further formal approval was required.

The junior school, with an enrolment of approximately 400, catered for students from Kindergarten to Year 6. It is situated on its own campus, separate from the senior school, and was led by a principal and two deputy principals. In each of the Kindergarten to Year 4 levels, there were two classes, while for the Year 5 and 6 levels, there were three classes for each. The Years 3 and 4 classrooms opened onto a large shared area. Two similar open areas were provided for the Year 5 and 6 classroom clusters, as well as a substantial workspace for science, art, and music, with library facilities housed in separate areas or buildings. There were about 24 students in each class. Except for Kindergarten to Year 2, all students were girls.

Teachers were provided with a laptop computer and each classroom housed a data projector. A range of computing resources was available for students. Each Year 4 classroom had a bank of 24 Mininotes, which had access to the Internet. The 72 students in the three Year 6 classes shared a bank of 24 Mininotes. One computer laboratory with 24 workstations was easily accessed from the library through a wall of bi-fold doors. Mininotes were also available in

the library space for students to use. An interactive whiteboard stood in each of the open area clusters and in the library.

Two full-time technical support staff were located in the senior school. It was reported that when teachers in the junior school encountered a problem they could not solve, a standard procedure was followed. Firstly, they sought the help of the deputy head curriculum ICT and library resource teacher. If she was not available or the problem persisted, teachers made email contact with the technical staff and a follow-up visit, whenever required, was arranged. Professional development on management resources, such as Study Whizz, was also made available to teachers through the support staff.

The researcher was given access to school policy on ICT and the Technology and Enterprise learning area (later to be known as the Technologies learning area). Strategic goals and initiatives included statements about student outcomes, the engagement of the teaching staff, the expected quality of the infrastructure and technical support provision. Principles for ICT usage were stated in terms of adding value to the learning environment, particularly in the enquiry approach used by the school in the learning areas of science, humanities and social sciences and the subject area of health. An ICT scope and sequence chart detailed expected computing skills to be attained at each Year level. The policy also placed heavy emphasis on the cyber safety procedures which teachers were to follow.

Sample

Five female teachers participated in the research. They were the deputy head curriculum ICT and library resource teacher, two teachers of Year 4 students and two teachers of Year 6 students. The deputy head curriculum ICT

was recommended by the director of CSaLT in the first instance and by the principal of the junior school. This female teacher had been recognised by ECAWA for her excellence in teaching using ICT and by national /international organisations, such as, the Teaching Australia National Award for Quality Schooling: Excellence by a Teacher and twice by Microsoft as an innovative teacher with ICT.

The sample of 4 classroom teachers was selected on advice from the junior school principal and the deputy head of curriculum ICT. The brief of the leadership advocates was to identify teachers who were:

- Using technology-supported strategies across the curriculum, regularly and with confidence,
- Demonstrating quality in such teaching,
- Electing to use ICT in their teaching program because of their belief in its effectiveness,
- Using ICT innovatively and creatively,
- Employing a cross-curricula approach in their teaching/learning program, and
- Providing for regular and frequent ICT use by their students.

These descriptors had been compiled from the review of the literature on teachers' qualities which had contributed to influencing successful integration (Cox et al., 2004; Goodwyn et al., 2009; Tondeur et al., 2013). In addition, it was important that these teachers were able to reflect upon their practices, that is, they possessed abilities to access and analyse their experiences and motives (Hughes, 2005; Schon, 1983; Tsui, 2009). At no time was the word

expert used in the brief to the advocates, nor were teachers selected on the basis that they satisfied criteria on an itemised list which delineated specific characteristics of experts.

Formal permission was obtained from all five participating teachers. No teacher withdrew from the study.

Table 3.1 provides a background summary of the teachers, the pseudonyms used in all relevant tables in Chapters Four, Five, Six, Seven and Eight and the accompanying codes T1-T5 for each pseudonym used in all figures in Chapter Eight.

Table 3.1

Summary of teacher backgrounds

Teacher backgrounds	Kath (T1)	Laura (T2)	Tonia (T3)	Peta (T4)	Jay (T5)
Teaching role	ICT curriculum head	Year 6 teacher	Year 6 teacher	Year 4 teacher	Year 4 teacher
Age (yrs)					
25-30			x		x
41-45		x		x	
56-60	x				
Teaching experience (yrs)					
5-6			x	x	x
20		x			
35	x				
Length of service at current school (yrs)					
≥ 1		x	x		
3				x	x
8	x				
Technology experiences (yrs)					
10		x			
15-20			x	x	x
30+	x				
Technology teaching experience (yrs)					
5		x	x	x	x
30	x				
High level of technology competency	x	x	x	x	x
Experience in different education systems	x	x	x	x	
Leadership roles	x	x	x	x	x

Data collection processes

Data collection processes attended to comparative analysis, triangulation and concurrent data collection (Corbin & Strauss, 2008; Glaser & Strauss, 1967; Patton, 1990, 2002). At this stage, the brief explanation below only summarises how the process of across analysis and triangulation of methods were followed. Further details will become apparent in the section on how data was collected and analysed.

Constant comparative analysis has been described as comparing points of view from different people, comparing views of themselves at different times, and comparing events, data and categories (Charmaz, c2003). This current research collected data about teaching practices from the different teachers, through different sources and at different intervals for constant comparative analysis. It captured the perspectives of teachers on their pedagogical practices, their beliefs about student learners, themselves as teachers, goals for their teaching and their personal goals. In addition, it uncovered their perceptions of significant learning experiences which had influenced their teaching over time, as well as their views on the strategies or events which had impacted most on the quality of their learning. A responsive and reflective approach to teachers' observations, explanations and commentaries on these aspects of their teaching enabled the researcher to interpret data constantly. This interpretive process facilitated the directions of the questioning and analytical pathways, and provided for the development of classification systems and modification of data categories.

Triangulation methods aim to verify and validate the data used for analysis and the subsequent derived findings. Therefore different data collection

methods and sources are advocated (Corbin & Strauss, 2008; Glaser & Strauss, 1967; Patton, 2002; Yin, 2009). In this study, different quantitative and qualitative methods of collecting data about the same set of characteristics or events were used, whilst data from different sources such as observations and interviews were compared. The use of multiple forms of data sources was able to assuage criticism of researcher bias or narrowness in the line of enquiry (Patton, 1990). Results were able to be confirmed or confounded as similar or dissimilar findings emerged from different methods. When conflicting results were found this provided the researcher with valuable information upon which to develop, refine or alter the direction of the research process.

Data collection methods

Different data collection methods and sources were used in this study to understand how and why the complexities of teachers' beliefs, goals, learning experiences and strategies were reflected in their pedagogical and technology-supported teaching practices. The methods used were:

- Informal and video/audio-recorded formal observations of classroom practices,
- A series of audio-recorded interviews guided by focus questions, and
- Documentation data from teachers' programmes of work, lesson plans, school policies and the researcher journal.

These sources not only informed teacher pedagogical practices, experiences and characteristics, but were also informed by, and guided, the

data collection processes (see Appendices A-H for details of focus questions and interviews).

Observations of classroom practices were central to the methodological approach of this research for the following reasons. Judgments about the characteristics of teachers using ICT successfully are often limited to teachers' self-reported skills and pedagogical approaches without authenticating this data by classroom observations and teachers' metacognitive reflections of their technology practices (Condie et al., 2007; Cuban, 2002; Judson, 2006). Data from self-report sources has not only been criticised for its inability to provide a comprehensive picture of practices, but also for the possibility that respondents exaggerate and choose to select or discard information (Cuban, 2002; Hargreaves, 1998; Pajares, 1992). Therefore a critical component in the collection of data was the use of a stimulated recall approach. Stimulated recall (SR) allowed the teacher to self-report on actions and specific situations through observing video footage of a lesson in the natural classroom setting, as well as providing reasons for decisions made at any given part of the lesson (Lyle, 2003; Vesterinen, Toom, & Patrikainen, 2010). With access to simultaneous audio and video records to both the researcher and the participant, this makes visible all actions of the teacher. Thus, by responsive questioning, a researcher is able to uncover reasons for all actions of the teacher.

The stimulated recall method is also a useful tool in accessing significant influences encountered on the pathway to achieving a teacher's current status as an expert practitioner in technology-supported teaching. In both instances, that is, classroom observation SR and delayed sequence of events SR, it was

crucial to the quality of the material gathered, that the teacher was competent in the process of reflection.

The reasons for choosing observations, interviews and documentation as sources of data are outlined below. This is followed by an explanation of the processes used to create the data collection units associated with each source.

Observations

Observations were central to the data collection methods in this study, as stated earlier. They aimed to add a further dimension to understanding teachers' practices as they have the potential to discover unreported actions and provide links to other reported verbal or written perspectives, such as interviews or planning documents (Patton, 1990). They took place in the natural setting of the classroom, where teaching strategies, questioning strategies and the structures of the learning activities to engage students were observed.

Because teachers had prior knowledge of the intended observations it was expected that the extent of their capacities in using digital resources and tools would be exhibited. This type of observational data was the key to discovering the nature of the relationships between this data and self-reported data gathered in interviews and from planning documents.

Self-report as a single source of data collection has not only been criticised for its inadequacies but also for the possibility that respondents exaggerate and choose to select or discard information (Cuban, 2002; Hargreaves, 1998). With video footage, however, being viewed by researcher and teacher simultaneously, and careful reflective questioning by the researcher, selective responses by the teacher were not apparent. Reflective questioning enabled the researcher to listen to a teacher's response and using

the information in that response, to frame a connected question. Where further clarity seemed warranted, questions were re-framed and guided not only by the video episode but from data gathered during other interviews. In this manner, influencing factors on the teacher's practices, such as content and pedagogical knowledge, beliefs and principles about teaching and learning, were explored, as well as the reasons underlying teacher's choices of strategies and resources at point of use.

An explanation of the decision to use observations as a data collection method is not complete without reference to the observer as a possible intruder on the proposed research setting. The influence of the researcher as the only observer on the contextual features is an issue and may be seen as interventionist. As this research was aiming to uncover quality teaching practices, the influence of the observer's presence was viewed as possibly beneficial, as it was expected that teachers would demonstrate the full scope of their pedagogical capabilities.

Interviews

A holistic approach to the gathering of data in a case study can be afforded through interviews consisting of both quantitative and qualitative items. Quantitative items are constructed on selected categories to provide data which may be analysed easily in numerical form. Responses to these items are able to be made quickly and easily by large numbers of people at the same time. On the other hand, qualitative items require responses to be considered and are potentially time-consuming for participants. However they produce rich data which facilitates depth of understanding for both the researcher and respondent. A benefit in using both types of items in one instrument is the potential for

evidence to be corroborated or refuted, and illuminate meaning (Patton, 1990). This combination of quantitative and qualitative items suited the purposes of the interview questions as detailed later.

Interviews are often conducted within the natural setting of a particular group or participant, and may be structured or unstructured. The degree to which the structure is planned depends upon the theoretical framework underpinning the research. Therefore, an unstructured interview format, yet built upon the findings of many research studies and viewpoints was deemed appropriate for the case study approach to this research (Corbin & Morse, 2003; Corbin & Strauss, 2008; Patton, 1990, 2002). It was flexible and had the advantage of both researcher and teacher reaching a consensus of understanding in seeking clarification of meanings. Responsive questioning on the part of the researcher was also constructive, that is, teachers' comments were used as cues to follow a particular line of enquiry in more depth if relevant, and to manage the flow and purpose of the interview.

Documentation

The term documentation here refers to school policies, teachers' planning documents, such as curriculum, learning area programmes, lesson plans and rubrics, and also to the researcher's journal.

Teachers' documentation not only provided data on their planning and the intentions of the learning activities but also acted as stimuli in pursuing fuller explanations of teachers' observed actions. As stated earlier in the rationalisation of the conceptual framework, this is an example of where focus questions on the documentation informed practice whilst making use of

previously gathered data from observations in the formulation of additional questions (see details of focus questions in Appendices A, C, E and G).

The researcher journal was vital to the process of providing descriptive notes on the observer's feelings, impressions and insights at the time of the observations, following interviews and in the analytical process leading to the classification and comparisons of data (Patton, 1990; Yin, 2009). It also provided a record of informal interviews, classroom observations and a commentary from other professional sources, together with ongoing analytical notes as data was collected. Appendix Q is an example from the journal showing notes from an informal discussion and an informal observation.

Sources of data collection units

The creation of the data collection units involved a process which began with the data sources and concluded with the construction of 4 interviews. A step-by-step procedure was followed, namely,

1. Expansion of the five conceptual framework domains.
2. Creation of data units, factors influencing teachers' practices, from these domains.
3. Classification of the data units to a domain, a data source and interview category.
4. Creation of focus questions.
5. Development of sequenced interviews containing focus questions.

Expansion of framework domains

The first step was to expand the domains of teachers' pedagogical practices, experiences and characteristics within the school setting of an ICT integrated curriculum to identify influencing factors (see Figure 2.1). This entailed synthesising the findings of studies from the literature reviewed, to identify and list those factors influencing the successful integration of ICT and the qualities of expert teachers. From this source, the data collection framework was created. The following outline briefly summarises the derivation of these features from the literature.

Creation of data units

From these findings of the evaluation studies together with literature about expert teachers and influences on their practices in an ICT setting, the data units were formed (see Tables 3.2 and 3.3 for details). Each unit was allocated to one of five conceptual framework domains, namely, 1) school characteristics, 2) technology-supported teaching, 3) teacher pedagogical practices, 4) learning experiences, and 5) personal characteristics. There was not always a clear reason why a particular unit should be assigned to a particular domain and not included in another. As stated in the research questions, the contention of this study is that all influencing factors are interrelated and mediated by one another. Thus the singular most important aspect of the process was to identify a comprehensive set of data units and ensure that each one was accounted for within the set of five domains. This foundation would then provide the breadth and depth of data upon which subsequent themes and domains of practice could be developed.

Classification of data units

The data units were then reviewed and the data sources of observations, interviews and documentation were scrutinised to ascertain which source/s would be best suited to the collection of data about each influencing factor (see Tables 3.2 and 3.3 for details).

Table 3.2

Data units and sources – school characteristics and technology-supported teaching

Domains	Data units	Data sources				
		Obs.	Int 1, Pt A	Int 1 Pt B post obs	Int 2 with video	Tchr doc.
School characteristics	School culture		x			x
	School policy and goals		x			x
	Technology-supported teaching policy and goals		x			x
	Leadership management		x			x
	Leadership curriculum		x			x
	Infrastructure	x	x	x	x	x
	Support - curriculum		x	x		
	Support – technical	x	x			x
	Support - team	x	x			x
	Professional learning opportunities		x			x
	Role of teacher		x			
	Involvement in ICT school programs		x			x
Technology-supported teaching	Integrated curriculum	x	x	x	x	x
	Cross-curricula	x	x			x
	Beliefs about ICT		x	x	x	
References: Ertmer & Ottenbreit-Leftwich (2010), Lloyd (2005), Ottenbreit-Leftwich et al. (2010), Tondeur et al. (2009).						

Key: Obs=Observations, Int 1, Pt A = Interview 1 Part A, Int 1 Pt B post obs.= Interview 1 Part B post video observation, Int 2 with video = Interview 2 with video, Tchr doc=Teacher documentation

While the allocation of data units to the observations and documentation sources was straightforward, it was necessary to separate the interview units into a more manageable format. Hence interview data was classified into three categories. Firstly these were general interviews (Interview 1, Part A), interview

post-observation (Interview 1, Part B) and interview post-observation with video (Interview 2). Secondly, Interviews 1 and 2 were reviewed to construct the specific content questions of Interview 3.

Interview 1 Part A was labelled as interview data of a general nature, that is, it contained questions about teachers' experience, their belief systems, their goals and their opinions of the school setting and characteristics (see Appendices A and B). Interview 1 Part B referred to the teachers' perceptions of the learning activity which had been observed by the researcher (see Appendices C and D). Questions were about the teacher's intentions, the resources and strategies used. Interview 2, with access to the video and audio data, contained specific questions from observed examples about the teacher's intentions, the resources and strategies used (see Appendices E and F).

In Table 3.2 it can be seen that the most prevalent instruments for collecting data about features concerning the school characteristics and technology-supported teaching were Interviews 1, Parts A and B, and teacher documentation sources. It was planned to compare and contrast observational data about the infrastructure and technology-supported teaching, in particular, with data from Interviews 1, 2 and 3, and teacher documentation, thus adhering to the research intentions of a triangulated comparative methodology. As could be expected, the main data source for the data units relating to teaching practices were observations, with Interviews 1, 2 and 3 providing further evidence, perspectives and clarification of meanings. Two main sources planned for data collection on teacher characteristics were Interviews 1, Parts A and B and Interview 2 (with access to audio and video footage of a lesson). Interview 2 sought to corroborate or confound what teachers had self-reported

about their characteristics in the light of the video footage which had captured evidence of their actual behaviours.

Table 3.3

Data units and sources – teacher practices, experiences and characteristics

Domains	Data units	Data source				
		Obs.	Int 1 Pt A	Int 1 Pt B post obs	Int 2 with video	Tchr doc.
Practices	Self-monitoring strategies			x	x	
	Reflective decision making			x	x	x
	Flexible modes of delivery	x	x	x		
	Flexible strategies	x	x			
	Type of contextual responses	x				
	Approaches in different learning areas	x				x
	Approaches to problem solving	x				
	Ability dimensions of teacher knowledge	x	x			
	Students' learning understood	x	x	x	x	
	Students' prior learning understood	x	x	x	x	
	Range of teaching strategies	x		x	x	
	ICT teaching opportunities recognised	x				x
	Change in practice		x			
	Role of teacher	x	x	x	x	
Experiences	Professional learning		x			
	Influences on teaching		x			
	Computing-related tasks		x			
	Computing skills	x	x			
Characteristics	Expansion of competency boundaries		x			
	Beliefs about students' learning	x	x		x	x
	Beliefs about teaching	x	x		x	
	Beliefs about teaching with ICT	x	x		x	x
	Own learning style		x		x	
	Own teaching goals		x		x	
	Continuous learning		x		x	
References: Australian Institute for Schools and Leadership (2012), Ertmer & Ottenbreit-Leftwich (2010), Goodwyn et al (2009), Berliner (2004), Hattie (2003), Koehler & Mishra (2009), Kozma (2011), Schempp & Johnson (2006), Stough et al (2001), Webster & Schempp (2008)						

Key: Obs=Observations, Int 1, Pt A = Interview 1 Part A, Int 1 Pt B post obs.= Interview 1 Part B post video observation, Int 2 with video = Interview 2 with video, Tchr doc=Teacher documentation

Again it must be pointed out that an occasional data unit could have been placed within more than one domain. An example is that of the role of the

teacher. Here, a decision was made to include it in both domains of practices and school characteristics, to ensure that data was collected from both these perspectives. Nevertheless, this did not mean that all data collected could only be assigned to one particular domain upon analysis.

Following the allocation of data collection units to the conceptual domains and connecting these with the data sources, the creation of the focus questions for the interviews was considered.

Creation of focus questions

The three categories of interviews referred to earlier, namely, Interviews 1, 2 and 3 were refined. The three interview model was drawn upon to elaborate the interview content and make decisions about the allocation of questions to particular interviews. The model suggested by Seidman (1998) was used for this purpose. That is, a first interview was constructed to highlight specific past experiences, a second interview to include an exploration of current experiences and a third to reflect on meaning. Although the content questions of the final interviews did not adhere strictly to this model, nevertheless, it was a guiding principle.

Before the final sequence of the study's interviews was resolved, a focus for groups of questions upon which to construct the content of the interviews was determined. These groups related to a list of possible influencing factors compiled from the *Literature Review* and were aligned with the conceptual framework domains (see Table 3.4).

It can be seen that the interview content also drew upon two other data sources, that is, sections of each interview were devoted to gaining insights into observations and the embedded aims of planning documents. This is evident

within the domains of practices, for example, where interview focus questions were connected to both observational and documentation data sources (see Appendices A, C, E and G for details of focus questions related to each interview).

Table 3.4

Focus of lead questions in interviews

Domains	Focus of lead questions
School characteristics	<p>Perceptions of school environment</p> <ul style="list-style-type: none"> • support including leadership, curriculum, technical, colleagues • resources • school policy • professional learning <p>Reflective analysis of observed lesson – key features, resources</p> <p>Perceptions of self as school community member</p>
Technology-supported teaching	<p>Comments on current curriculum and technology-supported teaching</p> <p>Reflective analysis of observed lesson – strategies, goals, pedagogical beliefs</p> <p>Description of self as teacher</p> <p>Feelings about using ICT</p>
Practices	<p>Reflective analysis of observed lesson – strategies, goals, pedagogical beliefs, choice of strategies, changes made, unusual aspects, plans for next lesson</p> <p>Explanations of programme of work – aims, strategies, learning activities, planned outcomes</p> <p>Descriptions of observed lesson – aims, strategies, learning activities, planned outcomes, planning documentation, resources, management, roles of teacher and students, role of ICT</p> <p>Descriptions of self as teacher- pedagogical beliefs including effective teaching, students as learners</p>
Experiences	<p>Years of teaching and computing experience</p> <p>Type of tasks</p> <p>Self-rated skills on computer applications and equipment</p> <p>Professional qualifications, learning and perceptions</p>
Characteristics	<p>Professional goals – attainment, attitude to learning</p> <p>Target class description e.g. student abilities</p> <p>Perceptions of self as teacher</p> <p>Descriptions of self as teacher – goals, pedagogical beliefs, teaching approaches in different learning areas</p> <p>Influences on teaching</p> <p>Comments on effective teaching</p>
References: Australian Institute for Schools and Leadership (2012), Goodwyn et al (2009), Berliner (2004), Hattie (2003), ISTE (2000b), Koehler & Mishra (2009), Kozma (2011), Schempp & Johnson (2006), Stough et al (2001), Tondeur et al. (2009), Webster & Schempp (2008)	

Through interviews integrated with observations, teachers' pedagogical practices incorporating ICT in classroom settings were also investigated. In this instance, the focus of some questions provided insights into these practices by exploring the personal learning strategies and experiences which had shaped the teachers' pedagogical approaches to integrating ICT within the curriculum. These questions required teachers to reflect upon, and appraise, their practices and experiences by describing themselves as teachers in an ICT setting. In this process they could refer to aspects such as their teaching strategies and goals, their pedagogical beliefs about effective teaching and students as learners, professional goals, beliefs about ICT, their own learning strategies and professional growth.

Figure 3.1 shows an overview of how each of five domains (see Figure 2.1) was expanded in the form of data units leading in turn to the development of the five different instruments used as data sources.

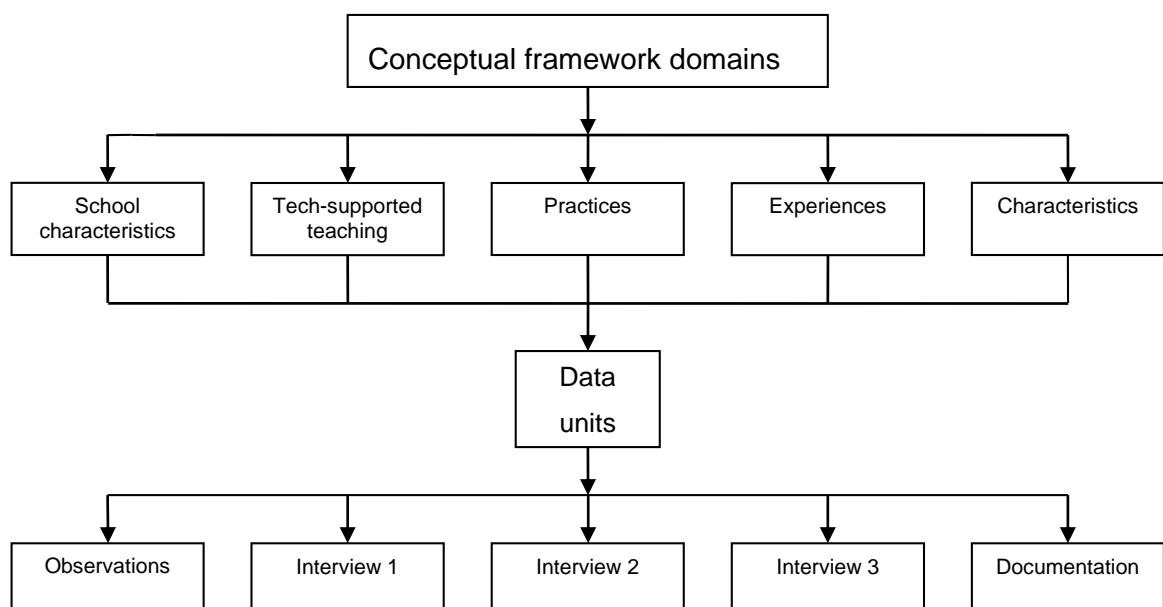


Figure 3.1 Development of content in data sources.

While this example shows how data was gathered from different sources about the same set of practices, data was also collected within a source about the same set of characteristics. To illustrate, lead questions about teachers' perceptions of themselves were derived from different domains across interviews (see Table3.5).

The focus of lead questions within five domains shows that differing aspects of teachers' perceptions of self could be revealed, dependent upon the context. A teacher's self-perceptions, for example, were explored not only in the school community but also with her own class and in an ICT setting. This form of triangulation was used across interviews not only for investigating teachers' perceptions of themselves, but for other aspects, such as seeking qualitative and quantitative data on teachers' computing skills, teaching and ICT experience.

Table 3.5

Perceptions of self

Domains	Focus of lead questions	Purpose
School characteristics	Perceptions of self as school community member	Characteristics in a community
Technology-supported teaching	Description of self as teacher Feelings about ICT	Characteristics using ICT
Practices	Role of teacher	Characteristics in a classroom
Experience	Self-rated computing skills	ICT competency
Characteristics	Influences on teaching	Motivating characteristics
	Comments on effective teaching	Related characteristics
References: Ainscow et al. (1995), Ertmer et al. (2006-2007), ISTE (2000b).		

The interview focus questions also utilised adaptations of three research tools, namely, the International Society for Technology Education (ISTE) teacher self-rated applications and equipment skills set (ISTE, 2000b), aspects

of the Experience of Change instrument (Ainscow, Hargreaves, & Hopkins, 1995) and a modified Becta Self-Review Framework (Becta, 2007).

The applications and equipment skills set of the ISTE applications and equipment skills set required participants to choose the brief description which best illustrated their degree of competency in items such as word processing, use of email and video photography and editing (Appendix K). For each item, a range of 4 descriptors was provided, from “can’t do much” to statements indicating a high level of competency about applications or equipment skills functions. For example, the word processing descriptors ranged from “can print a document, change fonts, spell check, insert footer and page numbers” at the lower competency level, to “can use columns and sections, set up styles, use mail merge” at the most competent level. In addition, qualitative data was collected, by asking participants to explain their selected competency levels, their uses of each application and piece of equipment, and when or how they had acquired their skills. In the analysis process, scores from 1-4, with 4 being the most competent, were allocated to participants’ self-rated choices. A total score was then calculated. This quantitative data was discussed in conjunction with the qualitative data (see Case Studies, Chapters Four, Five, Six and Seven, section Strategies for developing ICT skills).

The Experience of Change instrument aimed to gauge how teachers felt when using ICT with their students (Appendix L). The original intention of this instrument enabled quantitative data to be collected and with repeated administration, to gauge change of time. It was adapted for this study, to include not only quantitative but also qualitative data, and was used only once with the study. Participants were provided with a stack of 24 cards, upon which single

words about feelings were written, for example, “supported“, “stimulated“, “frustrated” and asked to place each one on a marker which best indicated the frequency of their feelings during their usage of ICT with students. These markers were labelled “Often”, “Sometimes”, “Hardly ever” and “It doesn’t seem relevant”. Participants were then asked to provide their reasons for the cards they had placed on the “Often” marker. The instrument had provided a scoring model where words on the cards were divided into 4 categories, attracting a score of 2, 1, -1 or -2. In the analysis process, these scores were allocated to each of the cards which the participant had placed on the “Often” marker. A total score was then calculated (see Case Studies, Chapters Four, Five, Six and Seven, section on *Significant influences on teaching*).

The original intention of the Becta Self-Review Framework was to enable schools to assess their own performance across many strands. However, in this study, the purpose was different and modifications were made (See Appendix H). Selections were made from the framework’s comprehensive strands to produce a final summary of focus questions, which required teacher participants to express their opinions about the overall goals and practices of the school.

Creation of interview sequence

With the focus of the lead questions clearly established, the sequence for a set of interviews was devised, namely:

1. Interview 1: Part A (prior to Lesson 1, Observation 1)

Interview 1: Part B (following Lesson 1, Observation 1).

2. Interview 2 (with access to video / audio records).
3. Interview 3 (following construction of experiences timeline).

Prior to Observation 2, Interview 1: Part A (Appendix B) gathered information about the teacher's technology skills and general experience, her programme of work, and the general school environment. The last part of the interview included an explanation by the teacher of the lesson to be observed in terms of its aims, the teaching strategies, the teacher's role, the planned outcomes and the resources to be used.

Immediately following Observation 2, Interview 1: Part B (Appendix D) enabled the teacher to describe and clarify pedagogical practices used during the activity. It also contained focus questions on the teacher's feelings and beliefs about ICT, perceptions of herself as a teacher and the most significant learning experiences which she felt had affected her current practices and beliefs about teaching.

The aim of Interview 2 (Appendix F) was to enable the teacher to comment upon, reflect about and analyse the observed lesson using a stimulated recall approach whilst viewing the video record and hearing the audio record. It was known that this would be a time-consuming process and had the potential to yield rich data about the teacher's pedagogy and her underlying reasons for decision-making.

Interview 3 (Appendix H) also used a stimulated recall approach to gather data. In this instance, the data related to the influences of critical events, environments and experiences which the teacher believed had contributed to the teaching qualities she now possessed. For example, it was possible the teachers could refer to particular career decisions they had made or professional learning experiences. A final aim of this interview was to provide

opportunities for gathering data on any gaps which may have surfaced as a result of ongoing researcher reflections upon data collected to that point.

Data collection and schedule

As discussed previously, the data sources for this investigation into primary teachers' practices in an ICT environment were observations, interviews, teacher documentation and the researcher journal. Before listing the schedule for the collection of data from these sources, it is necessary to summarise the purpose and gist of the informal meetings, interviews and observations which took place prior to the planned researcher-observed lessons.

An informal interview was conducted with the principal of the junior school (Appendix I), an informal meeting took place with each of the five participating teachers and informal observations of the teachers at work were undertaken.

The principal provided her perspectives on the school culture and policies, the leadership structure and avenues of support for ICT. Her beliefs about the role and management of ICT within the curriculum were sought. The researcher was given access to the school policy and goals, which contained a section on technology-supported teaching policy, goals and plans. Data from this interview provided additional information about the school context and either confirmed or confounded some responses made by the teacher participants.

The informal meeting with each teacher was used to discuss the nature of the research, the time commitment and schedule for collection of data and to obtain the teacher's formal written permission to participate. A disclosure

statement and a consent letter were provided to participating teachers and to parents of students in classes. This statement included information about the research study, advised participants they could withdraw at any time and that the material collected would not be made available to any other person.

Participants were also advised that procedures were in place to protect their identity and the security of records. This entailed pseudonyms for each teacher name and related class name being used. In addition all material in hard copy form was kept secure in a locked filing cabinet on university premises and electronic records were only able to be accessed by the researcher.

The informal observation (Observation1) gathered some situational analysis data, without the use of video footage or audio records and prior to the formal observation of the selected teacher lesson. The physical characteristics of the classroom in its normal working environment were noted , for example, layout of furniture, location of computers and other technologies used, as well as choosing the best position for the placement of the video camera. It also gave students and the teacher the opportunity to become comfortable with another person in the room. The researcher did not engage in any way with students or teachers and remained a passive observer. Importantly, it enabled the researcher to have some prior experience of the nature of interactions between teacher and students, in addition to observing teaching and management strategies in a range of learning areas. A block of about 1½-2 hours in each working classroom was allocated for this purpose.

The formal observations, Observation 2, Stage 1 and Observation 2, Stage 2 (Tables 3.6 and 3.7) of the teachers at work in an ICT setting were

conducted for a minimum of two 45-minute sessions. There was some variation here and this will be explained at a later stage.

A static video recorder with audio facilities was set up to track the teacher's movements in the classroom. An additional audio recorder attached to the teacher was used to capture a clear audio record of the teacher's voice regardless of her position in the classroom. Data was not collected from the students, although parental permission was obtained in the event of video footage of student images being inadvertently captured.

Data was collected in two stages over a period of six months— one towards the end of the first term of the year and the second near the middle of the third term. During the first data collection period a teacher-planned lesson was video and audio recorded, and interviews conducted with each teacher at various times during each week (see Table 3.6).

Table 3.6

Stage 1 Data collection schedule

Data source	Period of data collection					
	Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 6
Observation 1: Informal	x					x
Interview 1: Part A			x			x
Observation 2: Video & audio record			x	x		x
Interview 1: Part B			x	x		x
Interview 2				x		x
Interview 3				x		x
Teacher documentation			x	x		x
Researcher journal	x		x	x		x

There were varying and staggered periods of data collection during Stage 1, due to unavailability of teachers, as shown above. However this did not alter the order in which the data was collected from each teacher, namely:

- i. Observation 1: Informal
- ii. Interview 1: Part A
- iii. Observation 2: Video & audio record
- iv. Interview 1: Part B
- v. Interview 2
- vi. Interview 3

Each interview was conducted in a conversational style. Interview questions were used by the researcher as prompts to facilitate the flow of teacher responses. In that sense, interviews were unstructured and flexible to allow for deviation from a particular line of questioning and accommodate teacher responses. Thus a form of Socratic questioning was used to pursue clarification, to seek reasons for comments and to identify examples as evidence (Miller, 2008).

Each formal observation lasted for one or two periods according to the lesson and the class timetable, each period being of 45 minutes duration. Each interview depended on the available time of the teacher. For this reason, there were odd occasions when parts of the content of one interview were missed and included in the following interview. The important objective was to collect all data pertaining to all interviews for later analysis as a cohesive whole and not necessarily as disparate parts.

Teacher documentation was referred to during the course of each interview as required. Documents included the school policy on ICT, background resource material, teachers' term plans for a particular subject,

weekly planning sheets, lesson outlines with stated curriculum outcomes, assessment rubrics and student task sheets.

In the second data collection stage the same format was repeated though interviews were restricted to three, and focused mainly on the recorded lesson. However, Interview 2 included any aspect, which on reflection and preliminary analyses, warranted further investigation (see Table 3.7).

A three-week gap existed between data collection periods due to researcher time and distance constraints. Therefore, parts of Interview 2 were conducted by telephone with each teacher who still had access to the audio and video records of the observed lesson, but had made initial comments during Week 2. This time lapse also enabled the researcher to again review data collected and to re-visit any teacher response which needed further clarification. This ensured that the investigative process had been sufficiently thorough in providing for the analysis of all aspects of the research domains.

Table 3.7

Stage 2 Data collection schedule

Data source	Period of data collection						
	Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 6	Wk 7
Observation 2	x						
Interview 1: Part A	x						
Interview 1: Part B	x						
Interview 2		x				x	x
Teacher documentation	x	x					
Researcher journal	x	x					x

Data analysis

In order to develop domains on the nature of expertise, the data analysis followed three pathways in the first instance. These were:

1. The adoption of a case study approach in the analysis of data about each teacher.
2. An examination of the observed lessons in terms of the teaching and questioning strategies and ways in which the teacher managed the engagement of the students.
3. An investigation of data gathered during the construction of a timeline on the teacher's beliefs about significant factors affecting her practice.

Each of these three pathways - the case study approach to analysis, the lesson analysis and the timeline construction and analysis - is elaborated below. The data analysis concluded with a classification of teachers' pedagogical practices, learning experiences and personal characteristics in their use of digital resources and tools.

Case study approach

It has been asserted that the selection of teachers was not pre-empted by their disposition to possess particular features of expertise within a technology-supported curriculum. Nevertheless to facilitate analysis, it was most useful to draw upon the literature to amalgamate the numerous descriptors about experts, expert teachers and expert teachers in an ICT context, in order to generate domains of practice as a framework for each teacher case study (Appendices M and N, and Table 3.14). The *Literature Review* chapter has provided examples and described each of these three domains, namely, pedagogical practices, learning experiences and personal characteristics (see section on *Journeys towards expertise*).

Lesson analysis

Observed practices were central to this research, in that the purpose was to discover what teachers actually did in the classroom and to uncover the reasons for their actions. Therefore scrutiny of the video and audio footage from the lessons of all teachers in the first instance was critical in mapping a framework which accounted for teachers' actions.

The observed lessons, where teachers used ICT as a tool to facilitate students' learning, were analysed in three ways. The first method was to segment each lesson into sequential stages. The second approach was *informed* by grounded theory to facilitate the analysis of teachers' pedagogical practices in the form of their teaching and questioning strategies and modes of student engagement. Qualitative data from this study and from the literature (see section on *Expert teachers*) was used to assist in the development of these theoretical domains of practice. The third method was also supported by a grounded theory approach. Again in conjunction with the literature (see section on *Expert teachers*), it examined lessons through reflective comments made by teachers' as they discussed their reasons for the planning and delivery of lessons. From this data a list of features defining their practices was derived.

Lesson segmentation

A lesson sequence guide of teacher and student actions was designed by the researcher to assist in developing an understanding of the lesson flow (see **Error! Reference source not found.8**). Arbitrary decisions were made by the researcher observer in the selection of the labelled stages of the lesson, namely, introduction, lesson segments and conclusion.

Table 3.8

Lesson sequence of teacher and student actions.

Lesson stages	Explanation of teacher actions
Introduction	How the lesson was introduced e.g. learning outcomes stated, tasks involved, reference made to linked previous lesson Teacher role and management of students
Segment 1	Beginning of lesson task instruction by teacher and level of student engagement e.g. in the form of lesson sub-tasks or segments
Segment 2	Middle of lesson task instruction by teacher and level of student engagement e.g. in the form of lesson sub-tasks or segments
Segment 3	End of lesson task instruction by teacher and level of student engagement e.g. in the form of lesson sub-tasks or segments
Conclusion	How the lesson was concluded e.g. lesson summary of student learning, student achievements shared

The researcher was aware that each observed lesson may not contain such clearly delineated stages and that variation would occur from teacher to teacher and lesson to lesson. Therefore these lesson stages served only to act as possible reference points, in the knowledge that considerable flexibility would be required in determining each lesson's unique sequence of stages and the nature of the teachers' actions.

Lesson domains

Three domains emerged upon which to base the analysis of the teacher's, and students' actions. These were teaching strategies, questioning strategies and student engagement modes. Questioning strategies and student engagement modes could have been subsumed under teaching strategies. However, for ease of analysis in the first instance, it was decided to make distinctions among the three, whilst being aware of their interconnectedness and dependency. Teaching strategies were viewed as techniques the teacher used in the instruction process, whereas student engagement modes referred to actions of the students, that is, how they were involved throughout the lesson. The actions noted, however, were dependent upon teacher management

techniques. Questioning strategies referred to the types of questions asked by teacher.

Within each of these domains of practice, and taking note of all instances of teachers' different behaviours, the researcher derived units of analysis to guide the data analysis process. For efficiency in coding, each observed lesson was divided into five minute blocks to record occurrences of any of these units of analysis across all three domains of practice.

Support for the researcher's decisions in the derivation process was found in a range of teaching and learning theories, which have been outlined in the review of the literature (Miller, 2008). These assisted in confirming the basis for judgments made about the types of strategies employed by teachers in the delivery of their lessons. Nonetheless it was still necessary to devise some analysis labels which could be inferred from theory, in order to explain the actions of all teachers and management of their students.

Teaching strategies

The theories underpinning teaching strategies are numerous. Behaviourism, cognitive reasoning, constructivism, modelling, inquiry and discovery learning, expository teaching and the power of social interactions are some of the well-known learning theories which have impacted upon teaching approaches (Miller, 2008). These theories together with evidence of research studies have been outlined in the *Literature Review* chapter (see section on *Student-centred teaching implications*). From this material and the observed practices of the teachers in this study, units of analysis about teaching strategies were derived and formed a framework upon which to base judgments. In summary they revolved around the following features:

- Instructions and demonstrations as a combination of behaviourism, cognitive perspectives and constructivism,
- Modelling forms, and
- Teachers' recognition and responsiveness to students' understandings and knowledge construction.

Details of these features are shown in Table 3.9 which also gives an explanation of the observed teacher actions.

Table 3.9

Teaching strategies units of analysis

Derived units of analysis	Teacher actions
Instruction-learning objective	Aim of lesson / task stated
Instruction-information / exemplar	Task specific feature stated in a structured way
ICT instruction	ICT task specific feature stated by teacher in a structured way e.g. navigation steps
Explanation	Concept explained and language illustrations used to aid student understanding
Explanation of experience	Reference made to personal experiences, personal anecdotes
ICT explanation	ICT terms explained e.g. file extension names
ICT demonstration	ICT skill illustrated e.g. navigation procedure, menu functions
Modelling of concept or task	Contextual role-play or task
ICT modelling of concept	ICT visual images / contextual role-plays used to aid student understanding
ICT modelling task	ICT task modelled/undertaken e.g. verbalising thought processes, using student examples
Prior knowledge activation	Background knowledge prompted or reviewed
Scaffolding	Background knowledge prompts linked to student construction of new knowledge
Summarising	Review of task achieved/ to be undertaken; re-wording student response, providing feedback
Facilitation	Support and suggestions given to assist in task achievement
Checking for understanding	Clarification of individual student understanding during task
Monitoring learning	Observation and commentary given as students engaged in task
Praise / feedback	Verbal feedback given on quality of student performance
Assessment of learning	Observation / record of task achievement

It can be seen from **Error! Reference source not found.**⁹ that the teaching strategies of instruction, explanation and modelling have units which explain a teacher action with and without ICT. For example, when a teacher explained a concept relating to the learning activity content within a learning area curriculum outcome, this was coded as *Explanation*. When the explanation was an ICT concept such as the purpose of a computing function of the resource being used, this was coded as *ICT Explanation*. *Explanation of experience* was the code given to those occasions when a teacher related some of her own experiences or recounted a personal anecdote as an example relevant to the lesson content.

The teaching strategy of modelling was broken down into three units of analysis to account for differences in teaching strategies. *Modelling of concept* refers to the enactment by the teacher/s of a situation which provides an example of a concept within a section of the learning activity. The other two modelling units relate to how ICT was used to model a concept and how the achievement of these tasks could be accomplished. *ICT modelling task*, as distinct from *ICT modelling of concept* was based on Davey's think-aloud strategy (Wilson & Smetana, July, 2011). This strategy refers to a teacher verbalising thinking and giving decision-making reasons whilst modelling a task. In this situation the task was an ICT one. On the other hand, when a teacher used ICT for visual imagery or contextual role play to illustrate a concept, this was coded as *ICT modelling of concept*.

Questioning strategies

Similar to the numerous theories of teaching and learning, questioning strategies have been classified in many different ways, though all with the basic

aim of assisting students to develop knowledge and deepen understanding. Categories such as content and process questions, Socratic questioning techniques, reflective questions, rhetorical, open and closed questions are to name but a few (Borich, 2008; Ewing & Whittington, 2007; Standards, 2007).

Many of these questioning strategies can be traced to the hierarchical structure of Bloom's Taxonomy of Educational Objectives (Bloom, 1956), which assisted teachers to plan and deliver learning activities to aid students' cognitive levels of understanding. A model developed by Newcomb and Trefz (1987) reduced Bloom's taxonomy of six levels to four, namely, remembering, processing, creating and evaluating.

It was beyond the scope of this research to determine units of analysis which could provide sufficient detail to encompass all categories and levels mentioned above, especially that of Socratic questioning. However, they were useful in arriving at a simplified set of codes to analyse teachers' questioning strategies (see Table 3.10). Here questions asked by the teacher were not structured by level, rather questioning strategies were grouped according to a particular type.

Table 3.10

Questioning strategies units of analysis

Units of analysis	Question purposes
Factual	Knowledge facts to recall
Inferential	Use of facts to deduce answers or come to a conclusion
Evaluative	With knowledge of the facts to make a judgement, give an opinion
Open	Question where many answers are possible
Closed	Question where only a specific answer is possible
Reflective-interpersonal	Interactions with peers designed to assess student's own learning

Unlike the distinctions made in the coding for teaching strategies between teacher's actions with and without ICT, the analysis of questioning strategies was inclusive of both actions throughout the lesson. For example, a question was classified as factual if it required a student response about a particular computer function used to accomplish a set task (an action with ICT) or a previous lesson's sequence of events (an action without ICT). A question such as "What have you learned from others in your group?" was classified as *Reflective-interpersonal*. "What did you learn about (a lesson concept) today?" or "What new ICT skill did you use today" are examples of how a questioning strategy was coded as *Reflective-content*.

Student engagement modes

Student engagement modes could have been viewed as an integral part or a sub-set of teaching strategies as explained previously. The advantage of deriving units of analysis for this sub-set meant that the data could be viewed from a different perspective to that described by the units of analysis for the teaching strategies. That is, the focus on the data was on how the students were engaged through their actions as managed by the teacher, not on how the teacher was delivering the instruction. The teaching and learning theories referred to earlier, however, remained as a source of useful concepts to guide data analysis of this sub-set, particularly those pertaining to constructivism.

One of the aspects of constructivism relevant to a technology-influenced curriculum is the social construction of knowledge and the implications for teachers to have a greater understanding of the ways in which students learn

(Norton & Wiburg, 2003). For example, teachers need to be aware of students' social interactions and ways of communicating with others using chosen technology mediums, and their desires to take responsibility for their own learning. It follows that teachers need to take account not only of the design of learning experiences with the inclusion of ICT, but also of students' individual styles of learning. Hence it is expected in such an environment that teachers would plan authentic experiences which investigate reality and engage students actively, provide for students' construction of their own knowledge, encourage collaboration and cooperation, and incorporate processes promoting continuous learning, higher order thinking and problem solving skills (Hartnell-Young, 2003; Herrington & Kervin, 2007). Particular student-centred strategies arose from these ideas about learning.

One of the central features of student-centred learning is collaboration. The teacher's role is to facilitate cooperative learning in inquiry-based environments. The use of skill and interest groups to promote students' strengths and peer tutoring may also be used (Miller, 2008). Categories such as learners interacting with the resource and learners interacting with their peers and teachers, explained some of the pedagogical approaches used by teachers in a study on the analysis of learner interactions with and without ICT by Beauchamp (2011).

It was this form of classification and many of the ideas on constructivism which supported the derivation of the codes for analysing student engagement modes. Data on students' actions were classified according to their engagement with or without ICT (see **Error! Reference source not found.1**).

Table 3.11

Student engagement modes units of analysis

Derived units of analysis	Student actions
Individual responses	Individual students chosen by teacher answering a question
Whole class response	Class as a whole giving one answer to a question
Individual task	Class as individuals undertaking a task
ICT Individual task	Class as individuals / individual undertaking an ICT task
Group task	Students in groups of 3-6 undertaking a task
ICT Group task	Students in groups of 3-6 undertaking an ICT task
Group task with roles	Students in groups of 3-6 with roles assigned or unassigned by teacher undertaking a task
ICT Group task with roles	Students in groups of 3-6 with roles assigned or unassigned by teacher undertaking a task
Collaboration	Students sharing knowledge with peers, coming to a conclusion / making a decision
ICT Collaboration	Students sharing knowledge with peers, coming to a conclusion / making a decision during ICT task
Pair collaboration (think-pair-share)	Students in pairs facing one another and sharing knowledge
Pair collaboration task	Students in pairs undertaking a task together
ICT Pair collaboration task	Students in pairs undertaking an ICT task
ICT Procedural skill e.g. navigation	Students using a computing skill
ICT Application skill e.g. word processing	Students using a computing application
Knowledge construction	Students showing evidence of task objective achieved
Feelings expressed	Students' expressing feelings about task
Passive engagement	Students observing teacher's actions with interest and without teacher expectations of responses

Collaboration has been classified in four different ways. The *Pair collaboration (think-pair-share)* unit had been observed by the researcher during lessons. It was teacher directed. A short task about knowledge learned, an open, evaluative or reflective-interpersonal question was given. With a partner, students faced one another and shared their knowledge, shared answers or gave opinions. The *Pair collaboration task* required partners to discuss, plan, undertake and accomplish a task together. The *ICT pair collaboration task* was identical except the pairs of students shared a computer. The *Collaboration* code was designed to account for student engagement where individuals, a

large group or the whole class shared knowledge and opinions, then made a decision about what action to undertake. *ICT collaboration* was identical except the action involved the use of a computer, either an interactive whiteboard or a computer linked to a data projector.

Figure 3.2 provides a summary of the sequential development of these units of analysis derived from the domains of practice, namely, teaching strategies, questioning strategies and student engagement modes. These have been described in this section on Lesson domains in terms of either teacher or student actions, and from the domains of practice created for the purpose of lesson analysis.

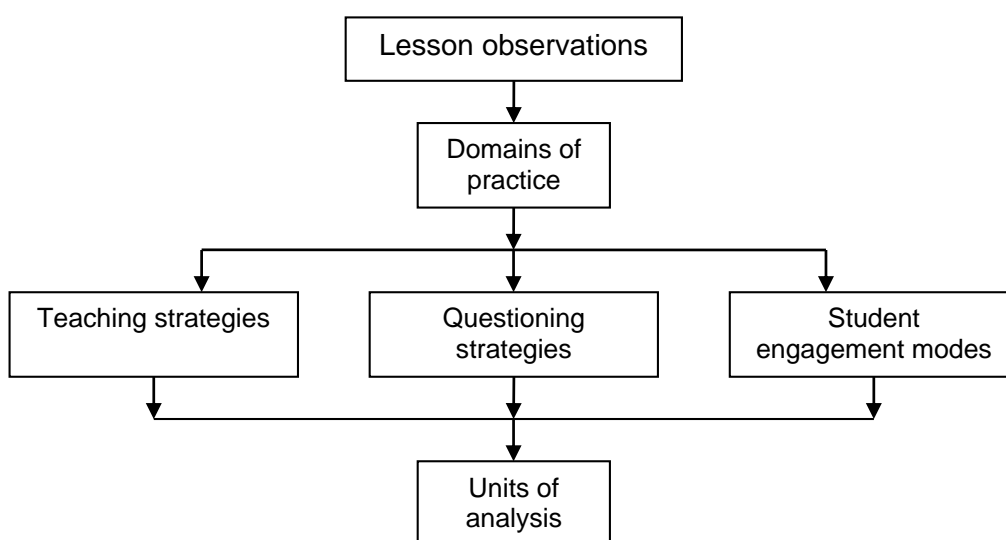


Figure 3.2 Development of lesson units of analysis.

Teachers' reflections on lesson features

In the process of data analysis, a list of lesson features was created by analysing descriptors in the literature of quality teaching, expert teachers and teachers expert in the use of ICT (Cox et al., 2004; Gipps et al., 2000; Hartnell-Young, 2003; Hattie, 2003; Kaya, 2008; Koehler & Mishra, 2009; Miller, 2008). It was supplemented by the literature on pedagogical theories about student

learning and aligned with teaching strategies (see *Literature Review* chapter, section on *Student-centred teaching implications*).

This list was constructed to accommodate teachers' reflections on their observed lessons and contained the following:

- Preparation and planning,
- Modelling,
- Differentiation,
- Authentic experience,
- Scaffolding,
- Collaborative learning,
- Monitoring learning,
- Higher-order thinking,
- Assessment of learning, and
- Student engagement.

Teachers' reflections on the observed lessons were gathered during the post-observation interview and the interview with video footage. In the latter case a stimulated recall approach was used. These have been explained in the section on data collection methods. No direct or leading questions about the above lesson features were asked. The aim of the researcher was to ascertain if the teacher had considered these features in her lesson preparation and delivery. Therefore upon analysis of the teacher's reflective comments, the researcher selected those which were considered to be relevant to an item on the lesson feature list. For example, the researcher coded the following comments of a teacher as *Authentic experience*:

(students) be able to go out and read visual images all over ... be able to say what the illustrator is trying to say ... all comes into the advertising ... human nature to be intrigued by colour, technology ...

These comments were made by a teacher immediately following the observed lesson and during her viewing of the lesson video footage as she explained the reasons for her lesson objectives and actions.

Timeline construction and analysis of influences on growth

During the course of the earliest interviews, responses from teachers provided on occasions some insight on their background, working lives and perceived significant role models or important episodes which they believed had impacted on their journeys as teachers and their growth as professionals. In the latter part of Interview 2 teachers were asked a focus question about what they believed were the critical influences which had contributed to the kind of teacher they perceived themselves to be today. Responses from all these sources were collated, each influence was identified and recorded by the researcher in abbreviated form on a card prior to Interview 3. Upon viewing the information on these cards, the teacher selected, discarded or added to these influences or indicators, which she considered to be significant. While arranging these in the form of a chronological journey, the teacher expanded upon descriptions of each indicator by providing reasons for her choices and experiences, to substantiate her selections (Hughes, 2005). The indicators were then rearranged into rank order by the teacher who was again asked to provide reasons for her choices. This strategy enabled the teacher to consider, modify or explain her experiences in more detail and the researcher to explore

underlying meanings of responses (see Appendices O and P for an example of the two sets of cards created for this purpose for one particular teacher).

It became clear upon analysis of the data gathered about these indicators and the teachers' explanations of their selections that similarities existed. Two categories were created, namely, influence and experience. Coding of the data allocated to categories produced a series of items which were supported and explained by teacher quotes. Table 3.12 summarises these items and their experience descriptors.

Table 3.12

Influence items and descriptions

Categories of influence	Category descriptions of influences as experiences
Guiding life principles	Formulating and establishing life goals
Guiding career principles	Choosing and maintaining career in teaching
Professional recognition of excellence	Receiving grants / scholarships / awards conferred by external professional bodies to undertake research projects / to honour teaching quality
Leadership role	Being appointed by management to a leadership role within the school
Role models	Reacting to / learning from pedagogical practices of other teachers
Contextual learning	Learning about and with technology in environments, other than teaching, which stimulated a desire to learn about the value of technology in education and how to provide students with experiences relevant to society
Contextual learning – as a teacher	Learning how to use ICT in the classroom to meet curriculum objectives in the management and delivery of student learning activities
Contextual learning – self-directed	Choosing to spend time improving ICT skills and exploring resources
Collegial	Learning from / sharing ideas with other teachers eg. in the classroom, conference attendance and participation or working as part of a team.
Professional learning	Participating in formal professional learning projects, courses, workshops or teacher training experiences

An example of this process now follows. A teacher had named her change in career from commerce to teaching as the most important influence on her professional career. The explanatory card created by the researcher for the

teacher to order chronologically and rank was titled *Career in commerce*. The reasons given by the teacher when she ranked this card first were that it “was a good idea (and it was the) best thing I ever did.” This card title and teacher explanation was categorised as an influence. An item in the influence category was created and coded as a *Guiding career principle*. In the experience category, an item related to this influence was created and coded as *Desire for change*. Below is a sample of the table showing the two categories, these items within the categories and an explanatory quote by the teacher.

Table 3.13

Perceived significant influences on teaching role

<i>Influence</i>	<i>Experience</i>	<i>Explanatory quote by teacher as benefits to growth</i>
Guiding career principles	Desire for career change	<i>I thought ... good idea ...best thing I ever did ...I love it ...I really do</i>

Expanded items and fuller descriptions supplemented by explanatory quotes relevant to each item can be found in the detail of the case studies (see Chapters 4, 5, 6, and 7).

Classification of teacher practices and experiences

After the creation of the data collection instruments, their administration and the beginning of analysis for this study, more recent publications were found, critical to the efficacy of this research. These were papers on the National Professional Standards for Teachers from the Australian Institute for Teaching and School Leadership (AITSL, 2012a) and the document UNESCO ICT Competency Framework for Teachers (Hine, 2011). The AITSL papers set out descriptors on standards expected of proficient, highly accomplished and lead teachers, as well as a set of ICT elaborations for graduate teachers. The

UNESCO document describes three stages of teacher development in the context of ICT, as technology literacy, knowledge deepening and knowledge creation.

The AITSL ICT elaborations for graduate teachers were extrapolated and incorporated within the three sets of career stage descriptors for teacher standards of professional knowledge, practice and engagement. The UNESCO descriptors on the knowledge creation stage of teacher development were amalgamated with literature categories on experts, expert teachers and teachers expert in the use of ICT and summarised in a similar way to that of the AITSL material (Berliner, 2004; Brown & Johnson, 2008; Ericsson, 2008; Goodwyn et al., 2009; Hattie, 2003; Koehler & Mishra, 2009; Kozma, 2011b; Pierson, 2001; Schempp & Johnson, 2006; Stough et al., 2001; Tsui, 2009; Webster & Schempp, 2008). A framework using the research design domains on teacher pedagogical practices and teacher learning experiences, and incorporating the AITSL headings for teacher standards was designed. The descriptors synthesised from the extrapolation and amalgamation process were placed in the relevant stages and categories of the framework. The result of this process was the creation of two reference tables upon which further analysis of the data from this study was based. In this way, Teacher pedagogical practices are described in Appendix M. Teacher learning experiences are set out also in tabular form in Appendix N.

From the descriptors in these tabular forms, it can be seen that reference is made consistently to *digital resources and tools* within the columns on proficient teachers, highly accomplished teachers, lead teachers (derived from AITSL Standards) and the teachers expert in the use of ICT, from the literature

cited previously. The inclusion of *digital resources and tools* in the descriptors was a decision made by the researcher, deduced from the AITSL Standards of ICT Elaborations for Graduate Teachers, to support the analytical process in the achievement of this study's aims. For example, within this Standard, "understanding of how student engagement and learning can be enhanced through the use of digital resources and tools" (page 1), was summarised and extrapolated to read *cater for ... characteristics in engagement of all students ... by use of digital resources and tools*, when referring to the professional knowledge of proficient teachers (Appendix M). For lead teachers, the corresponding words are lead colleagues ... *cater for ... characteristics in engagement of all students ... by use of digital resources and tools*. The column about teachers expert in use of ICT reads *cater for ... characteristics in engagement of all students ... by use of digital resources and tools*. These explanatory descriptors show a progressive development of teachers' professional knowledge and practice across the AITSL Standards for proficient, highly accomplished and lead teachers. Similar words are used in the last column descriptors on expert users of ICT, but only where they were supported by the literature.

Classification of teacher personal characteristics

Mixed method techniques were adopted to build a table on the classification of teacher characteristics. As the detailed analysis of the data unfolded, not only did the descriptors of teachers' pedagogical practices and teachers' learning experiences emerge, but features of teacher personal characteristics presented themselves. From the literature on experts, expert teachers and teachers expert in the use of ICT, some characteristics of the

research cohort were identified (Berliner, 2004; Brown & Johnson, 2008; Goodwyn et al., 2009; Webster & Schempp, 2008). They included traits or descriptors such as an ability to plan intuitively, a heightened ability to reflect upon performance, a desire to be an expert and a passion for their profession. In the analysis process, other characteristics of the research participants became apparent, for example, motivational factors and affective qualities which influenced the decisions they made about their teaching practices. The findings from the case studies in this current research, which related to personal characteristics, were further illuminated by literature on self-regulation and risk-taking (Bandura, 1991; Brazeau, 2005; Clifford, 1991; Ottenbreit-Leftwich et al., 2010; Pajares, 1992). Data from these sources was synthesised and a final list of descriptors about personal characteristics was then derived. Evidence in support of a descriptor was gathered from two sources, namely, from all interview data and researcher observational data.

Each descriptor was allocated to one of three domains. The domains consisted of characteristics of teachers who were able to appraise their teaching performances, were motivated to improve their practices and possessed positive affective qualities – see Table 3.14.

As indicated in Table 3.14, where the researcher found evidence that a teacher *Set high achievement goals*, this was coded as *Performance self-efficacy*. In this example, a teacher had stated that she was “striving to achieve something new” as part of her “goal setting plans”.

Table 3.14

Teacher personal characteristics

Experts, expert teachers & teachers expert in use of ICT	
Characteristics	Descriptors
Performance self- efficacy	Plan intuitively Monitor, analyse and reflect upon performance Are confident to take risks Set high achievement goals Seek understanding of problems Analyse creative solutions to problems
Motivation	Are motivated to succeed Are willing to learn Possess strong desire to be an expert Believe strongly in power of technology to improve performance Choose to spend long periods of time in practice, exploration and experimentation Persevere with and maintain focus on task
Positive affective qualities	Are enthusiastic Are passionate about teaching Have patience and a sense of humour Listen, inspire, communicate
References: Bandura (1991), Berliner (2004), Brazeau (2005), Brown & Johnson(2008), Clifford (1991), Ericsson (2008), Goodwyn et al. (2009), Kozma (2011), Ottenbreit-Leftwich et al. (2010), Pajeras(1992), Tsui (2009), Webster & Schempp (2008)	

Summary

This concludes the chapter on the rationale and methodological approaches adopted for this qualitative study. It explained the processes used to select a primary school as the study setting and the five participants. Details were provided on the construction and content of the data collection instruments, particularly, the three sets of interviews conducted pre- and post- observations of lessons, namely Interviews 1, 2 and 3. Data units of analysis on lessons have been described in the form of teaching strategies, questioning strategies and student engagement modes. Descriptive items classified in tabular form about teachers' perceptions of influences on the growth of their practices, teaching practices, learning experiences and personal characteristics were explained as a basis for comparative analysis of all data sources.

The findings on the commonalities and variations in the pedagogical practices, learning experiences and personal characteristics of the five participating teachers follow, in the form of four case studies. These case studies are presented as separate chapters, namely,

- An ICT curriculum leader and teacher,
- A teacher with varied contextual experiences,
- A teacher focused on goals and student needs, and
- Two teachers working as a collaborative team.

Each case study follows a similar structure though with some variations in the presentation of the data. The investigation and results cover features of each teacher's working classroom, the observed lessons, the teacher's beliefs about pedagogy, student learning and ICT, the factors influencing her growth of experience and her feelings of professional self-esteem. A cross-case analysis (Chapter Eight) then draws together these findings to compare the pathways of teachers in their progress towards excellence and the extent of that expertise in technology-supported teaching.

CHAPTER FOUR

CASE STUDY 1: AN ICT CURRICULUM LEADER

This chapter describes and makes judgements about the extent of technology-supported teaching expertise of Kath, a teacher who had held the positions of head of curriculum ICT, librarian and as a deputy head at the school for eight years. Her professional background and experiences, the development of her pedagogical knowledge and her teaching practices are analysed in relation to decisions she made about her professional growth. The analysis is augmented by an investigation of her perceived influences on her career path and her personal characteristics.

The study contains summaries of the sequential development of her observed lessons and an itemised analysis of strategies, supported by examples, which were shown in her teaching, questioning and engagement of students in their learning. Key features of the lessons have been presented, leading to a deeper explanation of her pedagogical approaches. This aspect of the investigation was enriched by exploring her beliefs about student learning, the use of digital resources and tools, and the value of technology to aid learning. The final sections of the case study detail her perceived influences on her professional growth and self-esteem, her professional goals and make suggestions about the significance of recognising her qualities as a measure of her expertise. The concluding summary has focused on her leadership qualities and expertise in 1) the comprehensive range of her pedagogical knowledge and teaching practices, 2) her demonstrated beliefs about technology to enhance student learning, 3) her pursuit of excellence, and 4) her dedication to the continual advancement of her own learning and that of her colleagues.

The following section outlines firstly some background on an introduction to Kath and the data collection procedures used. Secondly, her working environment is described. Thirdly, it provides illustrative examples and details of both lessons which were observed during Stages 1 and 2 of the data collection. This includes the strategies used by her in teaching, questioning and engaging the students, her reflections on the lessons and an analysis of their key features.

Background

Integrating ICT with the curriculum was “the only way to teach smart”, according to Kath, who described herself as a “learning-design person”: This was a conclusion she had reached after more than three decades of experience with work-related computing tasks and using computers with students across a broad range of teaching/learning contexts.

Kath was instrumental in facilitating the participation of the other four teachers in this research, which meant that some initial discussions were held with her prior to a formal meeting with the principal of the junior school and nominations of the other participants. Two observations of the lessons with ICT were audio and video recorded, one at each data collection stage. These were integrated with a series of focus questions embedded within interviews designed to gain insights into her practices. They also explored her personal learning strategies and experiences which had shaped her pedagogical approaches to technology-supported teaching (see the *Methodology* chapter and Appendices A-H for full content details of Interviews 1, 2 and 3). Due to her central involvement in the research study and her time availability, some informal short interviews were also conducted (and recorded with permission).

Their direction and content of researcher questions in this case were prompted by responses she had made in the standard interviews and which lent themselves to further exploration. The data gathered in this way were woven into all data collected about Kath.

The working environment

The learning activities were conducted in the library space and the adjacent computing laboratory which housed 24 computers and was connected by a wall of folding doors. A bank of Mini notebooks was also available for students to use in the library. It had a number of display areas, a quiet reading corner, teachers' work area, shelving with books for borrowing, a set of student tables and chairs and a mat area which could accommodate three classes of students. It also had an interactive whiteboard (IWB) and a computer mounted on a high café table where the teacher was visible to all students when seated on a stool.



Figure 4.1 Case study 1 – the working environment

Kath explained that she liked to “design all the learning” and regular weekly lessons such as these were conducted in the library space as part of the

teaching/learning program used in the school for all classes. They were known as PACE – Providing Academic Challenge for Everyone – and based on an enquiry approach incorporating cross-curricula activities which integrated learning areas such as English (literacy), science and history in the Australian National Curriculum. Class teachers had the responsibility for subsequent classroom lessons which had assessable and reportable specific curriculum outcomes. Students had access to Mini notebooks when required in the achievement of these outcomes.

Construction of observed lessons

Two lessons were observed, one in each data collection stage. Both were conducted with three classes of Year 5 students and with support from their class teachers. According to Kath, the topics had been discussed and activities planned in collaboration with the Year 5 teachers, and to ensure they met curriculum needs. Kath said that she led the team in the design of the learning activities and the selection of resources. No planning documentation was available either from the class teachers or Kath who said her role was to create “a learning path of different activities.”

The first was an introductory lesson to the topic of persuasive arguments – referred to as Lesson 1. The topic aim was for the students to gain an understanding of the features of persuasive arguments and to use this knowledge in creating their own negative or positive arguments on the issue *Children should be able to wear what they like to school*. Each student, Kath said, was expected to produce an oral message, a flyer and a traditional text, as the topic learning activities progressed over the coming weeks. The creative

beginning of the text product using an ICT persuasion map template was the task for Lesson 1 for one group of students.

The second observed lesson was the concluding learning activity on an integrated topic in the learning areas of English (literacy) and science – referred to as Lesson 2. Students were also required to use persuasive text in a visual literacy context, concepts which had been developed earlier in the year and referred to in Lesson 1. However, in this instance, the visual literacy text was to be supported by audio and video material in the creation of a multi-media product. The competition from the educational resource, known as *Ribbons of Blue/Waterwatch WA* and compiled by the Department of Environment and Conservation, Western Australia, was the focus of the topic's learning activities. The stated aim of this resource was to inspire young people to become aware of, and involved in, caring for the local river catchment area.

Delivery and management of lessons

For just over half of each observed lesson three Year 5 classes of 70 students were grouped together on the large mat area of the library, where Kath, as the lead teacher, was supported by the class teachers. Students were then separated into three groups and moved to adjacent library spaces, where the continuation of the lesson was managed by class teachers. For example in Lesson 1, one teacher had responsibility for one group of students, pre-determined by the class teachers, with weaker reading and writing skills. In Lesson 2, for example, another class teacher had a group of students, who were working on their audio files. In each lesson Kath was supported by the third teacher with a group who worked in the computer laboratory.

In order to examine the sequential flow of lessons it was useful to segment them into identifiable components. Although the timeframe for each subsequent division was not identical, nevertheless the process of segmentation was advantageous in making comparisons between lessons. Table 4.1 is a summary of the main components of the lessons conducted by Kath, followed by a brief outline of the lessons and their progression.

Table 4.1

Lesson sequence of teacher and students' actions

Lesson stages	Teacher actions	Students actions
Introduction	Logging on procedures reviewed Navigation procedures for task demonstrated Topic vocabulary introduced	Passive Few individual responses to questions Whole class responses to questions
	Lesson tasks summarised Teacher's responsibility explained	Passive
Segment 1	Concept modelling – story read, role play scenarios Topic vocabulary developed and reinforced	Passive with interest Few individual responses to questions Whole class responses to questions
	ICT tasks summarised ICT modelling of student examples ICT terms reinforced	Passive with interest Students explained examples Individual responses
Segment 2	Tasks explained Concept ICT modelling Lesson tasks summarised Topic vocabulary emphasised	Many individual responses All students engaged in evaluative task
	Learning objectives explained and summarised ICT modelling of student example	Few individual responses to questions All students engaged in evaluative task
Segment 3	Lesson tasks detail outlined Learning and technical support given	One group of students engaged in ICT tasks in computer laboratory
	Learning and technical support given	One group of students engaged in ICT tasks in computer laboratory
Conclusion	Achievement of task summarised Preparation for next lesson summarised	One group of students in computer laboratory completed tasks
	Task completion requirements summarised	One group of students in computer laboratory completed tasks

Key. Lesson 1 =



Lesson 2 =



As evident in Table 4.1, the two lessons followed a similar pattern of instruction and student engagement. Both lessons were introduced with

contextual clues for the students, namely the use of conceptual language in Lesson 1 and reference to their prior knowledge of the preceding task leading to Lesson 2. This was followed in Segment 1 by various modelling strategies which illustrated the lesson concepts. Up to this point in both lessons, students had remained largely passive with intermittent questions from the teacher while listening and observing. In Segment 2 of both lessons this changed when students became involved in evaluating information provided through concept modelling. It was also during this segment that the tasks and learning objectives were explained in more detail and summarised, as well as further student evaluation opportunities being provided. In both lessons, the summaries occurred just prior to students undertaking their ICT tasks during Segment 3. At the conclusion, teacher actions were also similar, in that the task requirements were summarised.

Further similarities and some differences can be found in the next section which sets out in tabular form the detail of Kath's teaching and questioning strategies, and ways in which the students were engaged. These are illustrated in a selection of examples from the lessons and supplemented by reflective comments made by Kath after the lessons and with access to the video records. Table 4.2, Table 4.3 and Table 4.4 show only those features which had been observed at any time during the course of the lessons. They do not show frequency of occurrence. It was felt that noted instances were sufficient to inform later researcher analysis and judgements on the scope of the teacher's pedagogical practices.

Full details on the derivation of each strategy and the associated descriptions used to analyse the raw data can be found in the *Methodology*

chapter. Researcher judgements of the raw data were based on these previously devised units of analysis and descriptors. For example, a teaching strategy was coded as an *ICT modelling task* when it was evident that the action of the teacher could be identified as an *ICT task undertaken whilst verbalising thought processes or using student examples*. Similarly for coding purposes, the questioning strategy *Inferential* was described as *Use of facts to deduce answers or come to a conclusion*. Student engagement, for example, was coded as *ICT collaboration* when their actions were observed as *Students sharing knowledge with peers, coming to a conclusion or making a decision on ICT task*.

Teaching and questioning strategies

The scope of Kath's teaching and questioning strategies observed during Lessons 1 and 2 are shown in Table 4.2 and Table 4.3, where it is evident that almost all strategies employed by Kath were similar in both lessons. The tables are followed firstly by examples of selected teaching strategies which were not used in both lessons. These are succeeded by examples of teaching and questioning strategies which were used concurrently by Kath throughout both lessons.

The teaching strategies used to instruct students on a feature of a task and on modelling a concept without ICT were observed only in Lesson 1 but on a number of occasions. An example of the former strategy is when students were instructed to follow particular steps as a process of casting and displaying a *Yes / No* vote on the persuasive argument issue of school uniforms. Kath said she used this strategy at this particular point of the lesson because she wanted them to actively participate and keep them interested.

Table 4.2

Range of teaching strategies during lessons

Teaching strategies	Lesson 1	Lesson 2
Instruction- learning objective	x	x
Instruction- information / exemplar	x	
ICT instruction	x	x
Explanation	x	x
ICT explanation		x
ICT demonstration	x	x
Modelling of concept	x	
ICT modelling of concept	x	x
Prior knowledge activation	x	x
Scaffolding	x	x
Summarising	x	x
Facilitation	x	x
Checking for understanding	x	x
Monitoring learning	x	x
Praise / feedback	x	x
Assessment of learning	x	x

Table 4.3

Range of questioning strategies during lessons

Questioning strategies	Lesson 1	Lesson 2
ICT Factual	x	x
Inferential	x	x
Evaluative	x	x
Open	x	x
Closed	x	x
Reflective - interpersonal	x	x
Reflective - content		x

Here is one example of this type of concept modelling. Two scenarios of a dialogue between a mother and a student who wanted more time on the family computer to do homework was acted out from a scripted dialogue by Kath and another teacher. This strategy seemed particularly relevant in this lesson where the modelling of an authentic situation familiar to students would assist them to develop an understanding of a persuasive argument.

The first time in Lesson 1 that Kath introduced *ICT modelling* of the persuasive argument, concept and language, a scenario from a Web 2.0 resource was projected. On-screen options were presented for students to

provide an answer to a statement about which clothes would be the most appropriate to wear. The teacher asked, “Which would be the best advice?” On viewing the video records at this point of the lesson, Kath said “This was critical to the lesson, as many students had not understood that a persuasive argument had to be very strongly worded and emphasised”.

ICT explanations were evident only in Lesson 2, for example, when Kath explained to the whole group, different file extension names under which students would need to save their work for later access. This is understandable given the nature of Lesson 2 which was focused on the creation of a multi-media product.

There was only one observed incident of a reflective - content question and that is included in the examples below.

All the observed teaching strategies were accompanied by frequent questions, to which either the whole class or individuals were expected to respond. Many of these questions were closed, where only one answer was correct and used by the teacher during her explanations, as illustrated in the following examples. The first two examples are taken from Lesson 1 in the context of the persuasive argument, while Examples 3 and 4 refer to Lesson 2 and the multimedia product creation.

Example 1: Strategies of explaining interwoven with inferential closed questions.

Kath read a story and showed pictures about why animals should definitely not wear clothing. She asked questions before she commenced reading and at the conclusion of the story. At both points, students were expected to respond as a whole class as follows:

T (in the beginning with reference to the title): *Do you think that sounds like a debate?*

Sts: *No*

T: *What's the issue?*

Sts and T: *Animals should definitely not wear clothing.*

T (at the end): *What was the issue?*

Sts: *Animals should definitely not wear clothing*

T: *Emphasise! Be convincing!*

Sts: *Animals should definitely not wear clothing*

Example 2: Strategies of scaffolding connected with evaluative open-ended questions

When Kath projected some advertising examples including ones about the school, she drew the students' attention to their background knowledge and linked this to the language used in the material. While doing this she interspersed her comments with questions such as "What would persuade me to go to (name of school)?"

Example 3: Strategies of ICT demonstration, explanations, facilitation and praise linked with closed ICT factual and evaluative questions

At the introductory stage of Lesson 2 Kath called upon two students, members of a self-selected group of 4, referring to them as "my expert panel", to share their work to date with the class. This was a prior arrangement she had made with the group who had volunteered, as she said she didn't want initially to nominate students who perhaps might lack confidence or would be

intimidated by such an experience. Their incomplete product was projected for all to see. The purpose of these strategies at this juncture of the lesson according to Kath, upon viewing the video record after the lesson, was to:

... help those whose work is being shown and ones who are watching...rubric focus so they didn't go off on a tangent...call to action (by making) people do things for the river...students also learned about what tools and functions they could use...

She asked questions of the two students during the demonstration, such as “how did you do that?”, “next stage is..?” and “you’re trying to?” Individual student opinions of the projected work were also sought, though prefaced by the teacher’s opinion when she said “I think it’s pretty good” and later “I love that transition ...I feel like I’m diving into the river.” In this way she modelled responses to assist all students in their subsequent evaluation of their work and that of others as a paired activity in a less threatening environment.

Example 4: Strategies of learning objective instruction, facilitation and closed, open and reflective interpersonal questions

Before Kath began to read aloud the descriptors of the eight different fields and the associated point scoring system in the competition rubric (see Appendix R), she said to the students “remember we are being critical friends...be friendly, be nice...” Throughout her reading of the entire rubric she gave students opportunities to discuss these with reference to their own copy of the rubric, their own work and that of their peers, as well as asking guided questions in this process and pausing frequently to ask questions such as:

What can we give it (that is, a score) to be a critical friend...what to improve...what has been done well?

Who is your target audience?

Are those people going to act on your advice...what did you suggest?

In her view addressing the detail of the rubric was a key feature of the lesson, as the main aim was for students to produce work that conveyed a strong message calling readers to action.

Student engagement modes

In the preceding section on teaching and questioning strategies and the examples cited, some ways in which the students participated in the learning activity have already been described. Nevertheless, this next section looks in a little more detail on the types of engagement modes and provides examples from both lessons. As stated earlier, only those modes observed by the researcher are listed in Table 4.4.

Table 4.4

Range of student engagement modes during lessons

Student engagement modes	Lesson 1	Lesson 2
Individual responses	x	x
Whole class responses	x	
ICT individual task	x	x
Collaboration	x	
ICT collaboration	x	x
Pair collaboration	x	
Pair collaboration task	x	x
ICT pair collaboration task	x	x
ICT procedural skill eg. navigation	x	x
ICT application skill eg. text input	x	x
Knowledge construction	x	x
Feelings expressed	x	x
Passive engagement	x	x

Only during Lesson1 was the whole class as a group expected to respond in unison to the teacher – see Table 4.4. Example 1, Lesson 1 in the preceding section illustrated this type of interactive dialogue between teacher and students, where the teacher at times began a questioning sentence and

paused to wait for the class to complete it with one or two words. Collaboration and pair collaboration were two other forms of engagement used only in Lesson 1, when students discussed and shared their opinions with a partner before contributing to a whole class decision on options which had been presented on-screen. The first instance was when pair collaboration, followed by group consensus, was used to make decisions on which on-screen options best suited the displayed arguments. A number of scenarios were presented, namely, fashions in clothes, school recess issues, dogs as pets and school uniforms.

Pair collaboration was again evident when students were required to discuss with a partner before voting *Yes* or *No* on the issue of whether children should be able to wear what they like to school (referred to earlier). Student pairs were required to write one best argument as a supporting statement for their vote and post their piece of paper on the pin-up board in either the *Yes* or *No* column. They then used this argument plus their choice of any two of the best arguments from the board to put into their joint persuasion map. The arguments had to be accompanied by examples and reasons of their own creation.

Kath believed that the first time in the lesson she used this paired collaboration strategy marked an important stage in the learning activity because of the way in which she was managing the learning and the students' level of participation. This is evident in her following post-observation explanatory comments while watching the video record of the lesson:

..instead of looking at me...chance to discuss...it's not about me talking and them listening...it's about them collaborating and working things out for themselves...about that stage I'd probably lost a

few...they weren't doing much...I had to pull them back...not participating...this was a starting point...getting them to be proactive or interactive I suppose..

All the remaining student engagement modes were observed in both lessons, which followed similar patterns of participation. These patterns are also readily identifiable in Table 3.8 which gave an overview of the progression of each lesson. Passive engagement was limited to the beginning parts of each lesson when all three classes were grouped together, instructions were being given and students were attending to explanations or ICT demonstrations. Students were most animated and enthusiastic whenever they were involved in discussions with their peers or partner and when working on their ICT tasks. However they did express some amusement during the story read by the teacher and were encouraged by the teacher to applaud when student work examples were demonstrated.

This section now concludes with an overview of the main features of the observed lessons before exploring in more detail Kath's pedagogical practices and beliefs about student learning and ICT.

Key features of lessons

Key features of the two observed lessons undertaken by the teacher stemmed from the decisions which had been made about their construction and her subsequent management of their development. Most significant were the variety of modelling strategies, the ways in which occurrences for student engagement in the learning activities were provided, the approaches used to monitor students' learning and the planning and delivery of the lessons' aims.

These will be summarised and interpreted by drawing upon the descriptive data and examples given in the preceding sections, complemented by the teacher's reflections of the lessons.

"I specifically work from a grid of multiple intelligences or learning styles," was how Kath described the basis for the affordances she provided to cater for all students' needs. This approach to student learning was reflected in the wide range of modelling strategies she chose to construct, demonstrate and deliver the content and concepts of each learning pathway. Contexts were all drawn from situations and experiences with which the students were familiar, therefore maximising the potential to stimulate their interest, engage their participation and facilitate their learning. A developmental progression of modelling techniques was evident, though more noticeable in Lesson 1 - an introduction to the concept of persuasive arguments. This lesson had begun with concrete examples utilising visuals, colour and sound whilst reading from an illustrated book, and interpersonal interactions and effective language through the role play scenarios enacted by the teacher and another class teacher. Examples with digital resources and tools in screen images and texts of real-world settings followed, though they still utilised visuals, colour, sound, interpersonal interactions, movement and concept vocabulary. In Lesson 2 this was taken a further step through the modelling of students' own work to illustrate the construction of the task as it related to the desired outcomes and again provided for interpersonal interactions. By providing diversity in this way the teacher showed not only her knowledge of the English (literacy) and science learning areas, but also her ability to cater for the differing learning needs of the students.

Catering for differing learning needs was also epitomised by the varied ways in which students were engaged in higher order thinking processes according to their particular levels. This was facilitated by collaboration opportunities, evaluation of stimulus materials and provision for student-centred activity. Collaboration occurred in pairs and small groups, both with and without digital resources and tools, and at intervals throughout the lessons. In these situations the grouping was determined by the students themselves and not teacher-directed. Lessons were also interspersed with a range of evaluation tasks with and without access to digital resource material. Individuals in the whole group situation and pairs gave and shared opinions which others were able to listen to, and process, according to their individual needs. This approach also enabled the teacher to monitor student learning and to provide responsive feedback in facilitating or scaffolding learning. Task differentiation was enabled through choices made by students in their achievement of the ICT tasks as they created and designed their own text material, content and visual imagery.

Lessons had similar patterns in their structures, namely, the introduction of the learning objectives, the management of students' engagement and the involvement of the class teachers. Both lessons did not begin with an overt statement about their aims. Rather the objectives were revealed gradually as the teacher introduced context examples through vocabulary and scenarios, as in Lesson 1 on persuasive arguments, or through the competition context and student modelling scenario of Lesson 2. In the first instance this was illustrated by the teacher's comments to the students when she said "this gives you a little bit of a clue about what our learning path's going to be over the next couple of weeks." It was only later in both lessons that learning objectives and tasks were

enunciated – in Lesson 1 as a four-step process and in Lesson 2 through the competition rubric.

The management of student engagement was analogous in both lessons. When all three classes were grouped together in the first half of the lessons, there were alternate periods, varying in length, of passive engagement and intense activity by the students. In the former the teacher was doing most of the talking, as students listened and individual responses to questions were elicited. In the latter activity stage, students discussed and shared opinions with partners, before making decisions. This management strategy indicates the teacher's timely responsiveness to the students' interest levels, corroborated by her reflections on Lesson 1 where she noted that she watched students' level of engagement carefully to maintain the pace of the lesson and stopped a task or activity when she saw their interest was flagging.

It was apparent that the structure and management of the lessons was the responsibility of Kath as the lead teacher, who had created their design and chosen the digital resources and tools. Although the decision-making process for the lesson themes had been a collaborative one, apart from the two-teacher role play, her colleagues had contributed rarely during the whole group sessions and were observers. However, it seemed likely that this form of collegial participation, particularly exposure to the modelling strategies, could facilitate an increase in their professional knowledge of how to use and integrate technologies within learning pathways. As Kath said she was at times "teaching teachers as well as kids": Further professional learning opportunities and putting knowledge into practice were made possible when a class teacher and Kath worked together during the student ICT task sessions.

This section on the management and delivery of the two observed lessons has described the strategies used by Kath to teach, question and engage students and provided an overview of their main features. The next section provides an insight into her pedagogical framework by examining her approach to teaching, her beliefs about student learning and the significance, for her, of ICT in the teaching/learning process.

Pedagogy, student learning and ICT

Underpinning Kath's approach to teaching was her belief that she could use ICT to create an environment which motivated and engaged students to learn in a happy, collaborative atmosphere. Embedding ICT in the delivery of a curriculum, where learning areas such as English, science and history were integrated, she considered, was essential to the construction of all learning activities. Her intentions, she said, were to cater for all differing learning styles in this environment, where students were presented with tasks of differing degrees of difficulty requiring them to create a product. These beliefs and intentions are explored further in the following paragraphs on her teaching and learning framework, on features of her interactions with students and her beliefs and feelings about using ICT. This exploration was informed by data from the observed lessons and interviews.

Teaching and learning framework

The depth of Kath's curriculum and pedagogical knowledge was evidenced by her practices and the quality of her insightful reflections. Her pedagogical knowledge and practices about teaching and learning were apparent in many spheres, from whole school innovations she had pioneered

through to the delivery of learning activities in which she involved class teachers. The PACE program referred to earlier as Providing Academic Challenge for Everyone was one example. Another was the school's visual literacy program. Both programs were exemplified by the integration of curriculum learning areas, which Kath felt was an efficient solution to the time constraints placed upon teachers to cover all the required content. To facilitate achievement of the desired outcomes in this integration process, according to Kath, the choice of topic and learning pathway plans was first discussed in collaboration with class teachers. Then it was she who designed the detail of the learning pathways by being mindful of the curriculum, in addition to choosing appropriate digital resources and tools. Her inception and maintenance of these innovations are testament to her extensive knowledge of curriculum content.

Although Kath made many references to the curriculum in describing the planning of learning pathways, she had no written records to illustrate these and said "you can't plan...it's always a work-in-progress with IT." However, her practices and reflections on the lessons did demonstrate her curriculum and pedagogical knowledge in her preparation and planning. They also indicated that she planned for both teacher-directed and student-centred learning pathways. For example, Lesson 1 was largely teacher-directed as she introduced new concepts, though some control was given to the students in the latter stages when they were required to provide evidence of their own preferences in the finished product. Furthermore, Kath said that in the follow-up lesson, she planned not to direct the topic content exploration, but to recommend to students that they work with a partner to extend their knowledge

by using an online resource which had been modelled in Lesson 1, and to continue with the construction and amplification of their persuasion maps. Even then, her intentions indicated her opportunistic pedagogic knowledge as she intended to provide peer-scaffolding interactions by partnering students – one of whom had a finished first stage of a persuasion map and the other with an unfinished first stage. In Lesson 2 a student-centred approach figured prominently. This was evident in the modelling of student work and students' unfinished products. Prior to this stage of the topic development, according to Kath, students had made many of their own decisions to demonstrate their learning, from the selection of their group members and the tasks for which each member was responsible, to the content, design and imagery of their competition product. She also believed that flexibility in the choice of tool was important, and said that she was open to student discoveries, as well as providing support or recommending a tool at the point of student need.

In the structure of the learning pathways which involved collaboration in part with the class teachers, it was evident that the purpose of her pedagogical approach was twofold, that is, it was aimed at both teachers and students. Firstly for teachers, this meant she had an expectation that following her introduction to the topic or lesson beginning, they would continue the delivery of the learning pathway details integrated within the curriculum, albeit with her support. As she said, "I just throw it all out there...only at the beginning...drive it during the progress of the topic...manage it by being there...teachers really have to run behind me sometimes and tie up all my loose ends." Secondly for teachers and students alike in the demonstration of her teaching and student engagement strategies, it meant she was desirous of creating a learning

environment for all. Her philosophy was “that we come from the perspective that we’re all learning together ...they teach us, we teach them. It’s like a little brainstorming and action research kind of lesson in a way for all of us.”

This attitude towards learning also indicates that Kath believed that it was essential to be flexible at all times to ensure students were interested, motivated and engaged in learning. “You’ve got to think on your feet. You’ve got to switch if it doesn’t work, try something else, keep the end point in mind.” As described previously, she frequently changed the forms and duration of student engagement modes and in so doing maintained high levels of participation, all aimed at the development of students’ content and process knowledge. She believed that she had “the knack of knowing – as most teachers do – of what will engage kids.” Again, as in her planning without written documentation, it would seem that she operated at an intuitive level that was nevertheless indicative of the depth of her teaching knowledge.

The same conclusions could perhaps be drawn regarding her approach to assessment of student learning. She said she was “no good at doing the assessments”, yet demonstrated in many ways her understanding of how students learn, the progress they had made through the use of rubrics, points they had reached in the learning and how to create a multi-faceted learning environment. For example, in her reflections upon the observed lessons she could identify students in need and to whom she gave specific support, occasions when learning was not occurring and strategies needed changing, how the design of activities engaged students in higher order thinking and knowledge of the learning which had been achieved and needed developing.

“The main outcome for me,” she said, “is improving the learning...whatever level and product is evidence of that.”

Features of teacher interactions with students

The two most prominent features of Kath’s interactions with students were the vibrancy of the working environment she had created for learning and the expectations she set in this climate. The energy exuded by Kath and her excitement for learning seemed to have infected both students and teachers. The working space buzzed with lively and purposeful activity. Students appeared to have great confidence in Kath’s knowledge and willingness to support their learning, as evidenced by the ease with which they asked her questions of varying difficulty, by the interest she displayed in their knowledge and the respect for their ideas.

Kath expected students to achieve a high standard in their finished products and work in a responsible, tolerant learning environment. These expectations were woven into Lesson 2 in particular as positive, encouraging comments, when she indicated to students that she was confident in their abilities and their willingness to give support to their peers. For example in Lesson 2, while summarising the competition rubric levels, she said that having seen the quality of their work-to-date, she knew all students would achieve scores in the mid to upper levels. In this same lesson, she expressed her belief to the students that they would view one another’s work as “critical friends helping one another.” This expectation was further emphasised as a group’s unfinished product was projected and she modelled a supportive comment about their work, before asking the class for responses with guided questions such as “What can be improved? What has been done well?”

Beliefs and feelings about ICT

Kath's approach to using digital resources and tools within the teaching/learning programme, she stated firmly, was to "teach with ICT... (and that) is my philosophy." The value of integrating the use of ICT within the delivery of the curriculum, according to Kath, was beneficial in many ways. It engaged and motivated students to learn and had the potential to provide for different learning styles. In addition, it empowered students to be seekers of information rather than being required to commit facts to memory and it enabled students to construct a product which could demonstrate learning to teachers. Her pedagogical practices observed in both lessons reflected these beliefs, as previously described. Indeed she felt so strongly about the potentially powerful role which ICT played in the educative process that she believed she would be successful in teaching the most difficult of learners.

A further benefit to learners and to her, she believed, was the versatility of digital resources and tools in providing possibilities for producing work that had a professional appearance and for users to be creative. She said, "I didn't ever think I was creative, but I think I am....The tools that you can use, that help you...and I think kids can see that too... that looks pretty good!" These opinions indicate her belief that learning in an ICT environment was one where users' positive feelings about themselves and their abilities to achieve could be nurtured and grow.

Since her first experiences with computers Kath said she had "always preferred to use (them) as computer-assisted learning tools", indicating she did not view their use by students as central to their learning, rather as a support to their achievement of learning outcomes. In fact, during the course of the

interviews she emphasised many times her belief that computers were best employed as tools to support learning. She wanted students to have access to any tool of their choice at any time on their learning pathways and in her view mobile technology tools would provide such a platform.

The feelings which Kath often experienced when using ICT with students were also explored through her responses to the Experience of Change Instrument (Ainscow et al., 1995), referred to in the *Methodology* chapter and Appendix L (see Table 4.5). She made no specific comment about her choices of *commitment* and *critical*, because she said that her other explanations encompassed these feelings.

Table 4.5

Feelings often experienced when using ICT with students

Feelings	Explanatory quotes by teacher
Committed	
Enthusiastic	<i>all of these reasons</i>
Confident	<i>this is the only way to teach smart and that's with ICT</i>
Stimulated	<i>makes me think, has the ability for me to locate information which is critical..trying also to teach this to kids</i>
Supported	<i>by principal, teachers and some networking</i>
Comfortable	<i>seems to fit like a glove, marries the real world into teaching as well ...lifting all boundaries ...social networking eg. blocking has to be tackled ...kids given responsibility</i>
Pleased	<i>getting my own way ...depends on how things are going</i>
Interested	<i>teaching short cuts and not waiting 30 years for it to happen ..using kids as sounding boards</i>
Satisfied	<i>with what's achieved</i>
Irritated	<i>that people don't trust the benefits ...for kids with problems it's the best way ..gives confidence, that's the best way</i>
Cynical	

Her score of 11 from a possible 20, at first glance would seem somewhat negative. However, her practices and beliefs in the value of ICT, which have been described previously, need also to be considered in conjunction with this judgement. Firstly, her explanation for feeling *irritated* related not to her own practices but to how she felt about the attitudes of other teachers to ICT.

Therefore, her responses could be interpreted as the result of an accumulation

of experience and knowledge in using digital resources and tools and as an honest appraisal of how she perceived the realities of the teaching profession, without diminishing her own personal passion and commitment to ICT. All her explanations related in some way to an overarching view of the benefits of technology-supported teaching across school learning communities, for example, with comments such as “this is the only way to teach smart” and “marries the real world into teaching as well.”

The development of her perspectives on ICT can be traced through her growth as a teacher. In the following section an explanation of her experiential pathways begins with the reasons she gave for choosing teaching as a career and concludes with an outline of her professional learning strategies.

The growth of experience

Kath believed that support from management and their belief in her capabilities was instrumental in the way her teaching career path had developed. These influences and the resultant opportunities afforded her, the teaching roles where she accumulated her years of experience and how she reached her current ICT capability levels, are now described.

Teaching as a career choice

According to Kath she took up teaching as a career at the end of her secondary schooling almost 40 years ago because that was one of two professions available at the time for female students and in her words she “stumbled into the profession.” She gained a scholarship in physical education due to her athletic prowess and graduated as a specialist in that field, though she felt that during her training she “just drifted along... was very disengaged.”

Teaching role development

Throughout her 35 years of teaching she has held a variety of roles in a variety of education systems, though dominating her career has been her involvement with computers. Initially as a physical education teacher she said she learned to recognise and cater for the differing skill and ability levels of students, as a necessary practice in an environment which contained potentially harmful pieces of equipment. One of her first teaching appointments, which she held for 7 years, was part-time in the catholic education system as a librarian yet without holding librarian qualifications. She took up this position she said, after her children were more independent, as a result of the need to exit the physical education sphere because of the effects of the sun and her love of reading. In this environment she became acquainted with BBC Acorn computers and the software programs it offered. "It was such fun!" she enthused of the simulation games. Later she became responsible for managing a computer laboratory of 18 Amstrads, where her belief in the potential of ICT to engage students in their learning, by providing enjoyable and dynamic experiences, began to be firmly established, she felt. A later position introduced her to the government system of education as a computer resource person.

Significant influences on teaching

Significant events and apparent influences were collected by the researcher throughout Kath's descriptions of her career and experiences. A long list resulted and was expanded in chronological order when she was asked to identify those influences which she believed had the most noteworthy effects on her current level of expertise as a teacher (see *Methodology* chapter, section *Timeline construction and influences on analysis of growth* for further details of

this data collection process). More than 20 events or experiences were mentioned by Kath. These were classified for the purpose of analysis into just six influences, though not in rank order nor listed chronologically in Table 4.6. Events such as scholarships and awards she received were coded as *Professional recognition of excellence*, while *Contextual learning – as a teacher* was a category created to code her different experiences in differing teaching roles.

In reviewing the categories into which Kath's responses were placed and her explanations about the benefits of these experiences, it is evident that she placed considerable importance on those which had enabled her to always progress her learning. They could all be seen as either extrinsic or intrinsic motivators. Recognition of her excellence in teaching and her participation in conferences, for example, all appeared to act as extrinsic incentives for her and in part were confirmation of an earlier comment she had made about herself as being "competitive." On the other hand, in her professional development activity and contextual learning experiences, it would seem that she was intrinsically motivated. That is, she was engaged in inherently interesting and enjoyable activities of her own volition with benefits transferred to the classroom.

Two negative experiences stand out as influencing Kath in her practices, though in a positive way. Her reactions to her initial teacher training, and her observations of the way a colleague used computers in a laboratory setting were viewed by her as uninteresting experiences and not enjoyable. From this, she expressed a resolve to provide learning opportunities for her students in which they were happy and engaged in purposeful activity.

Table 4.6

Perceived significant influences on teaching role

<i>Influence</i>	<i>Experience</i>	<i>Explanatory quotes by teacher as benefits to growth</i>
Professional recognition of excellence	Winning scholarship for subject area training, intensive and prolonged ICT study and research, receiving national awards for outstanding and innovative teaching with ICT	<i>you have to work in groups (with students and in that context) differentiation is so obvious and necessary</i> <i>profound effect ..all of the skills so useful</i> <i>..absolutely loved it</i>
Contextual learning – as a teacher	Embracing and expanding ICT responsibilities as a resource person in various schools	<i>when I've had that history of everyone doing something ... (students must be) reading, thinking, happy, engaged, discussing ..</i>
Contextual learning – self-directed	Spending time improving ICT skills and exploring resources	<i>..sit and play ..because I enjoy it ...I got pretty jolly good at it because at this stage of my life I had time</i>
Role models	Reacting to pedagogical approaches of other teachers	<i>School was not fun</i> <i>Poor kids ...it's computer time ... I'm not going to do that ...</i> <i>He was brilliant ... so passionate</i>
Collegial	Attending and participating in national and international conferences	<i>sharing with conference participants</i> <i>...learned about augmented reality</i>
Professional learning	Training as a teacher and being involved in an action learning project on visual literacy	<i>(visual literacy team) gave us different resources..I took that away, married it with our IT</i>

The second part of this data gathering process required Kath to rank these influencing experiences. However, she was adamant that each experience had built upon the other, her learning was progressive and no single experience was more important than the other. She maintained that without the encouragement, trust and belief in her capabilities shown by principals and management to move forward as she had done, this progress “wouldn’t have happened.” On this point she was resolute and chose to reinforce her opinion by including all teachers in terms of the universal *you* saying “it won’t happen ... it doesn’t happen ... it’s impossible to happen (if support from the school is not given).”

Strategies for developing ICT skills

Examples given by Kath from the beginning of her introduction to ICT and throughout her career indicated she continually sought and seized opportunities to acquire knowledge and develop her skills. According to Kath, attending computer courses, participating in conferences as a delegate and presenter, being involved in learning networks to create mentoring relationships and playing key roles in action research projects, all contributed to an increase in her knowledge. Her strategic approach to the selection of these contexts for learning appeared to be directed by her prevailing interest in how to use ICT as a tool to integrate within the curriculum and her beliefs in learning as a shared process.

Early in her career specialised computer courses were the means she chose. A 3-year postgraduate university computing course, awarded as a scholarship and completed about 10 years ago, she believed, was a turning point, not only in expanding her knowledge of different tools and the skills to apply them, but in introducing her to the power and effectiveness of online interactions. Her involvement in a number of cooperative research projects utilised these experiences.

In speaking about her career and the development of her ICT skills, Kath stated that she grasped opportunities to present at conferences and share experiences with participants in her pursuit of learning about technology-supported teaching. For similar reasons, she was also a willing participant in research projects, such as her experience as a Westfield Premier's Research Scholar. Part of her commitment to keeping abreast of new knowledge and practices, thereby gaining teaching ideas, was evident in the frequency of her

submissions, and success in receiving grants, to become involved in such projects. She was responsible, for example, in gaining approval from the Australian Curriculum, Assessment and Reporting Authority (ACARA) for her school to participate as a trial school in the development of the National Curriculum in English.

By contributing to these kinds of projects and conferences, her participation meant accountability to host organisations, she said. This took the form of reports, which although she believed they were not widely shared, nevertheless assisted her in analysing materials, practices and contexts. This led her to further advancements in her own learning and practices, which were then reflected in changes she brought about to programs in schools where she taught, for example, the visual literacy project in her current school.

Kath was emphatic about the need for plenty of time to play and undertake Internet research as essential to her learning in an ICT context. In her words, “If you don’t have time, forget it!” This she conducted in her own time and by herself. Time for learning, as collegial sharing, was also evident when school management relieved her of classroom responsibilities to study, participate in conferences and research projects. The accumulation of the time spent by her in these kinds of learning activities, according to Kath, meant she “got pretty jolly good at it!”

Her score of 41 from a possible 44 on the self-rated computer applications and equipment descriptive rubric (see Appendix K) indicates her high level of skill. Her rating scores showed she was highly proficient in all categories, except for a basic knowledge of spreadsheets, from word processing, email, file management and the use of databases to her ability to

use Web 2.0 tools and editing tools for video and digital photography. These were all skills she employed in her everyday teaching, she said, particularly in her role as a support for other teachers.

The preceding analysis of Kath's pedagogical practices, the growth of her experience and the influences upon these aspects of her teaching and learning is not complete without considering her perceptions of her own self-worth and the ways in which the quality of her teaching had been recognised.

Professional self-esteem

Throughout the descriptions of her career, Kath gave every indication that she was always confident in her own capabilities, evidenced by remarks she volunteered, such as "I'm good because I'm canny and I'm good because I was a naughty student." This belief in her own self-worth, her willingness to face new learning experience and be inventive in her practices appeared to contribute to, and generate, the constant encouragement and support given her by management. This was offered from the early stages of her career to later recognition of her excellence in teaching. Her professional goals and further details on how recognition of her teaching qualities benefitted her current role as a leader in the use of digital resources and tools are discussed in the following paragraphs.

Professional goals and teaching excellence

Kath maintained that her teaching goals were always to make learning enjoyable and stimulating, for activities to be relevant to students' interests and at a level commensurate with their needs. These were qualities that she also felt were those of an effective teacher, together with an ability to change plans

according to the flow of the lesson and whether it was achieving its aims.

Examples of this knowledge of students and how they learn were illustrated in the observed lessons, where she had exhibited her expertise as a lead teacher by modelling a range of strategies with diverse digital resources and tools.

Her professional goals were aimed consistently at expanding the boundaries of her knowledge of ICT by seeking and engaging in research projects, conferences and network groups. Choices such as these took her to different countries and exposure to culturally different ways of using ICT in education, for example, Thailand, Korea, Vietnam and the United Kingdom. For these reasons, an immediate goal of hers was to apply for a grant to visit schools in Arizona, United States of America.

Through these experiences; it can be seen that she was continually looking to the future and how she could not only contribute to her profession, but promote changes. She stressed she did not want to remain satisfied with her current skill and knowledge levels, that she had a desire to engage in purposeful learning and wanted “to make a difference.” In this regard, she felt very strongly that the power and the potential for progress rested with passionate teachers, of whom she believed there were but a few. Of herself, she said, “I’m passionate you can tell...love to teach.”

In the future use of digital resources and tools by students she hoped that all students would have unlimited and constant access to an iPad type device with a flip-out keyboard, touch screen and Internet connectivity. This facility, she believed, would give students the means to pursue their learning at anytime and anywhere they wished.

These selected examples of her goals, linked with her approach to the acquisition of professional knowledge, earlier descriptions of her experiences and references to her teaching excellence lead to an examination of how recognition of her teaching qualities benefitted her professional practice.

Recognition of teaching qualities

Her teaching practices and qualities have been recognised nationally, for example, by Teaching Australia with their National Award for Quality Schooling: Excellence by a Teacher and twice by Microsoft as an Innovative teacher. In addition, she has been awarded a number of research scholarships to further her knowledge and contribute to the profession.

Evidence of the benefits to the school and to her colleagues of her outstanding abilities as a teacher can be seen in her current role. As described previously, she has designed learning pathways with ICT, incepted innovative ICT programs within the school, modelled a range of teaching strategies, introduced students and teachers to a variety of digital resources and tools and supported teachers in the development of their professional knowledge and practices. In this latter aspect, Kath seems to be very aware of the specific needs of other teachers, their skill and confidence levels and how she could assist them. For example, she invited Tonia, as a young teacher and new to the school, to join this research study in its second stage and made this comment at its conclusion – “(she) feels really valuable... a contributor now... hasn’t she grown?... walking on cloud nine.” An inference here is that to be recognised by Kath as a worthy participant was particularly rewarding for Tonia due to the high regard she held for her ICT curriculum leader’s exceptional qualities and judgment. Indeed, all the teachers participating in this research study valued

Kath's knowledge and experience when, during the course of their interviews, they referred to her as being inspirational and a major influence on the development of their professional learning.

At the conclusion of the study, Kath proffered a voluntary appraisal of these teachers' and her own participation in this research. Her overall impression was that the focus of the research data gathering process had been enlightening for the school in the advancement of its goals for ICT integration. Benefits to the school, she believed, were gained by requiring the teachers to reflect deeply upon their practices, to show, explain and justify them, and to examine their pedagogical practices with ICT. It could be concluded that the selection of the school by the researcher was another form of external recognition, thus influencing the quality of its practices.

A further illustration of how her experience and comprehensive professional knowledge contributed to her leading role within the school was her confidence and willingness to involve parents in their children's education. She said that parents were delighted to be made aware of where their daughters' achievements were in relation to others and to have standards explained and examples given. It would appear that Kath had a strong belief in the quality of the programs she had incepted and was prepared for them to be transparent and scrutinised.

This case study has described and explored in-depth Kath's teaching practices with ICT, her related experiences and their derived benefits for her colleagues, school and profession. The following summary draws upon the findings of this particular investigation to illustrate the interactions of her pedagogical practices, learning experiences and characteristics which

contributed to her present level of expertise. It will not cite examples as these have already been given, rather as the title suggests, it is a summary only. Of importance however, is that this summary is also informed by practices and learning experiences of teachers' career stages from proficient to lead, and those considered to be experts in the use of ICT (Appendices M and N).

Summary

As the full scope of Kath's teaching practices, experiences and qualities emerged through the observed lessons, her reflections upon these lessons and her responses in the interviewing process, two pervading features of her approach to teaching became apparent. One was her confidence in her own worth as a teacher and the capabilities she possessed in using digital resources and tools. The other was the way she frequently elaborated upon her convictions of teaching with ICT from the perspective of a leader rather than in introspective terms about her own practices and experiences.

In her planning and preparation, a comprehensive knowledge of the curriculum was evident through the integration of different learning areas, which Kath drew upon, in designing learning pathways comprised of various learning activities conducted over time. Initiatives in the school instigated by her, such as the PACE program and the visual literacy projects, generated experiences for students that allowed them to collaborate with one another, interact with knowledge sources external to the school, engage in critical analysis and express themselves creatively. Learning activities were authentic and relevant to the world in which students lived and were of interest to them. In the delivery of the learning activities, a supportive environment was maintained, attention was paid to the choice of digital resources and tools, and when to use these

within a lesson, to sustain student engagement in the task and facilitate learning.

There was a pattern to the structure of the observed lessons, beginning with brief instructional strategies and moving quickly to a range of mostly ICT modelling strategies to motivate students and gain their interest. This practice was in keeping with her beliefs that ICT could capture students' attention and stimulate learning. Her approach also appeared to be influenced by her negative early learning experiences and as a consequence to make learning "fun" in her words. Her decisions not to make learning objectives explicit until about halfway through the lesson, could also be attributed to her belief in the motivating power of ICT. Her aim, in the first instance, was to immerse students in an enjoyable experience, rather than focus on outcomes to be achieved. Awareness of the progress of student learning was demonstrated by the teacher's observations of interest levels and when students were engaged in tasks using computers during the last half of each lesson. She did not employ assessment strategies as she gave this responsibility to classroom teachers, though it was sufficient evidence for Kath that the quality of students' products demonstrated their achievement of learning outcomes.

Student-centred learning was apparent where students had to make choices and justify their opinions, as in the persuasive argument lesson, and where students selected their own topic to create text and visual images in the environmental theme of caring for local waterways. This freedom of choice could have been influenced by her own experiences when she felt she was given the freedom to pursue and incept her ideas. Diverse needs of students were catered for in these ways, yet high expectations were set for student

achievement levels, as illustrated by the reinforcement of the competition rubric levels.

Kath played a leading role in the school as the learning design coordinator of resources, in developing an ICT integrated curriculum and modelling strategies which incorporated digital resources and tools. Teachers were able to observe and work alongside her, to seek her advice on the selection of resources and to discuss plans for learning activities, which they managed and recorded in their own classrooms. Written documentation was not part of her planning repertoire. It appeared that her comprehensive knowledge enabled her to plan intuitively.

Keeping abreast of current practices with ICT was a priority for Kath in order to continually expand her knowledge and inform her practice. She sought opportunities, often through grant applications, for involvement in research projects, in addition to receiving invitations to participate in these. Many of these experiences stemmed from peer recognition of her teaching practices in a technology-supported environment. Winning awards and scholarships was further evidence of the esteem with which she is held. In all these learning experiences she aimed to share her knowledge with her colleagues and amongst wider networks, to the extent of collaborating and communicating with teachers in other countries. Although she did not overtly state that her goal was the pursuit of excellence, it is evident from these examples that she was highly motivated and dedicated to the achievement of such aims in her teaching practices.

From her initial introduction to ICT and throughout her career, she was prepared to spend long periods of time searching for, and assessing, useful

teaching resources, to broaden her knowledge of digital tools and to increase her skill basis. Her view that this learning process was a shared experience between teachers and students was evident in her collaboration with her peers and her recognition of students' contributions to the gaining of new knowledge which could benefit all. In reflecting upon her own performance as a teacher, it was her strong belief that the power of ICT had assisted her to be creative and bring excitement to the learning environment, without too much effort on her part.

The influences of Kath's varied and noteworthy experiences were apparent in the beliefs she held about her own capabilities. Her high level of confidence was reflected in her approach to learning and teaching, when she said, "I can take risks and not worry about the consequences." She followed this remark, once again from the perspective of a leader who is concerned with the quality of education using digital resources and tools, by saying, "I think if teachers were more risk takers and they had the support...we'd be flying."

CHAPTER FIVE

CASE STUDY 2: A TEACHER WITH VARIED CONTEXTUAL EXPERIENCES

This case study is about Laura, newly appointed to the school and with a wealth of diverse teaching experiences in different educational settings and different roles, within and outside Australia. It describes and critically examines decisions she made about her learning experiences, her pedagogical knowledge and practices, her personal characteristics and the inter-related influences of these dimensions on the growth of her expertise in technology-supported teaching. Lesson observations and interviews were the data sources for this case study.

Firstly it examines Laura's teaching, questioning and student engagement strategies used in her delivery and management of two observed lessons. This analysis is informed and enriched by her stimulated-recall reflections during interviews and when given access to video and audio lesson records. Secondly her pedagogical goals and beliefs about student learning and teaching with ICT are explored. Thirdly her professional growth and self-esteem are appraised in the light of her perceived experiential influences. The final summary includes judgements on the scope of her technology-supported teaching expertise in relation to a review of her pedagogical practices, her learning experiences and her personal characteristics.

The next paragraphs provide an introduction to Laura and how data was collected. These are followed by a description of her classroom working environment and the construction of two observed lessons. The construction and management of the lessons, the teaching, questioning and student

engagement strategies employed by Laura are examined. The section concludes with her reflections on the lessons, which lead to researcher judgements made about the key features of the lessons.

Background

Seeking change and variety in a teaching career spanning more than 20 years defined Laura's approach to accumulating many different experiences which in her opinion "make you a well-rounded teacher." She sought experiences in primary and secondary catholic schools within Australia as a classroom teacher and middle school manager, interspersed this with extended adventure travel in other countries and taught for a period in a Thailand orphanage. Her passionate interest in science and photography, she declared, had grown and been extended during these experiences.

One of three Year 6 teachers, she was new to the Independent school system, though returning to primary school teaching from 8 years in middle school (students aged 12 to 14 years). Her class of 24 girls ranged in age from 10 to 12 years, and according to Laura, most had well-advanced literacy abilities. This enabled her to teach at a higher level than expected for this age group, she believed.

Audio and video recordings of Laura's lessons were made at each data collection stage, in which ICT were used. The three-interview set (Interviews 1, 2 and 3) of focus questions was employed in Stage 1, while in Stage 2, only interview material relating to the observed lesson was gathered (see *Methodology* chapter and Appendices A-H for details of the interview content). Part of Interview 3 in Stage 2 of the data collection process was conducted over the telephone about three weeks after the lesson observation. The researcher

and the teacher had simultaneous access to the relevant audio and video records for this interview. Both lessons were followed by informal observations where ICT was not used, though video and audio data was collected. This data did not form part of the interview process, but was used by the researcher to provide further background on the classroom climate and to support the analysis.

The working environment

Laura's classroom formed part of a cluster three year 6 rooms, which opened onto a large open area in which a bank of 24 Mininotes was housed. Rostered use of the Mininotes was necessary as all 72 students from the three classes were obliged to share these resources. Teachers cooperated with one another to schedule usage. This was particularly important for Laura as she was one of two teachers who used the Mininotes on a daily basis. At times, changes in programmed lessons were required to accommodate needs and therefore flexibility in sequencing lessons was essential. Laura said that she expected all students to have a USB stick in order to save copies of their daily work and for use at home, where they also had access to all worksheets and her instructional materials on the school U drive. This resource was known as activeBook and included Powerpoint, MS Word and Excel templates, as well as technical guidance information.

Students had access to the school computer lab on a rostered basis, usually at least twice a week for their PACE lessons (Providing Academic Challenge for Everyone based on an enquiry approach incorporating cross-curricula activities). These were led by the ICT curriculum leader and explained in Case Study One.

Displays of students' work, resources and reference charts created a vibrant visual atmosphere. On her desk the teacher had a laptop which enabled her to project material on to a whiteboard though it was not an Interactive Whiteboard (IWB). When a degree of interactivity was required by the teacher, individual students were called upon to use the teacher's laptop, thus projecting material for the whole class to see. In both stages of data collection a mat area was used for whole class discussions.

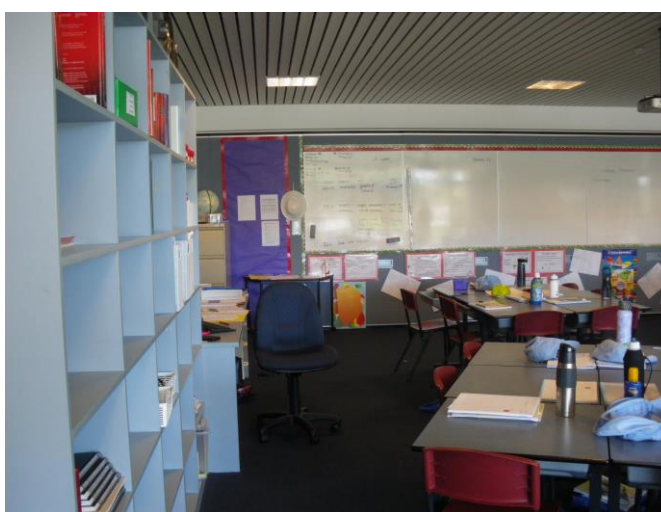


Figure 5.1 Case study 2 – the working environment.

Construction of observed lessons

The three year 6 teachers collaborated in the planning of their working programmes, by discussing the purpose and selection of particular themes across curriculum areas and by sharing resource ideas. Teachers then devised their own lessons based on these common aims. Two lessons were observed in Laura's classroom, one at each stage of the data collection. These are referred to as Lesson 1 and Lesson 2.

Lesson 1 was the second in a set of science lessons on food webs within a theme of ecosystems, on which the students had been working for some

weeks, according to Laura. She had prepared a number of food web diagrams from the African Savannah, which she told students she had chosen “because many of you are interested in these kinds of animals and from Africa”. She had designed the diagrams when using IWB software at her previous school. In the observed lesson, the students were required initially to answer a set of questions on the African Savannah and then work in pairs to create their own food web as stated on the Ecosystems computer task sheet (see Appendix S for copies of the worksheet and task sheet).

Lesson 2 formed part of a theme on visual literacy which the three Year 6 teachers had selected for a unit of work to integrate curriculum areas of English and science. They chose different topics to address curriculum aims, but ones which they believed would appeal to students’ interests and importantly, be relevant to the world of persuasive advertising found in people’s everyday lives. Bathroom science was the subject area selected by Laura. As she explained; the topic had been introduced through a science (chemistry) task the previous week when students had made bath bombs. In preparation for Lesson 2 she had located 25 different bathroom pictures through a Google search and made these accessible to students on U drive. The aim of their Lesson 2 tasks was twofold, as noted in the lesson documentation. Firstly they had to use the principles of visual literacy to select a bathroom picture from these digitally projected images. Secondly, the students were asked to consider the visual characteristics of the bathroom and what feelings these evoked. This task was significant, Laura stressed, as in later lessons students would be required to design a range of complementary bathroom products, which would also

demonstrate their understanding of advertising ethics (see Appendix S for details on the student instruction sheet).

Delivery and management of lessons

Both lessons were conducted within the classroom. Student pairs used the Mininotes, following Lesson 1 introduction. At the beginning of Lesson 2 each student had a Mininote, although pairs collaborated when undertaking the tasks. In the latter case, a technician was on hand at the beginning of the lesson in case of problems, but his services were not needed.

Before listing and providing examples of the strategies used by the teacher in the delivery and management of the observed lessons, an overview of their stages together with the subsequent teacher and student actions was compiled for the purpose of comparing the lessons. Lesson stages were not determined on a time basis, but on evidence of perceived segments in the lesson development, as observed by the researcher and outlined in Table 5.1.

A blank in Segment 3 of Lesson 2 is shown in Table 5.1, as it was clear in the analysis that both teacher and student actions were only continuations of Segment 2.

As illustrated in Table 5.1, there were many similarities in the delivery and management of the two lessons, though these were not always evident as a sequential pattern. Both lesson topics were introduced with teacher-prepared digital images and used as a stimulus to facilitate learning through frequent questions and opportunities for numerous students to respond. All the stages of both lessons were typified by many teacher questions. Throughout both lessons, concept language was reviewed in context and reiterated often. Lesson conclusions were brief with acknowledgement of work-to-date which

had been achieved; instructions were given to save this work and plans mentioned for its completion.

Table 5.1

Lesson sequences of teacher and students' actions

Lesson stages	Teacher actions	Students actions
Introduction	Reference made to science diagrams in workbooks Questions asked Topic image projected and concept reviewed Topic concept language reviewed	Referred to workbooks Individual responses to questions
	Topic image projected Questions asked	Individual responses to questions All students logged on
Segment 1	Difference topic images projected Questions asked Topic test items stated Concept language summarised New concept language explained	Individual interactive responses Many individual responses to questions Notes made in workbooks
	Topic images projected Questions asked Theme tasks stated Lesson task stated Navigation skills suggested	Individual responses Students engaged in ICT task
Segment 2	Worksheet tasks explained Topic concepts analysed Questions asked Topic images projected , explained, interpreted Lesson objectives stated ICT tools listed Navigation skills suggested ICT and worksheet tasks summarised	Many individual responses Some collective responses All students engaged in worksheet task All students logged on and engaged in ICT task
	Learning monitored Questions asked ICT instructions given	Students engaged in worksheet and ICT tasks Individual responses
Segment 3	Learning monitored Questions asked ICT instructions given	Many individual responses Students engaged in ICT task
Conclusion	Task achievement example of student pair given Learning monitored Reflective questions asked	Work-in-progress saved Many individual responses
	Task continuation requirements summarised Reflective questions asked	Work-in-progress saved Many individual responses

Key. Lesson 1 =



Lesson 2 =



A further similarity between lessons was that students were required to undertake two tasks in tandem with one another in each lesson. One was an

ICT task. To complete the other task, students were provided with a worksheet containing reference material on the topic and questions to be answered.

Details of other similarities with very few differences can be found in the next section which describes the teaching and questioning strategies used by Laura and how the students were engaged during Lessons 1 and 2.

Teacher strategies and student engagement

A complete list of all units of analysis and their corresponding descriptions on teaching strategies, questioning strategies and student engagement modes, which formed the basis for coding the raw data, can be found in the *Methodology* chapter. For example, an action by the teacher of referring to personal experiences or providing personal anecdotes was coded as a teaching strategy of *Explanation of experience*. A questioning strategy of *Reflective-interpersonal* was recorded when students were asked to interact with peers in order to assess their own learning. When the class as individuals or an individual student was required to undertake an ICT task, this form of student engagement was coded as *ICT individual task*.

Only those strategies and engagement modes, which had been observed by the researcher in Lessons 1 and 2, are shown in Table 5.2, Table 5.3 and Table 5.4. Their frequency was not counted, as it was felt that noted instances provided sufficient examples, in conjunction with other evidence, for further analysis of the teacher's pedagogical practices. Descriptive examples of Laura's strategies and forms of student engagement, as observed, have been provided below, often by selecting and combining data from each of the three tables. This explanatory process was adopted to show evidence that it was a constant practice of the teacher to blend strategies and maximise student participation.

Table 5.2

Range of teaching strategies during lessons

Teaching strategies	Lesson 1	Lesson 2
Instruction- learning objective	x	x
Instruction- information / exemplar	x	x
ICT instruction	x	
Explanation	x	x
Explanation of experience		x
ICT explanation	x	
ICT demonstration		x
ICT modelling of concept	x	x
Prior knowledge activation	x	x
Scaffolding	x	x
Summarising	x	x
Facilitation	x	x
Checking for understanding	x	x
Monitoring learning	x	x
Praise / feedback	x	x
Assessment of learning	x	

Table 5.2 shows that, except for *ICT instruction*, *Explanation of experience*, *ICT demonstration* and *Assessment of learning*, in both lessons the teacher used all other strategies. A brief description of the two strategies involving ICT follows, while the *Explanation of experience* strategy has been expanded upon, following Table 5.4 on student engagement modes.

ICT instruction and *ICT explanations* were limited to Lesson 1, which was conducted near the beginning of the year and understandably these strategies were not required for Lesson 2 given the students' development of computer skills since that time. In the former instance, some isolated students were given instructions on how to log on. The teacher also drew the students' attention to useful tools such as Paint, MS Word, the functions of drawing arrows, copy and paste, and the importance of appropriate keywords for Internet searches, in the

construction of their food webs. Instructions on skills were provided by the teacher as over-the-shoulder support while students worked.

The timing of teacher-instruction on learning objectives merits an explanation. Learning objectives were first introduced incidentally during Segment 1 of both lessons. In Lesson 1, when the teacher projected a food web diagram, she reminded students they would be tested on their knowledge of this diagram the following week. Similarly in Lesson 2, when the teacher showed a digital image of a bathroom and instructed the students to locate the same image on their Mininotes, the lesson objective was stated as a task which was “trying to fit things into this bathroom to make it look good,” she said to the students. In both instances, visual images were modelled using ICT accompanied by explanations which incorporated concept language illustrations, prior knowledge activation, prompts to construct new knowledge and questions. For example, in Lesson 2, the teacher invited students to respond to the projected image by asking questions such as, “How would you describe that?” and urged them to “think about what kinds of products could match a bathroom of your choice.” At this same juncture, reference was made to features of their science task from the previous week and their planning sheet headings of brand, range, motto/slogan and target audience, as a link to the proposed follow-up lessons.

Instructional learning objectives were again repeated in the form of tasks to be achieved during Segment 2 of both lessons. It was at this stage of the lessons that students were using ICT to complete a task and answer questions located on their topic worksheets. In Lesson 1, whilst reading aloud the task instructions on the Savannah worksheet, the teacher interspersed this with

questions about food chain examples on the worksheet diagram. In this way she was checking for students' understanding and summarising content by reviewing the task to be undertaken, re-wording student responses and providing feedback. While students were working at this task they were prompted to quickly move on to the ICT ecosystems task of creating their own food web, as stated on a separate sheet. Achievement of this task was facilitated by the teacher as she projected images of a number of food webs and said, "look at the links, follow the line, all different kinds of chains can be made through arrows." In Lesson 2, the teacher again read aloud from the task instruction sheet, the *Integration of Bathroom Science with Visual Literacy*, which also contained a summary of thematic material from previous lessons. Students selected and then referred to their chosen bathroom image in order to answer four worksheet questions and to devise a draft plan for the later creation of their bathroom products.

Learning objectives were also interwoven with an expected completion by students of questions on both worksheet and ICT tasks in the following ways. At intervals the teacher stated that students:

- Should be working on a particular task as part of a sequence,
- Had a given number of minutes to complete a task, and
- Would need worksheet answers for checking within a given time.

Furthermore, in these ways the teacher was not only ensuring that students were focused and on-task, but it could be argued that she was also challenging the students to pace their learning. This aspect is explored in a later section on the teacher's pedagogy.

One more teaching strategy is interesting to note when reviewing the approaches used by the teacher during the observed lessons, and that is praise. Praise took a number of different forms. Individual responses to factual questions in the beginning of Lesson 1 were all praised. To the whole group at the end of Lesson 1, the teacher said of the quality of work produced “I’m very impressed” and “excellent work girls!” Other forms of praise, it could be concluded, were also used as motivational tools. For example, the previous work of a group was described to the class and used by the teacher as a good illustration of what she expected in the following lessons. Suggestions made by students were also praised and valued, for example, to one student who had an interesting idea, the teacher said, “Can you bring it in and I’ll have a look at it.” Suggestions were also encouraged in another way. Near the conclusion of Lesson 2, the teacher invited students to find ways of superimposing their products on their bathroom picture and commented, “that would be really great!...(we can) discuss next week and we can have a go.”

Table 5.3

Range of questioning strategies during lessons

Questioning strategies	Lesson 1	Lesson 2
Factual	x	
Inferential	x	x
Evaluative		x
Open	x	x
Closed	x	
Reflective - interpersonal	x	
Reflective - content	x	x

As indicated in Table 5.3, factual, closed questions were asked only in Lesson 1. These were frequent throughout the lesson. Subsequent to content questions such as, “Who can tell me what a food chain is?” and “What are

producers?” the teacher explained to students, that these were facts they needed to know in order to understand and create a food web. This was different in Lesson 2, where evaluative, and not factual questions, were asked. In this case, students were expected to critically analyse bathroom images and form judgements based on their knowledge of visual literacy principles. The teacher often prefaced these questions with “Why?” as she directed them to the whole class and when walking around the classroom monitoring learning. This change in the teacher’s questioning indicates a strategy she used to differentiate between the aims of the lessons, namely, student knowledge of facts in Lesson 1 compared to student evaluation of characteristics and personal attitudes in Lesson 2.

Questions of a reflective interpersonal and content form were limited only to the closing minutes of the lessons when all students were brought together on the mat area to form a shape known as a *community circle*. Here students had opportunities to respond briefly to the teacher’s request by telling of “one thing you’ve learnt.”

Table 5.4

Range of student engagement modes during lessons

Student engagement modes	Lesson 1	Lesson 2
Individual responses	x	x
Whole class responses	x	
Individual task	x	x
ICT individual task	x	x
ICT pair collaboration task	x	
ICT procedural skill eg. navigation	x	x
Knowledge construction	x	x
Feelings expressed	x	x
Passive engagement		x

Table 5.4 shows three kinds of strategies the teacher used to provide for students as individuals to be engaged in their learning. Firstly, as indicated

earlier, there were many and constant opportunities throughout both lessons for individual students to answer questions. Secondly, students worked individually to answer worksheet questions, although it was observed that all tasks promoted informal discussions amongst students. Thirdly, there were two forms of individual ICT interactivity. In Lesson 1, individual students were called upon to jumble the teacher- projected food web image, by using her computer to make this visible to the whole class. Other individual students were then asked to make one move each to form correct links in the food chain, again using the teacher's computer. These moves were then appraised by the whole class. In Lesson 2, students as individuals, used their Mininotes to select their bathroom image, though as for the worksheet tasks, informal discussion occurred, as well as the unsolicited viewing, and critical appraisals given, of other students' selections.

There was only one example clearly evident of passive engagement by the students, and that was in Lesson 2, when the teacher was referring to a personal experience which involved an anecdote about a gift she chose for her parent's renovated bathroom. All students were seen to be totally absorbed in the telling of this account. Throughout both lessons, there were no other occasions when it seemed all students were expected to be passive listeners. The teacher frequently talked, asked questions and gave instructions while students were undertaking their worksheet or ICT tasks.

Teacher's reflections on lessons

Explanations of Laura's practices were sought during the post-observation interviews and as a stimulated recall commentary when she viewed video footage of the lessons. Her immediate comments following the conclusion

of Lesson 1 were that the “lesson went really well” and “I like the use of (IWB software) that I did at the beginning.” In summary, her overall satisfaction with both lessons she expressed in terms of:

- Her methods of delivery to achieve her aims,
- Her integration of curriculum learning areas,
- The ICT skills base of the students to accomplish their tasks,
- The reliability of the technology, and
- How the technology was used, given her perceptions of its limitations.

Particular features of her pedagogical practices have been listed in Table 5.5, accompanied by a selection of explanatory quotes. Comments were categorised according to particular lesson features which had been determined by an analysis of teaching strategies aligned with pedagogical theories on student learning (see *Literature Review* chapter, section on *Student-centred teaching implications*). No distinction has been made between lessons in the decision to select teacher’s explanations as informative examples of her practices.

Practice, flexibility, spending time searching for, and responding to ideas, were hallmarks of Laura’s preparation and planning for her successful delivery of lessons, as evidenced by her comments in Table 5.5. By these actions; she showed a willingness to spend time in creating lessons which would be motivating and exciting for the students, as cited earlier. Moreover, a change from her original intention in Lesson 2 – “not something I had in my head” –

would seem to be the result of her extensive pedagogical knowledge of knowing how best to achieve her aims.

Table 5.5

Teacher's reflective explanations on features of the lessons

Lesson features	Explanatory quotes by teacher
Preparation and planning	<i>I practiced this (lesson) on my friend's iPad (teacher key word search - prior to lesson) gave me this idea in the first place, because I wasn't quite sure how I was going to go ... wasn't the activity I had in my head I think on my feet all the time</i>
Modelling	<i>role modelling of how I use ICT to teach them ...so they can use it in their own learning ... instructing them using the computer ...they knew that I had made it (food web)</i>
Differentiation	<i>they were given that open-ended task wanted them to choose (their own picture) (I'm) going to match up weaker student with girl who was away</i>
Authentic experience	<i>(stories about self) the kids get to know me ... to make the learning more real ... I want them to see their teacher is real (they've) watched parents design and build homes</i>
Scaffolding	<i>involved me giving them lots of direction first, then revising their knowledge, so that they were confident enough to start on the computers ... (I) wanted to make links to what we'd done last term</i>
Collaborative learning	<i>(students) learn so much from each other ... wouldn't have got that if I didn't work in pairs</i>
Monitoring learning	<i>when I went around to most of the girls ... they understood exactly what was going on</i>
Higher order thinking	<i>(food web) very high order activity for 11 year olds</i>
Assessment of learning	<i>probably not a great conclusion because we're not finished yet like listening to their discussions ...their answers</i>
Student engagement	<i>whole bathroom topic ...girls are really interested</i>

Laura's understanding of factors contributing to the knowledge construction of all learners was confirmed by a number of her comments. Firstly, the reasons she gave for using ICT modelling strategies and why she chose to tell personal anecdotes indicated her belief that collaboration and sharing of experiences enhanced the learning process, in which all learners were participants. Secondly, she showed how technology could be used to teach as well as to learn, for example, when she described to the students the

criteria she had discovered to compile her set of relevant bathroom images. Thirdly, her reference to the students' homes, for example, demonstrated her awareness of the need to choose topics to which students could relate through their own experiences, thereby generating motivational power to stimulate learning.

The preceding detailed descriptions of the observed lessons are now followed by a concluding overview of their key features.

Key features of lessons

Key features of the lessons were the purposes for which ICT was used to engage students' interest and to demonstrate their learning, the strategies used by the teacher to maintain high levels of student participation, the manner in which learning objectives were conveyed and the lesson structures.

Both lessons featured a similar delivery structure. Lesson structure, according to Laura, was of prime importance. It generated a learning pathway resulting in students' confidence to create quality products which showed evidence of their level of concept understanding. Lesson construction did not take the form of an observable step-by step procedure; rather the teacher's intentions were embedded in what would seem at first glance, to be a laissez-faire delivery. However, close examination of the delivery showed a gradual unfolding of Laura's intentions as she firstly used multiple representations of concepts, such as ICT and reference book visual cues, to motivate students. Secondly, simultaneous activation of their prior knowledge was used to revise knowledge and to scaffold their learning. This was followed by the use of teacher-talk and focused questioning to promote concept development. Students' construction of knowledge was then further facilitated through their

analyses of concept examples supported by a degree of ICT interactivity. Finally differentiation of achievement levels was catered for as students had the freedom to create their own products.

A common feature of both lessons was the manner in which the introductory stages were delivered and the levels of student engagement. The teacher used digital resource material, which she had devised, as motivation to stimulate and engage the students. Of particular importance for Laura was her “aim to create excitement and I did”, she said about Lesson 2 for example. By using an IWB resource in Lesson 1, she believed she had “turned a boring diagram into something interactive and that they’ll remember.” Student’s high levels of enthusiastic participation in ICT and non-ICT tasks, their eagerness to respond to the teacher’s questions and to discuss or share their activity with peers were testimony to the success of the approaches she had used in order to fulfil her aims.

The teacher’s strategies of scaffolding and facilitation of learning were constant. These were evident as she linked students’ prior knowledge of previous lessons and the relationship of the current lessons to further planned lessons on the topic. Concepts were represented and reinforced in a variety of forms. These were apparent often when digitally projected images were interwoven with concept vocabulary, oral and written focus questions were asked and references made to resource material located in students’ activeBooks.

Learning objectives were not stated in terms of lesson aims, or of defined achievement levels, for example, in the form of a rubric. Rather, they were referred to as tasks and outlined on student worksheets, as questions to be

answered and as ICT activities. These tasks were first made known to the students after the introductory stages of the lessons and repeated at intervals during the course of the next stages. Assessment of learning about food webs was also associated with the description of the Lesson 1 tasks when students were advised that the following week's test would contain questions on this knowledge. The only other form of assessment observed was the checking of students' food web worksheet answers. This was conducted orally by the teacher, who targeted individual students for responses. However the teacher used this strategy to also check for students' understanding of the concepts as she challenged their responses with associated inferential questions. According to Laura, the ICT tasks in both lessons would not be completed for another two sessions and then they would be assessed. The criteria for this assessment were not provided. Nevertheless it could be inferred from the lesson delivery that students would be judged on how their completed tasks met the worksheet requirements, together with the range of computing tools used.

Both lessons had a form of open-endedness and could be considered as student-centred where provision was made for students to make their own choices to complete the requirements of the tasks. For example, they had to create and design their own food web and use computing tools of their own choice in the ICT task for Lesson 1. Some limitations of choice were evident in Lesson 2 where students selected their bathroom image from a given set provided by the teacher. This starting point was justified by the teacher as a time-saving device as it drew upon important student skills of critical analysis, an essential aim of the lesson, she said. In addition, Laura informed students

they were to be given further freedom of choice in follow-up lessons when they would create their range of complementary bathroom products.

As noted before, the teacher had prepared student worksheets which stated the lesson tasks to be undertaken. These showed evidence of curriculum integration. Lesson tasks did not change. However, in considering how she could best achieve her aims, Laura showed confidence drawn from her expertise in discarding her original ideas and replacing them with an approach more in keeping with her stated pedagogical practice of making the learning exciting to engage students. Furthermore, she showed responsiveness to the lesson flow and the focus of her planned aims, when she gave an example to explain her comment of “I think on my feet all the time.” In Lesson 2, she realised that the characteristic features of one particular bathroom image she projected would be particularly familiar to students from their own home environments. This prompted her, she explained, to introduce and briefly explore vocabulary and emotional reactions which she had not planned.

This investigation of Laura’s teaching, questioning and student engagement strategies in the two observed lessons, concludes this section. The following section examines her pedagogical framework by drawing upon her reported beliefs about the teaching/learning process and her perceptions of the role of ICT.

Pedagogy, student learning and ICT

Using ICT in a cross-curricula approach to teaching and learning to deliver exciting learning experiences for students underpinned Laura’s pedagogical practices. She believed curriculum content and conceptual knowledge should be integrated across learning areas, such as English,

science and history, thus making “your teaching more real and more cohesive for the students to learn”, she said. ICT resources enabled this integration, she felt. The following paragraphs expand upon these pedagogical beliefs through an analysis of her interactions with students and her feelings associated with the use of ICT. Data from the formal and informal observations of lessons, interviews and the teacher’s reflective comments provided the basis for the analysis.

Teaching and learning framework

Laura’s depth of pedagogical knowledge appeared to be considerable. This was evident in the extent of her stated beliefs about student learning and how these were manifested in her practices. The approach adopted by Laura to deliver lessons using ICT, the pace at which she expected her students to learn and the level of sophistication of learning activities typified her practices. It would appear that her reported breadth of experiences in primary and middle schooling were settings in which this knowledge had been accumulated, that is, knowledge about how students learn, the content to teach and successful teaching strategies to use.

During interviews Laura had made frequent reference to her middle schooling experiences and compared these analytically to her current pedagogical approach. In essence she believed that middle schooling was very subject-based, of which ICT was a skills subject, and that it did not lend itself to curriculum integration. Whereas primary schooling, she said, “is all about looking at the child.” The inference here is that curriculum is not the focus; rather the needs of the student become the priority. Her judicious management of curriculum delivery to meet those needs then, it could be deduced, became

her responsibility – a responsibility evident in her practices of integrating science and English for example, and her attention to providing exciting, motivating learning experiences. As she said, “(I’m) “doing something different, which is my aim” and therefore for the students it’s “more fun to learn and that’s my task, that’s what I’ve tried to set out to do.”

Enjoyment in learning therefore directed her teaching approach in an environment where she regarded learning as a reciprocal process amongst students and the teacher. Of particular importance, according to Laura, was active responsive listening on the part of all participants, including her. Examples from researcher observations attested to this. As she explained, “I like listening to the discussions... their answers...they like listening to each other and they learn so much from each other.” Furthermore, her comment that “they gave me much more than I gave them” affirmed her pedagogical beliefs that teacher and students supported one another in learning. To achieve such a tolerant learning climate, Laura encouraged students’ opinions and comments and made explicit how she valued these. Her range of facilitation strategies, which have been described previously in detail, also contributed markedly to the creation and maintenance of such a climate. In addition, she ensured that her own learning was made visible to students by providing them with some of the ways in which she prepared her lessons, for example, in her Lesson 2 key word search on the Internet. This action she also modelled for her students.

There was further evidence of her awareness of how students learn best, in the way she conducted her teaching. She believed students were visual learners and hence they were required to construct diagrams in their workbooks, to respond to digitally projected images and to create their own

digital images, for example, their food webs in Lesson 1. Laura managed the learning environment by engaging the students' interest and sustaining their participation through her demonstrations, explanations and intentions as the lesson unfolded. These occurred while students were simultaneously undertaking tasks and answering a constant flow of teacher questions. In this sense Laura's approach to student learning could be viewed in at least two different ways. Firstly, it could be concluded that she was providing multiple representations of concepts, thus attending to different styles of learning. Secondly, she could also be seen as encouraging students to learn the skills of multi-tasking to increase their rate of learning. Moreover, it seemed that Laura believed that the students would find these authentic learning experiences within an integrated curriculum inherently motivating, give them choice about participation and assist them to feel a sense of empowerment in their own learning. Laura's beliefs were reinforced by the observed enthusiasm of the students, and their high levels of active engagement throughout the lessons. No student was reminded to stay on-task.

Laura showed her understanding of differing abilities, by allowing students to create their own representations of a task, which according to her, encouraged them to use their initiative. It could also be deduced that she was providing for some differentiation in learning outcomes. She liked working with groups of differing abilities, particularly in mathematics, she said, but was concerned that if a student was categorised as weak and placed in a group accordingly, self-esteem would be negatively affected. To overcome this she would pair students who had different skills and they would therefore "learn from each other", she explained.

Means by which student learning was to be assessed were not evident in Laura's planning documentation, though the learning activity aims were clearly stated. Informal assessment was observed in the form of teacher questions and over-the-shoulder monitoring of students' work output.

Features of teacher interactions with students

The classroom learning environment as a whole was characterised by lively and relatively constant teacher talk, questioning, animated student responses and discussion throughout the observed lessons. Freedom of expression was also a hallmark of the learning climate which the teacher fostered as she listened and provided feedback to students' responses and comments. The *community circle* activity referred to earlier is further evidence of such free expression, as well as providing an avenue for student self-assessment.

Laura's expectations of the students were diverse and took different forms. She described expectations of classroom behaviour as, "we don't have rules we have expectations." As discussed above, her teaching approach implied that the students would attend to discussions and be particularly engaged by digitally projected images. Expectations of a good product at the conclusion of lesson tasks, she believed, were the likely outcome of the way her lessons had been structured. The pace at which students worked to complete tasks was an expectation that Laura held as she managed the flow of lessons, for example, by giving time limits and then progressing the lesson delivery.

Personal anecdotes were a feature of Laura's interactions with the students. She related these within the lesson context and in an easy conversational style. Her reasons were that "the kids get to know me and where

I'm coming from." It can be inferred that this was an avenue in which values would be made known, an empathetic understanding of shared experiences implied and one where students were able to perceive their teacher as part of their learning community. Whenever these incidents occurred it was observed that almost all students stopped what they were doing to listen.

Beliefs and feelings about ICT

Fundamental to Laura's teaching was a strong conviction that digital resources and tools should be used. This was encapsulated by her statement, "I can't teach without it." It was due to her introduction to computers at her previous school, some 8 years prior, which changed her teaching, she believed, from where she "felt like I was imparting knowledge" to her current approach where "I'm a lot more of a facilitator," she said. This she avowed, "is where I've seen the beauty of using computers." Throughout the interviews she provided unsolicited detailed examples from her teaching experiences to expand upon her beliefs about technology benefitting students' learning.

The selections of bright, colourful visual images, the possibilities to manipulate these, the power to display a variety of images in a short space of time and to promote student engagement were the most evident reasons why Laura used digital resources and tools for teaching/learning purposes during the observed lessons. By these actions she demonstrated her intentions of motivating students' desire to learn. Her profound acknowledgement of their technological world was further corroborated as she asserted "that's how kids are wired these days. If you're not using it in the classroom, then they're behind already."

In her opinion, she felt that by utilising the students' computing skills fostered in PACE lessons, it was "important to integrate PACE with my lessons, rather than have it isolated", and that this was "a good way to combine ICT skills with the food web (for example)." Learning facilitated by ICT, as she reported, and evidenced in her practice, was not about separating computing skills and topic content, but combining them in a selective, creative way to foster knowledge construction. This approach she believed also enabled students to "learn faster."

The Experience of Change Instrument referred to in the *Methodology* chapter and Appendix L (Ainscow et al., 1995) was also administered to explore feelings which Laura experienced often when using ICT with her students. These are listed in Table 5.6 and are accompanied by some explanatory comments from the teacher.

Table 5.6

Feelings often experienced when using ICT with students

Feelings	Explanatory quotes by teacher
Committed Exhilarated Stimulated Optimistic Confident Valued Comfortable Pleased Satisfied Interested	<i>I became committed, so I taught myself how to use the smartboard when we got the laptops (at previous school) it created exhilaration and stimulation straightaway ... this makes teaching so much more visual for the kids didn't have enough (laptops) but then I became optimistic that it would get better and it did I learned to be confident with what they (the graduates) taught me valued by students and valued by me because I've combined a variety of outcomes from two different subject areas now I feel quite comfortable in class using what I have with how technology can work in the classroom particularly satisfied with lesson (yesterday) because it all worked the way I thought it should creates interest for me and in the work ... what to put up on the screen and what clicks for you ... to go on researching on the Internet ... what things are worthwhile using on the computer and what are not</i>

Laura scored 16 from a possible 20 on this instrument. Her elaborations on these feelings illustrated her very positive attitude towards the use of technology and why she valued its use in her teaching. Her initial enthusiasm

appears not to have waned as she showed a continuing desire to expand her knowledge through her own efforts and to explore how this could impact upon her practice. This commitment would appear to be founded on her beliefs about learning, particularly the appeal of visual imagery and integration of subject content. It seemed that she was discerning in her selection of material to use, by employing her pedagogical knowledge and experience to critically analyse its value to her teaching.

The growth of Laura's attitude to technology and her beliefs about the benefits to her practices can be traced through her teaching and decisions she made about her life experiences. The next section begins with the reasons she gave for adopting her approach to her teaching career and how that career developed. It concludes with the influences which she perceived impacted on the quality of her teaching and how her ICT capabilities improved.

The growth of experience

For Laura to continue her interest in teaching she maintained that it was essential to spend time away from teaching in different environments and to teach in different systems. The influence of these experiences, her feelings about change and its impact upon the teaching roles she undertook are explained in this section.

Teaching as a career choice

Immediately upon finishing her secondary schooling she chose aboriginal, intercultural and religious studies in her teacher training. After her first year of teaching, she completed a degree majoring in advanced dance. She gave a number of reasons for this choice. Firstly, she said, she was a dancer

and wanted to do something different. Secondly, as she was engaged in performances at her then current school, this enabled her to conduct many useful case studies as part of her course requirements.

Teaching role development

Change of year levels and schools was a feature of Laura's first 14 years of teaching. As a classroom teacher at first, her experience was gained in the catholic education system in both primary and secondary schools. On occasions during this time she held acting assistant principal roles. Then for 2 ½ years she travelled in Europe, as a tourist in Canada and in Thailand, where she taught at a college, and later spent short periods of time working in an orphanage.

On returning to Australia she took up a middle school classroom teaching position in a catholic school. After one year she was appointed to middle school coordinator, a role which she said she reluctantly accepted. "I didn't want (it)," she explained. "I just wanted to fade away into the classroom." Her responsibility was to meld the philosophies of primary and middle schooling. It was the introduction of laptops for students and IWBs for teachers at this school that ignited her enthusiasm to change her teaching, she said. As a consequence, her resolution to "make my lessons more visually appealing to the kids today" has become part of her everyday teaching, as evident in her observed practices. However, in her account of her teaching career, she described how she became increasingly frustrated at a lack of change in the practices of the Year 8 and 9 teachers in middle school. In addition, she felt that her administrative role isolated her from what she really enjoyed, and that was classroom teaching. This led to her seeking her current position, she said.

Significant influences on teaching

To gain a deeper insight into her growth as a teacher, a list of apparent influences and significant events was compiled by the researcher from data gathered over the course of the interviews (see *Methodology* chapter). Laura was asked to identify, add or discard, and then elaborate upon those career highlights and experiences which she believed had impacted most upon her perceived level of teaching expertise. Highlights of her career and experiences were categorised and coded for the purpose of analysis. For example, Laura's belief about taking time out from teaching was coded as *Guiding career principle*, while her introduction and response to laptop and IWB technologies was coded as *Contextual learning – as a teacher* (see Table 5.7). Perceived influences are not listed in order of importance.

Upon analysis of Table 5.7, a desire for change and avoidance of boredom, both for herself and that of her students, appears to underpin Laura's reasons for identifying those experiences and events which most influenced her teaching career. In this regard, two significant areas of influence stand out. One is her belief that she needed to seek changes from teaching, and within the teaching environment, to rejuvenate her interest in the profession and to motivate her to enliven her practices. Engagement in experiences outside of teaching and across teaching systems is testimony to this. Furthermore, her perceptions of her own schooling, as being boring at times, served to reinforce her current pedagogical approach of making learning activities interesting and exciting.

Table 5.7

Perceived significant influences on teaching role

Influence	Experience	Explanatory quotes by teacher as benefits to growth
Guiding career principle	Spending time away from a teaching environment	<i>with teaching ...a significant break, not just going to another school ...you become old and crusty ...try something different</i>
	Teaching in different schools and systems	<i>change again ... stop me from getting bored</i>
Leadership role	Creating and managing teams, appraising staff, directing innovative ICT projects as a middle school coordinator	<i>because it was so different ... I think I'm a natural leader that people see ... as soon as you're a leader all your friends are not your friends anymore I was doing a lot of things not related to teaching</i>
Role models	Employing two young graduates	<i>showed me how well they could use Smartboard ...how to get the kids really actively participating in any subject and not making it boring</i>
	Reacting to pedagogical practices of other teachers	<i>like teachers I had when I went to school ...boring to kids ...I don't think these kids would say that I'm boring if things are not totally easy for teachers they tend to give up ...(my style) use what's available and make it work</i>
Contextual learning – as a teacher	Embracing introduction of new technologies	<i>so if we don't keep up with the changes – and they're hard to keep up with ... then we're behind as educators</i>
Collegial	Sharing ideas and resources	<i>much better than (PD) ...watched what they did in their classrooms after school, gave us their resources</i>
	Working as part of a team	<i>important for me to be a better teacher, to be able to work on a team and get ideas from other people</i>

Another important area for her, concerns her belief that keeping abreast of technological change and its associated challenges, is critical to teaching success. She appears to willingly pursue collegial support and learn from others. In her current role, this attitude was evident in the cooperative way the three Year 6 teachers worked as a team in planning their teaching programmes, confirmed by Laura's comment of "our team – sharing (of ideas) rather than competitive." The importance of team work for Laura could also be inferred when appraising her purpose in employing the *community circle* strategy at the

conclusion of each day, where students and the teacher gathered together as a group to share their learning experiences.

Strategies for developing ICT skills

The apparent catalyst, which set Laura on her pathway of passion for technology, was her experience at her previous school. There, Laura reported, all record management was computerised, teachers were given laptops, IWBs were introduced and graduates proficient in their use were employed. The differences in the delivery of the curriculum afforded by the technology quickly ignited Laura's enthusiasm, as there was "always something new to learn," she said. Subsequently she seized every opportunity to acquire and develop her ICT skills, as well as choosing to spend considerable practice time after school.

Numerous strategies were undertaken at that stage of her learning it seemed. According to Laura, she observed primary school teachers modelling the use of IWB software. During informal meetings she listened as teachers explained their practices: "What worked in my Year 2 class", Laura gave as an example. She described how she made notes constantly and asked questions. "I just stayed back at school and practised ...practised and practised", she said.

Laura's opinion of sharing with other teachers, she deemed, was a better way of learning than participating in professional development courses. In her current role she said she was learning about resources relevant to the curriculum through the expertise and advice of the head of curriculum ICT. Other colleagues from whom she learned, were Tonia (Case Study 3), whom she acknowledged was far more technologically proficient, and Jay (Case Study 4), who showed her how to use *Mathletics*.

An indication of her proficiency with ICT can be gained from the computing applications and equipment checklist (ISTE, 2000b), where she scored 33 out of a possible 44. Skills on which she scored the highest were those which she used frequently in her classroom. She showed most proficiency with word processing, email and digital photography. All classroom documentation including reports, programmes and worksheets were word processed, she explained, and communication with parents was by frequent emails. Her hobby of photography, prompted by her travels, had led her to explore the full capabilities of this medium and utilise this in the classroom, she stated. The next highest scoring ICT skills accorded by her were databases, file management and the Internet. In the lesson descriptions earlier, file management and use of the Internet were integral to the successful delivery of the learning activities.

Despite this level of proficiency and her frequent use of digital resources and tools, Laura expressed frustration that she was “losing my skills at the moment” because she had no access to an IWB in her classroom. Nevertheless she was pragmatic and felt she had adapted ideas from this resource to suit the current technology-resource situation. This resource apparently was high on her priority for successful use of technology in the classroom.

This section has dealt with an account of Laura’s teaching experiences, the development of her ICT skills and an analysis of her reported influences impacting upon her expertise. This case study concludes with an exploration of her professional self-esteem and a final summary of findings.

Professional self-esteem

“I’m not brilliant at anything, but I’m quite good at a number of things and OK at other things,” was how Laura described herself. This level of confidence typified her beliefs about her own teaching abilities as she supplied reasons for her teaching approaches in the observed lessons and supplemented these with stories of other practices with ICT. Further corroboration of her confidence was apparent as she recounted examples of the innovations with ICT which she had managed at her previous school. The following paragraphs expand upon her self-perceptions and discuss her professional goals in conjunction with their relationship to her teaching excellence.

Professional goals and teaching excellence

Laura was adamant about her desire to seek ways in which she could “make myself a better teacher.” Change of environments in motivating her to teach appeared most necessary to the achievement of this goal. These included teaching in different systems at different levels, taking breaks from teaching and having other interests outside of school, all of which have been explained earlier. Most recent testimony to the decisions she has made in pursuing changes to her career is her present role as a classroom teacher in preference to her previous management role. As she explained, “(I wanted to) get back into the real nitty-gritty of teaching.”

A significant change, which impacted upon her pursuit of growth and improvement in her teaching, was the inspiration afforded her by the introduction of technology to her repertoire of knowledge and skills, according to Laura. In mastering and utilising this resource, she showed a determination to

succeed and adopted a problem- solving attitude of “go and make it (ICT) work.” This attitude stems perhaps from an underlying drive to be successful in facing challenges and overcoming difficulties.

Proficiency for Laura seemed to be not only synonymous with embracing challenges and facing risks in her teaching, but also in her personal life. In teaching with technology, she was enthusiastic about her exploration of new websites, searching for new ideas and wanting to find different approaches to presenting material to students. This was even to the point of being unsure of desired results, as for example, her Lesson 2 bathroom images and plans illustrated previously. In her personal life she described how she was preparing to tackle an adventure in the Antarctic. It would seem that she enjoyed being excited by confronting, and learning about, some unknown features outside her spheres of experience.

Her excitement in learning was reflected in her strong belief and her practices that the learning environments she created for her students were also exciting. Many examples of this have already been provided. In addition, however, she maintained that her teaching goals were to “allow students time to explore, investigate and draw conclusions.” A high level of facilitation skills, according to Laura, was crucial to effective teaching.

Her professional goals were in part met by attendance at professional development courses in different subject areas. However, these did not include technology.

Recognition of teaching qualities

In at least two of Laura’s previous teaching positions her leadership qualities had been recognised through her appointments to management roles,

as she reported. She believed that she possessed these qualities, yet did not feel she was outstanding in any field and therefore was not desirous of seeking such appointments. Her reasons were that she felt separated from her peers and therefore lost her friends. In an attempt to understand her feelings, a number of possibilities present themselves. It seemed highly important to her to be liked by her colleagues, and in feeling part of a group, that there existed equality amongst its members. A management role set one apart and did not have these characteristics apparently. Her frequent reference to teamwork among her colleagues as necessary to good working relationships and delivery of a quality curriculum also indicates her desire for group membership. This attitude towards teamwork was reflected in her beliefs about students and teacher learning together and evidenced in her *community circle* strategy. Furthermore, it could be concluded that if she felt a sense of equality within a group, her reported reluctance to place students in ability groups was a transference of these feelings.

As a member of the Year 6 group of teachers, she did express pleasure that some of her ideas were used by the other two teachers. So it would seem that she was proud of these contributions and willing to support colleagues, rather than play a leading role.

There was one other particular example of her teaching quality which warrants mention. It concerns her satisfaction with the success of lesson 1 about the food webs and how she adapted IWB software to meet the learning activity objectives. She said she would have liked the principal to be present to witness the lesson, not only to observe her teaching prowess, but also to support her request for the installation of IWBs in the Year 6 area. This opinion

confirms her desire for management to have first-hand knowledge of her teaching practices with technology and to reinforce her judgements about technology.

The aim of this case study was to describe and explore in depth the pedagogical practices, learning experiences and characteristics of Laura with specific relevance to her use of ICT. The following summary draws upon the findings of this particular investigation to illustrate the interactions of features which have led to her present level of expertise. It will not cite examples as these have already been given, rather as the title suggests it is a summary only. Of importance however, is that this summary is also informed by the literature on experts, expert teachers and experts in ICT integration (see Appendices M and N).

Summary

An almost boisterous environment typified Laura's approach in the classroom. This was generated by her energy, dynamism and the visible enjoyment of both teacher and students in teaching/learning with technology. Her responses and comments throughout the interviews were conveyed with this same enthusiasm, yet tempered by an honest, matter-of-fact forthrightness in her self-appraisal.

The inspiration and challenges brought about by Laura's apparent need for change to rejuvenate her interest in teaching, appeared to govern the experiential choices she had made, and planned for the future, in her varied teaching career and adventurous personal life. Maintaining a teaching/learning atmosphere devoid of boredom was her aim. The inclusion of digital resources and tools in her teaching repertoire provided an avenue which met these goals

and ignited her desire to create stimulating and authentic learning experiences for her students. Being cognisant of students' interests and immersion in technology as part of their everyday world, she therefore designed learning activities which motivated and challenged them. Her style of delivery reflected her expectations that technology afforded students opportunities to learn more quickly than without it. She seemed undaunted by any attendant problems which could ensue from creating experiences with a difference. In fact, her attitude was one of determination to understand the problem in order to resolve it. Confidence in her extensive pedagogical knowledge and teaching skills enabled her to deviate from planned lesson development as she perceived the need, yet still adhere to her lesson objectives.

A comprehensive range of teaching strategies was displayed by Laura in the structure of her lessons using digital resources and tools. To excite students, lessons were introduced with digitally-projected images accompanied by teacher talk and a range of questioning strategies. Early in each lesson students were engaged in completing ICT tasks accompanied by worksheet task requirements. Written lesson planning took the form of objectives and tasks within a topic. Stages of delivery were imperceptible as lessons unfolded and objectives evolved, to embed the content of the lesson within the topic and not in isolation. By this form of integration, students could develop deeper understandings of the content, aided by the facilitation and scaffolding strategies employed by the teacher. Thus, although the teacher directed the content, some choices were given to students in the creation of their products, that is, their food webs and their bathroom designs.

Deep representations of knowledge-building by students were made possible, through her role as a facilitator, by activating their prior knowledge, integrating content across subject areas, for example literacy and science, and frequent responsive questioning (Hattie, 2003). Integration of ICT skills with curriculum content and integration of ICT tasks and worksheet tasks further attested to Laura's comprehensive knowledge of curriculum goals. Catering for differing needs within learning experiences she professed was not a strength of hers. However, open-ended tasks provided for differentiation of achievement levels. Her *community circle* strategy contributed to the building of a learning community (Kozma, 2011a), where students and teacher alike shared their knowledge and learning pathways. All contributions were valued without judgements being made. Her respect for students in this way extended to her practice of sharing appropriate personal experiences with them.

Good working relationships were a priority for Laura. Therefore she valued being part of a team and collaborating with her peers, rather than taking on a leadership role, regardless of her belief that she possessed leadership qualities. To advance her teaching prowess she was prepared to learn from her peers and to spend considerable time, by herself, expanding her competencies and knowledge of digital resources and tools. For Laura, technology was the stimulus and the means by which the community of teachers and students shared in developing and creating knowledge as members of society.

CHAPTER SIX

CASE STUDY 3: A TEACHER FOCUSED ON GOALS AND STUDENT NEEDS

This is a case study about a class teacher, Tonia, whose personal goals and experiences with special needs' students were an integral part of her pedagogical practices. The study explains and analyses these goals, experiences and practices, in relation to her personal characteristics, her perceptions of influences and choices she made on her growth of expertise in technology-supported teaching.

Analysis and discussion of the data collected about Tonia through observations and interviews are explained in the detail of this case study which differs in part from the previous two case studies. This is due to her participation, upon recommendations of the school leadership, only in the second stage of the research. However, like Case Studies One and Two, it consists of an examination of the strategies the teacher used in her teaching, questioning and engagement of the students as she constructed, delivered and managed the lesson observed by the researcher. This descriptive analysis leads to an exploration of her pedagogical beliefs and goals, her understandings of student learning and their impact on her teaching with ICT. Finally, links from these are made to her perceived influences of reported experiences on her professional growth and her self-esteem. The final summary includes judgements on the features of her expertness in technology-supported teaching with particular reference to her pedagogical practices, her learning experiences and her personal characteristics.

In the following section a brief introduction to Tonia is made with an overview of data collection procedures. Her classroom working environment and the teaching, questioning and student engagement strategies employed by her in the observed lesson are described. In conjunction with her stimulated-recall reflections of the lesson, its key features are appraised.

Background

“I want to be a teacher of excellence” is how Tonia voiced her career goal. The unfolding of this goal, its development and contributing factors, were gradually revealed during observations of her at work, in conjunction with a range of interviews. A newcomer to the school from New Zealand, she was one of the two younger teacher participants and one of three Year 6 teachers. She was responsible for 24 students ranging in age from 10-12 years, five of whom were considered by the school to have learning disorders.

Due to Tonia’s participation in Stage 2 only of the study, data was collected over an intensive two-week period. A formal and informal observation of her at work was undertaken, together with data gathered using the three-interview set (see Appendices A-H). The formal observation, which was video and audio recorded by the researcher, covered one 45-minute lesson. The informal observation was conducted over a double class period, during which time, only journal notes were made by the researcher. Interviews had to be broken down into five components to accommodate the teacher’s workload schedule, with Interview 3 being conducted over the telephone some three weeks after the formal observation. During this particular interview both the teacher and the researcher had access to the video and audio records of the observed lesson. Despite the necessity to deviate from the original planned

sequence of interviews, their aims were met. Importantly, the researcher ensured there was sufficient flexibility to manage the flow of the content and be responsive to Tonia's comments.

The working environment

The classroom was situated in a cluster consisting of three rooms, one for each Year 6 group and a large open area onto which all classrooms opened. Here a bank of 24 Mininotes were kept. These had to service all 72 students in the three Year 6 classes and teachers were therefore obliged to work closely with one another to roster use. Sometimes changes in programmed lessons were required to accommodate needs and therefore flexibility in sequencing lessons was essential, as students in two of the classes (one of which was Tonia's class) used the Mininotes on a daily basis. Access to a computer lab was organised on a roster basis, usually at least twice a week.

Tonia's classroom was bright and colourful with many displays of students' work and various helpful charts. A whiteboard was situated on one wall and a ceiling mounted data projector linked to the teacher's laptop. Desks were arranged in such a way as to provide a mat area in which a small stand-alone whiteboard was placed.

Construction of observed lesson

The three Year 6 teachers, who planned their teaching programmes cooperatively, selected a theme of visual literacy, in which the observed lesson was embedded. It was selected primarily for three reasons. Firstly, the teachers felt this topic had real world relevance, given society's emphasis on visuals to convey all forms of information in people's personal, social and working lives,

particularly in the persuasive realm of advertising. Secondly, in an education context the teachers believed it would provide opportunities for activities to be integrated across learning areas, notably English and science. Thirdly they felt it would appeal to their students' interests.

In Tonia's teaching programme, this visual literacy topic was part of the English learning area and documented in the form of its curriculum outcomes which she planned to target over a period of four weeks in eight lessons, four of which were integrated with ICT. A copy of this plan was made available to the researcher (see Appendix T). All students possessed their own copy of a sophisticated picture book *The Red Tree* by Shaun Tan. It was used as the given text. The stated topic aims were for students to:

- Interpret and analyse the symbolism of images which conveyed emotional messages and were of cultural significance in telling a story,
- Acquire and use particular ICT skills, and
- Apply these skills in the creation of their visual images and related text.

The observed lesson was lesson 4 in week 2 of the topic plan. The students were expected to make use of the plan they had already devised in the previous lesson on this topic about the re-creation of visual images and refer to visual image features such as colour, clothes and body language. Their task for this particular lesson was to show their interpretation of an image of their own choosing from the book, by importing and manipulating Google images to create a montage effect in a word document. This lesson took place in the

computer lab attached to the library and afforded all 21 students a workstation each.



Figure 6.1 Computer laboratory.

Prior to the commencement of the lesson, Tonia had prepared a visual literacy rubric (see Figure 6.2), which linked to the product rubric she had created on Achievement Standards from the four report indicators of the Australian National Curriculum. These levels were *working towards*, *consolidating*, *achieved* and *highly achieved*. This format was considered by her to be useful in reporting later to parents. She had also prepared her own visual images using the picture on the back page of the text book as an example.

Visual literacy rubric						
Cutting & pasting	Removing background from pics	Bringing images fwd	Sending images back	Use colour	Use correction tools	Images support text

Figure 6.2 Visual literacy rubric.

The next section provides a description of Tonia's management and delivery of the observed lesson. It consists of an overview of the lesson, the

teaching and questioning strategies she used and forms of student engagement noted by the researcher. Firstly, the main components of the observed lesson are set out in table form, followed by brief explanations. Secondly, teaching and questioning strategies and student engagement modes are mapped in separate tables with accompanying examples and descriptions. This data was used to conclude the section where key features of the lesson are summarised and reviewed.

Delivery and management of lesson

The lesson delivered by Tonia had five distinct segments – the introductory segment, three segments comprising the main body of the lesson and the concluding segment. Table 6.1 shows the sequence of these segments, their duration and a summary only of observed teacher and students' actions, as these are elaborated upon in the following sections on teaching and questioning strategies and student engagement modes.

Before proceeding to these sections, the teacher's management of the environment and the lesson time frame are explained briefly. It can be seen from Table 6.1 that each of the three lesson segments 1, 2 and 3 was epitomised by a structured instructional pattern followed by achievement of a task by the students. During the first four minutes of each segment the whole class as a group was seated on the mat while the teacher used her laptop and the data projector to model procedures. The remainder of each segment was utilised by the students working individually at a computer on their own images. For example, in Segment 2 the teacher modelled continuously while explaining why she had created a particular image to convey her intended message, and how to use particular functions to remove a background from her created

image, yet retain some desired features. Task 2 for the students was to duplicate this process with their own images, which they had selected or created previously, by experimenting with the relevant functions to increase their own ICT skills base.

Table 6.1

Lesson sequence of teacher and students' actions

Lesson stages	Teacher actions	Students' actions	Duration
Introduction	Learning outcomes stated Preparation for tasks reviewed lesson tasks summarised ICT context & skills stated Questions asked	Passive A few individual responses to questions	5 minutes
Segment 1	Task 1 explained, demonstrated, modelled Questions asked	Passive A few individual responses to questions	4 minutes
	Assessment undertaken Support given	Students engaged in Task 1 at computer	4 minutes
Segment 2	Task 2 explained, demonstrated, modelled	Passive	4 minutes
	Assessment undertaken Reduced support given	Students engaged in Task 2 at computer	5 minutes
Segment 3	Task 3 explained, demonstrated, modelled Questions asked	Passive A few individual responses to questions	4 minutes
	Lesson outcomes and tasks re-stated Increased support given	Students engaged in Task 3 at computer	20 minutes
Conclusion	Lesson achievements summarised Reflective questions asked	Many individual responses	5 minutes

Teaching strategies

Only Tonia's teaching strategies, which had been observed by the researcher in this lesson, are shown in Figure 6.3. The full list of teaching strategies, where each unit of analysis is explained as a teacher action, can be found in the *Methodology* chapter (see Table 3.8). For example, the first unit of analysis is *Instruction-learning objective* and explained as a teacher action by *Aim of lesson / task stated*. The shaded parts indicate phases in the lesson when particular teaching strategies were observed. Refer to Table 6.1 for the

time frame related to each lesson segment during which the teacher used these strategies.

Teaching strategies	Lesson Development					
	<i>I</i>	<i>Sg1</i>		<i>Sg 2</i>	<i>Segment 3</i>	
Instruction-information / exemplar						
Instruction-learning objective						
ICT instruction						
Explanation						
ICT demonstration						
ICT modelling task						
Prior knowledge activation						
Scaffolding						
Summarising						
Facilitation						
Checking for understanding						
Monitoring learning						
Praise / feedback						
Assessment of learning						

Key. In=Introductory segment, Sg=Segment, C=Concluding segment

Figure 6.3 Range of teaching strategies during lesson

From Figure 6.3 it can be seen that instructions about the lesson learning objective and information about specific tasks within the lesson only occurred simultaneously during the introductory segment of the lesson. Here the teacher stated the overall aim of the lesson in terms of its literacy goals, what was to be achieved, and the literacy and ICT tasks students were expected to undertake. These matched the topic aims which Tonia had recorded in her lesson planning. She described achievement of the objective in the form of task features as a partly repetitive process. Firstly, she told the students that one small chunk was to be demonstrated by her with each student then having the opportunity to practise and accomplish this small task at the computer. Secondly, she explained that this step-by-step process was to be followed as the lesson

progressed. Thirdly, she alluded in general to problems which could arise, and assured students these could be solved with support, if required, and as they occurred.

Instructional strategies on the lesson learning objective were used not only during the introduction and the beginnings of Segments 1 and 2, but also in Segment 3 when the students were working on their own tasks at the computer. Instructional strategies during segment 3 were epitomised by the teacher's intermittent reminders of expected outcomes and of the overall aim of the lesson, as well as providing task specific information. For example, Tonia said,

I'm looking for creativity and I'm looking for originality....don't forget that at the end when you've produced your whole picture you're going to have to write about what it shows...and see all the different features on that visual literacy sheet

And in response to a student question on how to use a particular tool, the teacher gave an over-the-shoulder instruction, allowing the student to carry out the task, by saying "you click off the picture, go to orientation, landscape...there you are ..."

From Figure 6.3, it can be seen that the teacher's use of explanations, ICT demonstrations and modelling of the task followed a pattern, evident at the beginning of every segment. In each case the teacher used a *think-aloud* strategy whilst modelling an ICT task, by explaining her thought processes and demonstrating her actions. Having previously prepared the steps she wished to model, she referred to the text book and the visual literacy concepts in conjunction with one another. For example, during the teacher-directed

segment 1 she explained while she worked: “I decided that I was going to re-create the image from the back page...I wanted to find a bed, a leaf and a tree...so what I did, I went in here and imported...”.

The students’ prior knowledge was activated not only in the lesson introduction but in a number of ways. Firstly, the teacher reviewed the standard school procedure for student action if inappropriate images were found. There was a stated expectation by the teacher that all students would exercise appropriate judgements during their Internet searches for images. Secondly, the students were shown a familiar list of visual literacy features and reminded of the planning they had undertaken in preparation for the lesson, that is, the selection of their book image they wished to interpret and the accompanying text. Here she indicated to the students that they would build on their current computing skills knowledge, use a picture manipulation tool and choose to draw, scan and import their own images if desired, as well as drawing upon their prepared plans. Finally she linked the literacy aims with the ICT aims and described the MS Word tools to be used. Again reference was made to prior knowledge which included stating some problems previously encountered, and through a form of scaffolding how this lesson would overcome these. “I’m going to teach you,” she said.

It can be seen from Figure 6.3 that Tonia’s teaching strategies were similar in the second part of Segments 1, 2 and 3, when the students were undertaking tasks at their computers. Whilst roaming the room throughout this period, she monitored, facilitated and supported the learning of individual students by summarising what she could see on the screen and responding to student questions, by encouraging them occasionally to search for themselves

and to seek the collaboration of another student or view their work. Three different kinds of facilitation are illustrated below.

Firstly, the following example is a dialogue of how the teacher facilitated learning, yet gave responsibility for decision-making to the student.

St: Well, I ..um..was going to make it a bit more like abstract in a way.

T: That's fine. I just was checking to see if you were actually going to get rid of some of those bits.

St: Yair. I tried to get rid of...

T: So if you actually mark areas to keep and actually click on / mark areas to remove

S: OK. Yep.

T: ...but if you want to keep it like that, that's OK.

Secondly, at intervals Tonia suggested ways in which the students could develop their computing skills base, by exploring the functions of the picture tools through experimentation and play. Some of her phrases were: “just (try) trial and error... use the tools that are there and see what happens...you can always undo your work...have a play with those tools...”.

Thirdly she provided students with strategies to consolidate their learning by reminding them to refer to their plans and visual image features whilst working, and to record in their notebooks any changes they had made.

Scaffolding was also a teaching strategy employed by the teacher during the introduction and the beginning of Segments 1, 2 and 3. One example of this

was when Tonia indicated how the new knowledge gained during the lesson could be transferred to more sophisticated manipulation tools and applications, such as Photoshop and Flickr, for use not only at school but in students' personal lives.

Figure 6.3 shows that praise was a continuing teaching strategy throughout the lesson. This occurred whenever the students were engaged in a computing task and after each task had been completed. It was given either on an individual basis or to the class as a whole. Largely it was used by directly relating it to the ICT and topic objectives of the tasks, for example, "I'm very impressed with the way...and (you) remembered that you're not really re-creating the picture, but you're re-creating the text.... really great linking of pictures to text".

Only during the students' computer-work phases in Segments 1 and 2 was assessment of learning in the form of a visual literacy rubric (see Figure 6.2) undertaken by the teacher. With this computer skills checklist in hand the teacher moved quickly around the room recording completion of the task when indicated by each student.

Questioning strategies

Similar to the teaching strategies units of analysis, the questioning strategies were derived from the literature and explained in the *Methodology* chapter on data analysis. Only those observed are listed in Figure 6.4. The shaded parts refer to the period during which particular questioning strategies were used. They do not show the frequency of questions. The complete list of questioning strategies and accompanying explanations to guide coding of teacher verbal data can be found in the *Methodology* chapter (Table 3.9). For

example, a question was coded as *Evaluative* when the phraseology used by the teacher allowed students to make judgments or give opinions based on their knowledge of the facts.

Questioning strategies	Lesson Development					
	In	Sg 1	Sg 2	Segment 3		C
ICT Factual						
Evaluative						
Open						
Closed						
Reflective-interpersonal						
Reflective-content						

Key. In=Introductory segment, Sg=Segment, C=Concluding segment

Figure 6.4 Range of questioning strategies during lesson

ICT factual, open and closed questions asked of the students as a whole group, predominated. They were about the functions of specific MS Word tools and procedural steps to undertake. For example, to open, copy, paste and wrap an image the teacher asked “What will happen if I try to...?” and “Who can remember the short-cut key to paste?” Or about tool functions, she asked, “Who has already seen tools that....?”

ICT factual questions were asked of individual students as they worked or when the teacher responded to a student question during segment 3. Questions such as: “Is that what you wanted? Little bits of background there?”, “Which text are you re-creating?” and “Can you define that more...?” These kinds of questions often formed part of a short dialogue between teacher and student.

Figure 6.4 indicates two forms of reflective questioning strategies used at the lesson conclusion. Firstly, the teacher asked a reflective- interpersonal question “Who saw some (work) that really linked words to pictures?” As

students replied she prompted them to comment critically with reasons on how the images, which they had observed while walking around the room, conveyed the intended messages from the book. Reflective-content was the second form of questioning when the teacher asked students to name three ICT skills they had learnt during the lesson.

Student engagement modes

Student engagement modes were derived from the literature and explained in tabular form in the *Methodology* chapter (see Table 3.11). For example, when students were engaged in sharing knowledge with peers or having done this, coming to a conclusion or making a decision, this was coded as *collaboration*. As for the previous tables on teaching and questioning strategies, only the observed forms of student engagement are shown in Figure 6.5.

Student engagement modes	Lesson Development						
	In	Sg 1	Sg 2	Segment 3			C
Individual responses							
ICT individual task							
ICT procedural skill							
ICT application skill							
Passive engagement							
Collaboration							
Knowledge construction							
Feelings expressed							

Key. In=Introduction, Sg=Segment, C=Conclusion

Figure 6.5 Range of student engagement modes during lesson

It is evident upon reviewing Figure 6.5 that the periods of passive engagement and individual responses to the teacher's questions occurred during the same sections of the lesson. While the teacher was undertaking the

short instructional and modelling sections of the lesson, the students were focused and absorbed in what was being shown on the whiteboard, but were also expected to respond to intermittent teacher questions on the task in hand. Whenever questions were asked, many students were quick and eager to respond. Some example questions have been described earlier in the section on questioning strategies.

Positive feelings expressed by students were displayed consistently throughout the lesson. For example in Segment 3, when some features of picture manipulation were being modelled by the teacher, student reactions were audible and animated, and they responded willingly with a show of hands to indicate they had already discovered something new. In other instances they were eager to show a peer and the teacher what they had achieved, as well as reciprocating interest in their peers' efforts.

Students were encouraged by the teacher to work as individuals; however, there were some occasions during Segment 3 when collaboration was evident. This occurred in two ways. The teacher recommended to a couple of students that they share ideas. Some collaboration occurred on a spontaneous basis between neighbouring peers as students were engaged in individual tasks.

The overall pattern of the planned lesson construction as a step-by-step process, referred to in the section on teaching strategies, is shown clearly in the levels of student engagement periods. Their active participation in constructing knowledge to achieve the computing and literacy objective tasks was always preceded by passive engagement with intermittent teacher questions. In the

latter case students were attending to the teacher as she delivered the requirements of the forthcoming task.

There was no evidence of behaviour management intervention. No student had to be reminded to stay on-task, as all were focused on their work.

Teacher's reflections on lesson

The teacher's overall impressions of the lesson were that she had "explained it really well", the "technology worked well" and she had achieved what she set out to do.

Table 6.2

Teacher's reflective explanations on lesson features

<i>Lesson features</i>	<i>Explanatory quotes by teacher</i>
Preparation and planning	<i>reinforces for me good preparation, good modelling ..lesson went well ..achieved what I wanted</i>
Modelling	<i>pre-empting what we're going to do ..students know the process of one step at a time ...I decided to go back and show (how I arrived at this point)</i>
Differentiation	<i>(task) met all of their needs ..challenged those that needed the challenge, supported those that needed the support</i>
Authentic experience	<i>(students) to be able to go out and read visual images all over ...be able to say what the illustrator is trying to say...all comes into the advertising ... human nature to be intrigued by colour, technology ...</i>
Scaffolding	<i>practice through play, discuss what's been done, learnt, prompting what next lesson will contain ...provide some reflection time ...opportunity to hear other levels</i>
Collaborative learning	<i>they (students) were really the learner but they were also the teacher as well</i>
Monitoring learning	<i>(teacher)standing and watching, giving hints and tips, making notes in my head of who knows what they are doing / might need help later</i>
Higher order thinking	<i>gives them that insight by seeing others work, can help others who are struggling to come up with ideas, reinforces the visual image creation and the message</i>
Assessment of learning	<i>the more complex the picture, the more complex their thinking</i>
Student engagement	<i>(teacher) hoping they would experiment, practice, get the layout of the program ...unusual that every single girl was focused</i>

Table 6.2 sets out a selection of her comments immediately following the lesson and later those made during the re-playing of the video recording. As

she observed the footage, she explained her thinking, her actions and provided insights into the pedagogical approaches she had used.

These observations of Tonia on features of the lesson indicate her pedagogical approach to teaching and technology-supported teaching. Her account of the lesson demonstrated her knowledge of how students learn using ICT by explaining her decisions to use modelling and scaffolding teaching strategies as well as providing opportunities for collaboration. Her views on collaborative learning indicated that she believed learning was a two-way process of students teaching one another and learning at the same time. The relationship she drew between the complexities of students' images and their thinking showed she had a clear understanding of the diverse achievement levels of students. Knowledge of their diverse learning needs was also evident as she described why the task was differentiated and why she provided an opportunity for students to view the work of others.

Tonia's comment about her selection of visual images integrated with ICT as a topic for lesson construction affirmed her deep understanding of the need to relate learning experiences to real-world situations. She believed firmly that thorough preparation when using ICT resources was essential to the achievement of lesson objectives and to the engagement of students.

In reflecting upon the flow of the lesson structure, Tonia explained that she had made one successful change to the original plan. As she re-counted, the lesson had proceeded smoothly with the students demonstrating their acquisition of new knowledge at an earlier stage than she had expected and this had prompted her to add the "view the work of others" strategy with subsequent questions. She believed this was most successful in providing an

opportunity for reflection and promoting critical analytic skills. On the other hand, she felt her intervention strategy of interrupting students at work to call their attention to the picture choices made by everyone, was unnecessary. In her view it did not aid their learning, rather it distracted the flow of their thinking and purposeful activity.

Key features of lesson

Key features in achieving the stated aims of the observed lesson on visual literacy were the preparation and planning undertaken by the teacher and the students, the delivery processes and the variety of strategies used by the teacher to facilitate learning. These will be outlined and interpreted as an integration of the explanatory data on teaching and questioning strategies and student engagement modes.

The comprehensive nature of the preparation and planning for the topic of visual literacy, in which the observed lesson was embedded, was evident in the detailed documentation. As indicated earlier, this included curriculum topic and lesson outcomes, resources to be used, progression of, and sequential steps, within lessons, and assessment strategies. There were two stated major learning objectives for the observed lesson. The first was for the students to acquire and use particular ICT skills. The second was for students to apply these skills in the creation of visual images which reflected their interpretation of the given text. Prior to the lesson, the teacher had made herself thoroughly familiar with the ICT tools which were to be used by the students, had prepared her own visual images and the visual literacy rubric. The students were prepared with written plans in their notebooks about the messages they wished to convey from their selected image in the given picture book.

Lesson delivery was managed as structured repetitive phases. Each phase began with teacher modelling of the ICT tool to be used by the students, accompanied by explanations to the whole group and factual questions about the functions necessary to complete the task. Specific steps towards skill development were modelled by visual displays, explained and reinforced verbally by the teacher. This was followed by a skill development and text image interpretation session where students worked individually at their work station, with encouragement by the teacher to practise, experiment and play. Individualised and liberal praise was given to each student by the teacher, as well as noting achievements on her checklist and again to the group as a whole when they re-assembled. Each phase was repeated twice. About two thirds of the lesson time was devoted to the students undertaking tasks at their work stations. The remainder was led by the teacher.

In order to aid students' construction of knowledge according to her understanding of their differing needs, the teacher differentiated the task in three ways. Firstly, students who had special needs were provided with starting images, rather than finding or creating their own. Secondly, the majority of the class was required to find their own images and use their new ICT skills to create their montage. Thirdly, it was expected that the brighter and more gifted students would be challenged to extend their ICT skill knowledge and be more creative in their interpretation of the text.

Integration was also a feature of this lesson in the sense that both content and context processes were evident. The chosen context of visual literacy as a topic afforded opportunities for students to analyse features which relate to their everyday world and to use the context of ICT in the development

of ICT content skills. Furthermore, the concept/content language of visual literacy and contextual ICT language were interwoven by the teacher throughout the lesson. This integration indicated that the objective in acquiring particular ICT skills was to convey message images which are interpreted and judged in real world contexts.

Scaffolding was a constant feature of the first half of the lesson when frequent reference was made to, and questions asked, at different levels of different students, enabling them to access and build upon prior knowledge. Critical thinking in a supportive environment was facilitated when students viewed the work of others. Finally Tonia made it clear that she also was a learner and had made decisions following her experimentation with the tools.

Although this lesson was largely teacher directed there was some evidence of students having the opportunity to make their own decisions, particularly in the latter part of the activity. Except for the small group with special needs, students were able to make their own choices from the picture book and show degrees of complexity in the creation of their own visual images through Internet searching, drawing and scanning, as well as their own text messages. The teacher also accepted individual variations to the task by some of the more able students.

This now leads to a discussion in the next section on the pedagogical framework which underpinned Tonia's design and management of learning activities, and the part which technology played in her delivery.

Pedagogy, student learning and ICT

The framework within which Tonia designed learning activities was based on her stated pedagogical belief that an enquiry approach was the best

way to engage students in their learning. Here she believed the use of technology and her understanding of student learning were essential in the attainment of learning intentions. An expansion of these beliefs and the characteristics of her interactions with students are outlined below. This is supported by, and reflected in, the observed lesson and interview data.

Teaching and learning framework

To Tonia an enquiry approach meant a safe and encouraging environment where students could discover and construct knowledge for themselves through discussion, interactive tasks and experimentation. This was evident in the visual literacy task where all students' ideas were accepted. They were actively engaged in their learning through practice and discovery by trial and error while using digital tools, as well as demonstrating learning through achievement of tasks and their responses to teacher questions. The activity was managed according to the differentiated needs of her students, whose learning she was constantly assessing to guide her future planning and modify outcomes of learning activities, she explained.

Learning was the responsibility of the students to manage and feel in control of their learning, was a stated belief Tonia held. However, it was observed she used a step-by-step approach to the construction of her lessons. While she accepted input from the students she did not want them to "go off on another tangent" if it appeared her objectives for the lesson were not going to be met. To that degree it can be concluded she was managing and controlling the students' learning pathways. Another example indicating her role as being central to the direction of the learning was near the beginning of the observed lesson when she asserted "I'm going to teach you" In this instance it

appeared her intention related to ICT skills. However, she had previously stated that this particular lesson would be teacher-led and that her plan was to take on a facilitation role with subsequent topic lessons. Students' control of their own learning in the observed lesson was evident when more freedom was given to them by the teacher in their creation of images to reflect their invented texts. It was their decision on how complex these images were, whether they were computer generated, incorporated material from other sources or were hand drawn and scanned.

Features of teacher interactions with students

A calm, relaxed and quietly spoken manner typified Tonia's style in all interactions with the students. "Getting to know one another" according to her was important in her teaching. From a teacher's perspective this meant sharing her own learning experiences, as evidenced in the observed lesson, and personal anecdotes with her students, for whom she expressed a high regard.

Expectations of the quality of work output were clearly enumerated by the teacher, together with defined objectives of the learning activity. This was essential to the on-task behaviour of students, as group work and individualised programs were a feature of the working classroom, where different students were working at different levels and on different tasks within the confines of the subject topic. However Tonia scheduled her time so that she was able to monitor and interact with each student during the course of a lesson. An example was an informally observed mathematics lesson, when small groups rotated on the mat area with the teacher, while others were engaged in working at a task on the Mininotes or on a worksheet.

Beliefs and feelings about ICT

Having grown up with access to computers, technology had become an integral part of her everyday life, Tonia asserted, and therefore she considered it to be “so important...every single thing you do every day basically involves some sort of ICT”. Likewise she believed that her students were equally “savvy with technology”, though in her view, as yet unaware of its powerful tools to facilitate creativity. To support their learning, her students used digital tools and resources daily, which in her opinion should occur in all classes.

A distinct advantage in using ICT with her class, Tonia said, was that many of her students were visual learners. For her students with learning difficulties, she considered ICT to be particularly engaging in its use of colour, its forms of imagery and interactive functions. In addition, she believed all students could produce work at their own level without fear of comparisons being made. In this way their sense of achievement and self-esteem was promoted. In her opinion it was therefore essential to her program that she used digital tools and resources which could accommodate different levels, allowing her to plan for different starting points and learning objectives according to the knowledge and needs of each individual student. The visual literacy lesson had evidence of all these features.

Feelings she experienced often when using ICT with her students were all very positive, except that of frustration, as described in her responses to the administration of the Experience of Change instrument (Ainscow et al., 1995), listed in Appendix L. Tonia’s responses gave her a score of 12 from a possible total of 20. Of interest however are her explanations of these feelings which are set out in Table 6.3.

Table 6.3

Feelings often experienced when using ICT with students

Feelings	Explanatory quotes by teacher
Committed	<i>to what I'm doing, the learning, myself and the girls</i>
Enthusiastic	
Optimistic	<i>that it's going to work out well</i>
Confident	<i>pretty confident using ICT</i>
Supported	<i>definitely</i>
Comfortable	
Pleased	<i>with work produced and the programs we've got access to</i>
Interested	<i>in what is coming next or what the possibilities are with ICT</i>
Satisfied	<i>with work produced</i>
Frustrated	<i>with lack of resources ..21 mini notes for 72 girls not adequate ...problems when they are not working</i>

Although Tonia had expressed frustration at the limited availability of resources her responses indicated that she was confident in her ICT capabilities to utilise existing programs in the implementation of learning activities and facilitate students' achievement of planned outcomes. However this did not seem to limit her desire to extend her knowledge about the future developments of ICT in education and the learning opportunities this could afford her students. Her commitment to her own learning and that of her students indicated a strong belief in the pedagogical practices she had adopted in her teaching role.

This approach to continuous learning leads to the next section on Tonia's teaching and perceived life experiences which impacted upon her current role as a teacher and describes how her ICT capabilities developed.

The growth of experience

Tonia believed that formal study experiences and her approach to learning contributed in part to the growth of her expertise as a teacher and with ICT. The following description of these experiences begins with the background behind her decision to choose teaching as a career, moves on to influences which she believed affected her development as a teacher and concludes with her explanation of what strategies she used to develop her ICT skills.

Teaching as a career choice

Immediately following completion of her high school final exams, which she failed, Tonia said she undertook office work and simultaneously repeated her final school year at a post high school college in New Zealand, attaining excellent grades. Always yearning to be a doctor, she revealed, but now with insufficient grades to undertake university study in medicine and still unsure of a profession, she gained a Bachelor's degree majoring in English. But at the conclusion, she enrolled in further post-graduate studies having by then decided on a teaching career. She said that perhaps this had been influenced in part by the teaching quality and approach at the post high school college she attended, where it was advocated to put failure aside and focus on the job at hand. This choice seemed also to be influenced by the unspoken expectations of her parents and the professional careers which had been chosen by her older siblings.

Teaching role development

Her first teaching position was a split role, where she spent 0.5 time as a class teacher and the remaining 0.5 time as a learning support teacher working 1-on-1 with children who had learning difficulties. As she explained, this led to her involvement in a numeracy project in her second year of teaching. She was given a management role where she supported and gave advice to older, more experienced teachers. Now in her late 20's and her 5th year of teaching, she has been in her current position for just six months.

Significant influences on teaching

The most important experiences which Tonia believed had significantly affected the growth of her teaching expertise were ranked by her from “setting short and long term goals” through to “meeting new teachers and gaining inspiration” which she ranked sixth (see Table 6.4). For the purpose of analysis, categories were devised to code her descriptions of these influences. For example, Tonia’s belief about goal setting was coded as *Guiding life principles*, while the inspirational influence of other teachers was coded as *Collegial*. Ranked below this were two other minor influences which she had referred to, namely her end of Year 12 results and a primary school experience as a buddy, but these were not included in the table. Refer to *Methodology* chapter for background on how this data was collected and coded.

Table 6.4

Perceived significant influences on teaching role

<i>Influence</i>	<i>Experience</i>	<i>Explanatory quotes by teacher as benefits to growth</i>
Guiding life principles	Setting short and long term goals	<i>striving to achieve something new... 1yr, 5yr and 10yr goal setting plans</i>
Role model	Reacting to pedagogical practices of other teachers from own experiences as a student	<i>no looking back (on failure)...here to do a job.... you don't have to be a stranger to your students .. can involve them</i>
Contextual learning – as a teacher	Planning and implementing 1-on-1 individualized programs for students with learning difficulties	<i>gave me an insight into what teaching is all about</i>
Leadership role	Giving advice and support to older, more experienced teachers in the management of a school's numeracy project	<i>a boost of confidence and makes me feel that I'm a very capable teacher</i>
Professional learning	Participating in Numeracy project	<i>this experience makes me a good maths teacher</i>
Collegial	Meeting new teachers and gaining inspiration	<i>gives me a passion to become a better teacher</i>

As can be seen and inferred from Table 6.4, in explaining her reasons for setting both short and long term goals as being of the utmost importance, Tonia also aligned this with her desire to be challenged by new ideas in her learning. This seems to indicate that her goal setting was flexible and open to change, dependent upon the opportunities with which she was presented and which she intended to pursue. Her comments on the type of influence of particular role models were reflected in what she decided to emulate in her own teaching, for example, the way she chose to relate to her students.

Second in importance to her goal setting approach to life and her teaching were the opportunities she'd been given to plan and implement individualised and specialised programs for students. Here, the implications for her teaching practices were that gaining such a depth of understanding about learning needs meant she viewed each student as unique and that she would teach to those diversities.

The additional role of responsibility which she had been given at one of her schools and her participation in associated professional learning she placed high on her list of influencing factors, as both contributed to her belief in herself as being a capable teacher. This external recognition of her teaching capabilities appeared to be needed by her to confirm the quality of the pedagogical choices she made and demonstrated in her practices, as well as providing encouragement to pursue her pathway to excellence.

Again this external influence was evident in her decision to select colleagues whom she felt had affected her development. Similar to the discerning way in which she chose specific characteristics of other role models,

it seemed she may also have been selective in those qualities she felt would inspire her determination to maintain her goal of attaining excellence.

Strategies for developing ICT skills

Experience with using computers began in her early high school years and had been supported by availability of a home computer, Tonia said, and this had formed a basis for her continual learning with, and about, ICT throughout her teaching career to date. On the computing applications and equipment checklist (ISTE, 2000b), she self-reported a high degree of proficiency in the use of slideshow software, email functions, computer file management, using the Internet, digital photography and image editing, with proficiency in word processing, and video photography and editing. Her limited competency in the use of spreadsheets and databases, and knowledge of web authoring, she explained was due to her lack of need for these tools. Her overall score on this instrument was 31 from a possible 44.

With students she reported that ICT was used in a range of learning activities, for example, games, quizzes, research, timelines, charts, posters, Powerpoint, online books, saving/ editing video clips, word processing and most recently tagging using iPods.

To develop these skills and knowledge Tonia said she spent considerable time at home playing and experimenting, as well as researching on the Internet. She felt a strong desire to be constantly aware of new ideas, professed a love for learning new things and wanted to be stimulated by things she hadn't previously encountered, typified by the following comments:

...like to be up with the play...I'm not an expert on everything, but I like to know what's going on (in ICT)...I don't want to feel (behind) with the current technology...I want to be able to use it confidently ...

Thus her competency boundaries were being continually probed and expanded, as she took risks in her desire to overcome the challenges of unfamiliar material and as a learner in isolation. Her opinion was that this was best achieved by doing, rather than being an inactive participant on a course.

Sources of particular value within the school for up-skilling, teaching ideas and resources to use for lessons, she felt, were the deputy head of curriculum ICT and the other Year 6 teachers.

The final section of this account and interpretation of the data gathered about Tonia's teaching practices, before the concluding summary of this case study, deals with an investigation of her professional self-esteem.

Professional self-esteem

Influences on the development and sustainability of Tonia's professional self-esteem could be viewed from many perspectives. In the first instance her professional goals and the importance of recognition of her skill as a teacher appear to be at the centre of her desire to be a teacher of excellence. Added to this was her opinion of the quality of support, management and resources in her current position and how this affected her perceived value as a teacher. These aspects of her professional self-esteem are discussed in the following section.

Professional goals and teaching excellence

Tonia professed that her goal-setting approach to life was fundamental in her approach to teaching excellence. This meant she dedicated herself to the

achievement of short and long term goals and encouraged her students to adopt a similar attitude to their learning. For example, in the observed lesson, having made the overall learning intentions clear, she then reminded students to review their task plans and intentions, modifying them if necessary. Thus she focused their attention on what they had planned to accomplish in the lesson.

For her intentions to culminate in the acquisition of new knowledge or skills she not only had to be self-disciplined, but motivated by a strong belief in her ability to succeed, to face new challenges and take risks in her teaching practices; hence her reported commitment to continuous learning about new technologies and teaching possibilities. With this attitude, she felt she could make a worthwhile contribution to the school and wanted to become more involved with its ICT planning.

Currently in her pursuit of excellence, her goal is to become more efficient in her assessment strategies. She had not readily embraced formal testing as she believed useful assessment was a “snapshot of what the child can do (giving) the right picture”, that is, of a student engaged in learning. This effective method for her was the reason why she had designed and used the rubric as a checklist while the students were involved in their visual literacy tasks.

Recognition of teaching qualities

Confidence was not only mentioned by Tonia in the context of describing influences on her development as a teacher, but on a number of other occasions throughout the data collection period. Even though she perceived herself as being “very energetic...patient...relaxed... adaptable” and having “high level expectations...(being) good at setting routines”, her confidence levels

were affected by how others viewed her. In her leadership role at a previous school she had experienced recognition of her teaching knowledge. In other teaching situations she said: "Every year I've got to work with new people who've really inspired me... new ideas, new approaches, confidence as well because they've really valued what I've done...boost of confidence when someone says *Wow! That's really a great idea!*

While these experiences had positive benefits, her confidence levels at her current school had fallen quite considerably, she admitted. This was due, she felt, to a perceived lack of trust by management in her ability and a lack of support for her ideas. In her view, this had impacted upon her creativity and willingness to implement new ideas, thus restraining her desire for constant improvement of her teaching capabilities.

However, it was reported by the deputy head of curriculum ICT, that at the conclusion of this research study as a result of her participation, Tonia now felt she was a valued contributor to the ICT school program. While this study has no other evidence of her improved levels of confidence, it would seem that for Tonia, recognition of her teaching prowess was an essential motivating factor in the attainment of her teaching goals.

The aim of this case study was to describe and explore in depth the pedagogical practices of Tonia with specific relevance to the scope of her technology-supported teaching. The following summary draws upon the findings of this particular investigation to illustrate the interactions of her pedagogical practices, learning experiences and characteristics leading to her present level of expertise. It will not cite examples as these have already been given, rather as the title suggests it is a summary only. Of importance however, is that this

summary is also informed by the summary descriptors of teacher pedagogical practices, learning experiences and personal characteristics found in Appendices M and N, and Table 3.14.

Summary

Highly articulate, candid and carefully considered comments were typical of Tonia's interview responses as she reflected upon the observed lesson and her teaching career. Her pedagogical practices with ICT were illustrated in her elaboration and justification of her decision-making in her planning, preparation and teaching strategies. These were epitomised by her choice of the digital resources of word processing tools, whiteboard and data projector to plan for the diverse learning needs of her students. Not only was her knowledge of curriculum objectives managed successfully using these tools but their application also provided an authentic context for understanding and analysing visual literacy features and their relationship to the influences of advertising mediums. Expectations of student achievement of lesson tasks varied. For some the starting point was modified. For others, variations of the task were accepted as they managed their own learning by creating and inventing representations of their chosen text image and constructing their own text messages. This freedom of choice allowed students, in part, to follow their own learning pathways and to demonstrate the complexities of their thinking. The supportive environment encouraged them to be challenged in their learning. However, this process was still confined within a set period of time, resource and task-directed framework managed by the teacher.

The pattern of delivery evident in the observed lesson, Tonia acknowledged, was a typical routine she adopted in all lessons, undoubtedly

influenced by her earlier experiences designing individualised programs of work for students with learning difficulties. This background, it seemed, also enabled her to manage simultaneously the learning of small groups and individuals, and to maintain high levels of engagement. Planned differing periods and modes of engagement ensured students were focused continually on the task throughout the lesson. An example of this repetitive process was the ICT lesson where the teacher stated the task intention, modelled it by using a think-aloud strategy, provided practice and experimentation time for the students and then monitored, facilitated and assessed learning.

In addition to the teacher's learning experiences, it would seem that the teacher's own learning strategies and goal-setting approaches, which guided her life, also impacted considerably upon her pedagogical practices. She was an example to her students as she showed enjoyment in the challenges and risks offered by an ICT context, in her choice to improve her ICT skills by experimenting and practising over long periods of time and in setting high expectations for herself in achievement of her goals. All these aspects were embedded within her lesson delivery - evidence of her understanding of the need for students to know about effective learning strategies and setting their own learning goals. Moreover in her choices of modelling her own learning processes and the opportunities she provided to review and reflect upon the work of others, she validated her stated belief that learning with ICT was a shared process.

Her belief that learning and working together was a shared process was further corroborated by the way in which she interacted with the students. Her manner indicated a respect for them as individuals and their needs. A trusting

learning environment was maintained through strategies such as sharing some of her personal, relevant experiences with her students. Another example of this was her stated expectation of students' acceptable behaviour in following the school's cyber safety procedures.

Collaborative learning with colleagues and support was illustrated in two ways. Firstly, she and her year-group peers chose the curriculum topic of visual literacy and together decided upon a subject in which they intended to integrate the relevant objectives and utilise digital resources. Secondly, Tonia relied upon, and sought, the support of the ICT curriculum leader in finding and using appropriate resources, both digital and text-based. Recognition and appreciation of the ICT skills and knowledge of the curriculum leader, as a role model and colleague, also contributed to Tonia's objective of keeping abreast of the latest developments in ICT.

Underlying this objective and her overall attitude to her growth as a teacher of excellence was her strong motivation to succeed in her chosen career. To do this she was dedicated to continuous learning, to seek support from others and appraise critically her own performance. Recognition of the quality of her performance by her superiors seemed necessary to maintain confidence in her teaching ability. Yet she was still adamant in describing herself as enthusiastic and passionate about teaching.

CHAPTER SEVEN

CASE STUDY 4: TWO TEACHERS WORKING AS A COLLABORATIVE TEAM

This case study compares and contrasts the pedagogical practices, learning experiences and personal characteristics of two teachers, Peta and Jay, who were supported by the school in their decision at the beginning of the year to work as a collaborative team.

The data gathered from observations and interviews were used in this process of comparison of both teachers as they worked individually and as a team. Firstly, their stimulated recall reflections of the Stage 1 lessons are used to assist in the exploration of their teaching, questioning and student engagement strategies. This is accompanied by the strategies employed in Stage 2, with particular emphasis on the roles played by each teacher in the lesson management and delivery. Secondly pedagogical beliefs, goals and teaching with technology are examined. This is followed by an investigation of experiences influencing their professional growth and perceptions of their own teaching qualities.

This case study begins with an overview of their working environments. The construction of informal and formal observations of lessons, their management and delivery, including the strategies used by the two teachers, are examined in the light of their similarities and differences. The section concludes with a similar process where the teachers' reflections on the lessons and their key features are analysed.

Background

Similar planning, teaching goals and pedagogical approaches supported by a belief in the value of technology in this process drew Peta and Jay together in this first year of working as a collaborative team with two Year 4 classes, they said. Both teachers had already spent two years at the school in higher year levels and had previously taught elsewhere for three years, though in different systems. Each had experience in using technology for about 20 years, but for different purposes. Almost 20 years separated them in age: Peta was the elder.

Only two Year 4 classes existed at the school. According to the teachers, the allocation of students to each class of 24 was not based on any achievement ranking and therefore they had a wide range of mixed abilities. Students were all girls and ranged in age from 8 to 10 years.

Informal observations were made in each classroom prior to the formal observations in Stage 1 of the data collection. This enabled the students to become familiar with the presence of the researcher and provided useful background data on the teachers' pedagogical practices. Audio and video recordings were planned for the formal observations, but due to a technical failure only video data was collected. However, this was augmented by researcher notes and some elaboration of the post-observation interviews when the teachers viewed the video data only and recalled their actions and those of the students (see Appendices A-H for content of interviews). At the beginning of Stage 2, both teachers wished to be interviewed together in the pre-observation phase, as the classes were to meet as one group in the library space. The observed lesson was recorded in audio and video form. Post-observation interviews were conducted separately with each teacher. About three weeks

after this observation, part of Interview 3 in Stage 2 of the data collection was again conducted separately over the telephone with each teacher. The researcher and the teacher had simultaneous access to the relevant audio and video records for this purpose.

The working environment

The two Year 4 classrooms formed a cluster with two Year 3 classrooms. These four classrooms opened on to a large common area housing an interactive whiteboard and a casual arrangement of some tables and chairs for students. Various spaces were available for students to work on benches and mat areas.

In each of the Year 4 classrooms, where student desks were arranged in groups of 4, a bank of 24 Mininotes was accessible to students whenever they were required. Students were rostered to ensure all Mininotes were charged and ready for use. Rooms were visually appealing with many examples of students' work displayed and numerous teacher-made reference charts. Teachers' laptops sat on their desks and were able to be used to project material on to a whiteboard at the front of the classrooms. Some interactivity was therefore possible dependent on the digital resources selected by the teacher.

Rostered use of the school computer lab was organised at least once a week for their PACE lessons (Providing Academic Challenge for Everyone based on an enquiry approach incorporating cross-curricula activities and computing skill development). These lessons were led usually by Kath and explained in Case Study One.



Figure 7.1 Case study 4 – the working environment.

Construction of lessons

In separate explanations of their programme and lesson planning Jay and Peta were in accord, in that, they planned the aims and goals of their programmes collaboratively and adhered to the same daily schedule of content for every lesson (see Appendix U for teacher plans). This required them to be constantly aware of the progress each had made on a weekly basis, though usually this communication occurred daily, they said, before commencing on plans for the following week. “We’ve found that weekly planning is better because we can go from what we’ve achieved to...,” said Jay.

In Stage 1 of the data collection, one informal observation and one formal observation were made of each teacher at work in her classroom. The informal observations were conducted during the first hour of a teaching day. These were followed by the formal observations of a mathematics lesson on chance and probability (referred to as Lesson 1).

Team teaching, when both classes were combined either in the cluster open area or the library spaces, was also informally and formally observed. A

lesson on problem solving was observed informally in Stage 1 and a formal observation of an environmental crime scene investigation called *Murder under the Microscope* (referred to as Lesson 2) was made during Stage 2 of the data collection.

Peta's Lesson 1 with her class was the first in a two-week investigation of chance and probability in mathematics. Prior to the lesson, the teacher explained that the aim was for students to develop and demonstrate an understanding of the language of chance words, for example, *likely*, *unlikely*, *possible*, and *uncertain*. Jay's Lesson 1 with her class took place on the following day and was the second in the two-week investigation of chance and probability in mathematics. As explained earlier, Jay had already conducted the first lesson on this topic on the previous day to coincide with Peta's topic introduction. Jay's objective, she said, was to build on her students' knowledge of probability language and to provide experiences in which they were required to apply their understandings in different contexts. The teachers had jointly decided they would use learning activities from *Scootle* and *Rainforest Maths* digital resources to facilitate students' concept development. These resources were aligned with the Australian National Curriculum and as the school was trialling the Mathematics Curriculum, they were deemed by the teachers to be most suited to their purposes. Similarly, they had both emphasised that constant use of language and multiple representations of concepts were necessary to achieve their aims.

Lesson 2, the planned team teaching approach, was the second lesson in the *Murder under the Microscope* online environmental game which the developers asserted had been mapped against the Draft Australian National

Science Curriculum. In the pre-observation interview which was conducted simultaneously with both teachers at their request, Jay described how this resource was linked to curriculum subjects of English, science and mathematics, as well as involving students in the PACE program. The task was to find the villain, the victim and the crime site. A further aid to the solving of the mystery was a set of ten quizzes on different topics related to the environment. Apart from exciting students' interest, according to Jay, the aim of this lesson was for them to gain an understanding of environmental topics, to use key word Internet searches and to work collaboratively in mixed ability groups. Achievement of these aims was planned through some explicit teaching, modelling, analytical strategies to use in assessing clues and discussion on trustworthy Internet sites, she summarised. Peta did not proffer any additional comments on their plans or clarification, except briefly when prompted by the researcher.

The next section begins with an overview of the delivery and management of the mathematics Lesson 1, as each teacher worked in her own classroom. It is followed by a comparison of their use of teaching, questioning and student engagement strategies in these lessons, and their stimulated-recall reflections. The team teaching roles adopted by Peta and Jay, their actions and strategies are then examined through the crime investigation Lesson 2. Next, the teachers' reflections of Lesson 2 have been used to make further comparisons on their pedagogical practices. The section concludes with a summary of the key features of the lessons and on the teachers' roles when teaching in their own classroom and when team teaching.

Delivery and management of Lesson 1: Own class teaching

Peta sat on a small chair at the front of the classroom with the whole class grouped around her on the mat area, as she conducted the first part of lesson 1 on chance. As stated earlier, this lesson was the first of a planned set on this topic of probability. Chance language words were introduced by her, and blackboarded on a number line, by using examples relevant to students' interests and experiences. For example, Peta asked: "What would be the chances of a train driving through the middle of the playground?" Students were required to provide reasons for their decisions. The teacher often repeated their responses, which were liberally praised. A short session followed in which Peta used *Hot Maths*, a digital resource, to project probability examples on the whiteboard. Options were discussed through the use of concept vocabulary and judgements made by the students for the teacher to input their responses to check for the correct answer. Students were enthusiastic with this feedback and at one stage shouted, "Yes!" In pairs, students then worked with event cards, in the form of a competition, to sequence events according to their probability of occurring. The lesson was concluded by the teacher as she summarised students' responses, sought their opinions and checked for understanding.

Jay's began her Lesson 1 on chance, the second in the set on this topic, by reviewing chance vocabulary through questions to students, seeking their explanations and placing the relevant words in sequential order on the board. A group of students then modelled this sequence by physically placing themselves in a line while the teacher asked questions and summarised responses using concept vocabulary. She then used probability examples from *Scootle*, a digital resource, to project these on to a whiteboard, while modelling

the concept on an imaginary number line with herself and another student. This was accompanied by teacher questions, seeking predictions from the students and providing feedback through explanations and summaries. Students spent the last part of the lesson using their Mininotes to work individually on different levels, according to teacher directions, with a set of chance learning activities from the digital resource *Rainforest Maths*. The lesson concluded with student pairs facing one another while they explained what they had learned. Finally the teacher used a digitally projected image as a focus for a last set of questions on probability, to which many students were enthusiastic in their willingness to respond.

The most marked difference between the two lessons was the amount of time each teacher used digital resources. Students were exposed to technology for less than one third of Peta's lesson. In contrast, Jay's lesson utilised technology for two thirds of the time. Both teachers used their chosen digital resource in the first instance with the whole class to assist in the development of students' concept knowledge. Later in the lesson, Jay chose to use a digital learning activity for individual students while Peta's students worked in pairs with a non-digital resource (the event cards) to further develop and demonstrate their new knowledge.

A further difference between the management of the two lessons was the pace which the teachers adopted to progress their objectives. Peta spent considerably more time on focused discussion with the students in the introductory stages of the lesson than Jay. "I don't like to rush through," explained Peta, with a preference for "not sticking to a schedule" when she deemed her planned pace of the lesson was not matching student

understanding. On the other hand, Jay said, “Girls can dawdle ...had to move on.” Nevertheless Jay stressed that she would follow-up with some students in subsequent lessons to ensure understanding.

The next section compares the teaching and questioning strategies used by Peta and Jay and describes how the students were engaged while the teachers were working in their own classrooms.

Teachers’ strategies and student engagement: Lesson 1

Teaching and questioning strategies were coded according to the units of analysis and their corresponding descriptions, which can be found in the *Methodology* chapter. For example, when an achieved task, or one to be undertaken, was reviewed or a student response re-worded, this strategy was coded as *summarising*. An *open* question referred to one where many answers were possible. When students in pairs faced one another to share their knowledge or explain their understanding, this student engagement mode was coded as *pair collaboration*. Only those strategies which had been observed by the researcher are shown in Table 7.1, Table 7.2 and Table 7.3. A frequency count was not made, as it was felt that noted instances from lesson 1 and the informal observations provided sufficient examples, in conjunction with other evidence, for further analysis of the teachers’ pedagogical practices.

As shown in Table 7.1, both teachers used ICT to model chance concept language as they projected examples of probability events in the second part of their lessons. This was managed with the whole class. However, Jay made further use of technology when students proceeded to work on individual tasks with their Mininotes. Instructions were given on task requirements and navigational procedures demonstrated. In addition, when Jay was monitoring

students' learning she noted their degree of success and speed of responses in order to instruct some students to increase the level of difficulty within the activity.

Table 7.1

Range of teaching strategies during Lesson 1

Teaching strategies	Peta	Jay
Instruction- learning objective	x	x
ICT instruction		x
Explanation	x	x
ICT demonstration		x
Modelling of concept or task	x	x
ICT modelling of concept	x	x
Prior knowledge activation	x	x
Scaffolding	x	x
Summarising	x	x
Facilitation	x	x
Checking for understanding	x	x
Monitoring learning	x	x
Praise / feedback	x	x

Concept language was emphasised by both teachers in the introductory stages of the lesson through explanations, drawing upon students' background knowledge to scaffold their learning and to use authentic examples within the students' experiences. Concept development was further promoted through modelling, a strategy also listed in Table 7.1. Furthermore, Peta and Jay both illustrated concept vocabulary through diagrammatic representations, affording opportunities for facilitation of learning and summarising. Jay selected students to create a concrete representation by using themselves as models, whereas Peta chose to generate further blackboard examples.

Questioning strategies used by the teacher were similar, as shown in Table 7.2, except for the type of reflective questions.

Table 7.2

Range of questioning strategies during Lesson 1

Questioning strategies	Peta	Jay
Factual	x	x
Inferential	x	x
Evaluative	x	x
Open	x	x
Reflective - interpersonal		x
Reflective - content	x	x

The reflective – content questions asked by Peta were aimed at students assessing their own understanding of chance events. For example, students were asked to describe an event which was *unlikely* to occur. Conversely, the teacher described an event and students were required to choose the correct chance vocabulary to decide on its probability. Jay’s strategy was also to select events requiring students’ opinions of their probability, but her events were digitally projected. Immediately prior to this Jay had used a reflective – interpersonal question as she requested students to sit knee-to-knee and tell one another what they had learned.

Factual questions were infrequent and only occurred in the introductory stage of the lesson. For example, Peta asked, “Is today Sunday?” Inferential and evaluative questions, however, were common throughout the lessons of both teachers. These often took the form of “Why? Why not? Why is it an even chance?” In these ways teachers were constantly seeking reasons for students’ choices. “Oh no! That couldn’t go there because...” is one example of a student response to these types of questions.

Table 7.3 illustrates how the students were engaged in their learning during Lesson 1.

Table 7.3

Range of student engagement modes during Lesson 1

Student engagement modes	Peta	Jay
Individual responses	x	x
Whole class responses	x	x
ICT individual task		x
Group task with roles		x
Pair collaboration	x	x
Pair collaboration task	x	
ICT procedural skill eg. navigation		x
Knowledge construction	x	x
Feelings expressed	x	x

It can be seen that no periods of passive engagement were noted. Although both teachers directed their lesson through explanations, as indicated earlier, these were interspersed with questions used to promote discussion of conceptual language. Hence the listening time of students could be considered as thinking time and not passive inactivity, as the teachers were expecting responses.

Some differences were evident in the methods the teachers adopted to facilitate student engagement in their learning. Jay used a greater variety of concept representations to engage her students. Firstly, she assisted a group of students to place themselves on an imaginary probability continuum. Secondly, she projected digital images for student interactivity. Thirdly, she afforded opportunities for individual students to demonstrate their own knowledge when they were engaged in their individual ICT task at a level suited to their abilities. The difference in Peta's choice of method was to organise pairs of students to

undertake a collaborative task with the event cards. The only instance of collaborative learning in Jay's lesson was at its conclusion when students were requested to share and explain their new knowledge to their partner.

In both classes students were vocal in their enthusiasm for arriving at computer-generated correct judgements on the likelihood of the projected event occurring. This was evident in occasional clapping and shouts of joy for choices made by their peers and through class consensus. Peta and Jay had expressed pleasure in teaching mathematics and it could be concluded that the students' high levels of engagement were a reflection of the teachers' delivery of the lessons. They exuded energy in their speech and manner, showed a lively interest in students' responses and mirrored students' excitement.

Teachers' reflections on Lesson 1

Further insights into the teachers' pedagogical practices were sought through post-observation interviews when they reflected upon the course of their lessons and described judgements about their methods of delivery. This interview data was complemented by the teachers' observations and commentaries about their lessons when they were asked to recall the reasons for their actions as they watched the video recordings of Lesson 1. All of these interviews were conducted separately with each teacher.

Evidence of their reflective analysis which best epitomised features of their pedagogical approaches has been shown in Table 7.4. Comments were categorised according to particular lesson features which had been determined by an analysis of teaching strategies aligned with pedagogical theories on student learning (see *Literature Review* chapter, *Student-centred teaching implications*). A selection of the teachers' quotes illustrates their explanations of

Lesson 1. These were used to examine the similarities and differences between Peta and Jay, when teaching their own class in the chance lesson.

Table 7.4

Teachers' reflective explanations on features of Lesson 1

Lesson features	Explanatory quotes by teachers	
	Peta	Jay
Preparation and planning	<i>my objective (reached)... them to be exposed to chance language</i>	<i>I achieved what I set out to do ... nitty-gritty planning better on my own</i>
Modelling	<i>wanted to get them physically to stand up, but ran out of time</i>	<i>it's definitely modelling ...like I did up on the board ...deconstructed</i>
Differentiation	<i>making tasks open-ended, so students can make it involved or as simple as they are capable ... their own events were good</i>	<i>ones I told to move up (a level) were ones I knew who could handle it</i>
Authentic experience	<i>do try to have fun with them, but I think about real situations ...using words in everyday language – kids use it, live it</i>	<i>doing the Rain Forest activity ...they need the concrete, but for the purposes of applying the language</i>
Scaffolding	<i>(teacher) talking about scenarios, not giving answers ...seeing if they could make a decision themselves</i>	<i>get them to use the chance words which we'd learnt previously and apply in a new setting ...connecting with previous lesson so they know it's all related</i>
Collaborative learning	<i>work well together ...do a lot of paired / shared</i>	<i>common for students to help each other ... promote that a little ...sharing their responses with other people</i>
Monitoring learning	<i>language they used particularly when I was walking around</i>	<i>to see if they could carry over to a different context ...if they really understood the context</i>
Higher order thinking	<i>girls giving excellent reasons (for choices)</i>	<i>asking questions that would make them think</i>
Assessment of learning	<i>happy with learning outcomes ... confident to put hands up (so I could) gauge knowledge of concepts</i>	<i>looking who's putting hand up for right answer and who is not ...keep in mind those students for next lesson</i>
Student engagement	<i>(students) talking and doing so much more productive</i>	<i>show that they are all engaged eye-to-eye, knee-to-knee ... everybody was participating and doing</i>

Table 7.4 indicates some commonalities in the comments made by both teachers about the reasons behind their teaching practices in Lesson 1 on chance. They expressed satisfaction with the lesson outcomes, thereby confirming their choice of teaching and learning strategies. Peta elaborated on her level of satisfaction, though not illustrated in the above table, by relating comments which her students had made the whole day following the lesson. An

example she gave was her students saying, “That would be unlikely wouldn’t it, Mrs H?”

Their understanding of the importance of language in the facilitation of student learning was demonstrated by their repeated reference to concept vocabulary and its use in everyday settings. The modelling of contextual language, the monitoring of learning by posing frequent questions and their emphasis on students being active through discussion and working together, are some examples.

These were not the only reasons that questioning, discussion and cooperative learning seemed important to Peta and Jay. They both had similar views on the need for students to construct their own knowledge, rather than through teacher direction. For example, Jay stressed that she used strategies to enable her students to be thinking and participating actively by *doing*: Peta said she also wanted her students to be *doing*, as well as making their own decisions.

A further similarity between the teachers was their reliance on students making a show of hands and their responses to teacher questions, in order to gauge student understanding. Once again, this was also an indication that language played a crucial role in the delivery of their lessons.

The next section begins with the teachers’ perceptions of team teaching in order to establish a background upon which the lessons could be analysed. It then examines the informal observations of the problem solving activity and Lesson 2 formal observation on the environmental crime investigation when Peta and Jay were team teaching.

Delivery and management of lessons: Team teaching – teachers' perceptions

In all areas of the curriculum, Peta and Jay shared the planning and production of written documentation, as evidenced by their identical programmes of work, their weekly schedules, their day-to-day timetables and their explanations of the content. According to the teachers, they took responsibility for different subject areas, depending upon their strengths and interests. For example, Peta had a particular interest in science she said, and this not only led to her major input in planning but also sometimes she took the lead role in the delivery of lessons in this subject.

Both teachers expressed a high degree of satisfaction with their decision to team teach. Their reasons for this appeared to differ and provided some insight on their views of what team teaching entailed. Peta's explanations were centred on teaching styles and personalities, while Jay spoke of approaches to planning and pedagogy.

A distinct advantage of team teaching according to Peta was for students to be exposed to two teachers with different styles, yet perceived by the students as having the same levels of responsibility for facilitating their learning. "She's a brilliant teacher!" she said of Jay admiringly. In Peta's opinion, they were both perfectionists though with different teaching approaches, remarking "I like to have fun with teaching...(but Jay) is more serious." She felt it was most beneficial that they had a dynamic exchange of ideas and held similar beliefs about the value of ICT in their teaching / learning programme.

"I think it works brilliantly," was Jay's opening remark on team teaching. "We want to plan in the same detail." In her view, this suited her because she

needed a lot of detail in order to direct her strategies and focus on her aims. She believed they shared similar pedagogical viewpoints and it seemed to her that they had comparable methods of achieving planned outcomes. As confirmation of her confidence, she described how this was evident in practice when either teacher was leading a lesson, by saying, “we kind of can switch over and jump in.” Like Peta, Jay also felt students benefitted by their exposure to two teachers, saying “they get two teachers for the price of one,” but she did not elaborate upon this statement.

Delivery and management of lessons: Team teaching – lesson descriptions

Only an overview of the problem solving activity and of Lesson 2 stages accompanied by brief teacher actions, teaching and questioning strategies was compiled. It was felt that this approach would enable a useful comparison to be made on the roles played by Peta and Jay in team teaching situations, given that their teaching and questioning strategies had already been detailed for Lesson 1. Before presenting this analysis, the activity and Lesson 2 are briefly summarised below.

The problem solving learning activity was conducted in the cluster open area. Instructions were given by Jay. Both teachers then modelled how to share knowledge when working with a partner. Mathematically-based problem cards were distributed to student pairs, who followed this collaborative learning strategy to arrive at a justification of their solutions. No ICT was used in this lesson.

Lesson 2 was conducted in the open area of the library space. The two classes of students were grouped together on the mat for the first 45 minutes of

the lesson which was led by Jay. Online clues in the form of text, visual images, MMS, voice and email messages about an environmental crime were projected and discussed with students. The final 15 minutes of the lesson, prior to its brief conclusion, were spent by students working with Mininotes in groups of 4 or 5. Jay nominated two students from each class to a group and gave them a different environmental topic to research for answers to quiz questions. Topics were on climate change, sediments, nutrients, run-off, land use, salinity, water temperature, accidents, vegetation and storm water. Each topic contained 10 multiple choice quiz questions. One pair of students within each group used a Mininote to access their allocated quiz questions from the online program *Murder under the Microscope*. The second pair in the group used their Mininote to conduct Internet searches for information which aided the group to answer the quiz questions. Students were told that at the conclusion of the lesson, groups would share their results, as the collective answers were needed to solve the mystery. Kath, the ICT curriculum leader, was present during the lesson.

Teachers' actions and strategies: Team teaching

Table 7.5 summarises lesson stages from the introduction through to the conclusion and sets out the actions and strategies employed by both teachers. Lesson stages were not determined on a time basis, but on evidence of perceived segmentation of the lesson development, as observed by the researcher. There was no discernible Segment 2 stage in the problem solving activity, therefore it was left blank.

Table 7.5

Sequences in lessons and teachers' actions and strategies

Stages of lessons	Teachers' actions and strategies	
	Peta	Jay
Introduction	Modelled pair collaboration with Jay Problem cards distributed	Attention strategy to introduce lesson Task instructions given Modelled pair collaboration with Peta Open questions asked Problem cards distributed Task instructions repeated
	Key words put on board	Attention strategy to introduce lesson Digital information shown: ICT instruction & demonstration strategies Closed & open questions asked Explanations and summaries given Kath input invited & given
Segment 1	Learning monitored, understanding checked, feedback summaries given by discussing, questioning, using concept language as student pairs worked	Learning monitored, understanding checked, feedback summaries given by discussing, questioning, using concept language as student pairs worked
		Digital information shown: ICT modelling strategy of concepts Closed and open questions asked Input from Kath facilitated
Segment 2		
		Students' group task given: ICT instruction, demonstration & modelling of concepts strategies
Segment 3	Summarising, facilitation, checking for understanding & monitoring learning as student groups worked on ICT task	Facilitation & monitoring of learning as student groups worked on ICT task Input from Kath valued
		Praise and feedback given
Conclusion		Problem solving strategies solicited. Open questions asked: Reflective-interpersonal
		Open question asked: Reflective content

Key. Problem solving activity =



Lesson 2 =



It is evident from Table 7.5 that the roles played by Peta and Jay were noticeably different. Jay took charge of the delivery of the problem solving activity and Lesson 2, despite in the latter instance being ill. Peta's role in both the activity and Lesson 2 fluctuated between that of an observer to a team teacher (Piechura-Couture, Tichenor, Touchton, Macisaac, & Heins, 2006). She only took an equal role, as a team teacher, in facilitating student learning during the problem solving activity when students were working in pairs and at a similar stage in Lesson 2 of the cooperative group learning activity. Peta's

observed actions and strategies indicated that she seemed to focus more on clarifying students' understanding by asking questions, listening to, and building on students' responses. For example, she asked: "Are there other parts to it (the question)? Read on a little bit more." This was followed by listening to students' discussion, making a suggestion, allowing an incorrect quiz response to be made and then drawing students' attention to the guiding instruction she'd given previously. During students' group work, the problem solving activity and Lesson 2 were no longer teacher-directed and there was freedom for both teachers to make their own choices on the roles they wished to play, independent of one another.

Except for a brief part of the introductory stage of the problem solving activity when Peta was invited to model a pair collaboration strategy with her, Jay did not provide any opportunities in her management of Lesson 2 for Peta to contribute. This was in contrast to Jay's involvement of Kath, who was encouraged by Jay to relate some personal experiences and relevant content knowledge during Lesson 2. In addition, it was observed that Jay relayed her advice to students about a useful strategy in answering quiz questions. It seemed that Jay valued Kath's contribution in preference to Peta. Perhaps this deference was due in part to Kath's position as the school's respected ICT curriculum leader. Nevertheless, the disparity remained between the contributions of both classroom teachers, who had said prior to the commencement of the lessons that they would be team teaching.

Teachers' reflections on Lesson 2

The same basis exists for the collection and analysis of data on the teachers' Lesson 2 reflections as for those on Lesson 1. These have been

explained previously. Of interest now are the perceptions of the two teachers as they recalled their reasons for the actions and strategies they had employed during the course of the lesson – see Table 7.6.

Table 7.6

Teachers' reflective explanations on features of Lesson 2

Lesson features	Explanatory quotes by teachers	
	Peta	Jay
Preparation and planning	<i>would have liked more participation in that lesson I would be more liberal with sharing time in front of the girls ... students see reciprocity between 2 teachers responsible for learning and not just 1</i>	<i>Generally pretty good It (the lesson) wasn't done as well as I would have liked it to be done ... (if not sick) would have engaged more with the kids in the second half</i>
Modelling		<i>modelling for them what to do</i>
Differentiation	<i>weaker student should have been sitting in a different position ... had it been me – beforehand would have (students) write down meanings of words ...</i>	<i>(some) have difficulty with that ...vocabs a bit more sophisticated for Year 4 in a lot of this</i>
Authentic experience	<i>making a web(about the clues) in my classroom like a real crime scene</i>	
Scaffolding	<i>would have liked students to do more research on given topic before the quiz ...important for students to learn searching skills</i>	<i>revision at the start ...old connection thing</i>
Collaborative learning	<i>encouraging students to listen more to one another</i>	<i>didn't like the way (some of the) students worked together</i>
Monitoring learning	<i>I could see that some were not doing what they were supposed to be doing</i>	
Higher order thinking	<i>encouraging them to look a little bit deeper into it</i>	<i>questions to help students assess more subtly-presented information</i>
Assessment of learning	<i>(I wanted to see) are students just clicking on any old answer?</i>	<i>none for this lesson ... just anecdotal observations</i>
Student engagement	<i>Students were really loving it so I'll help to get to the next question</i>	<i>built up a lot of student engagement (in introduction stage)</i>

After prompting, and with a reminder from the researcher that all material was confidential, Peta was forthcoming in her reflective elaborations on the conduct of the lesson. Only a brief selection of her full explanations has been shown in Table 7.6. Conversely, Jay's comments were short, particularly in comparison to her reflections on Lesson 1, when she provided detailed

descriptions of many of her actions. This difference was despite Lesson 2 data being collected from Jay at Stage 2 in the later telephone interview when she was no longer ill.

It can be seen that both teachers expressed dissatisfaction with the delivery and management of the lesson but from different perspectives. On the one hand, Peta's comments stemmed from her feelings about her lack of participation in the lesson delivery. Jay, on the other hand, spoke of her illness impacting upon her perceived success of the lesson.

"Normally we team teach. I know the program competently, confidently," Peta said. She could not understand, particularly in view of Jay's illness, why her participation had not been invited or discussed. Nevertheless, she had apparently not initiated any planning to be involved prior to the lesson commencement. This stance appeared to corroborate the reasons for her earlier lack of contributions in the pre-observation interview. She explained that she has a dislike of interrupting when someone else was talking. Her main Lesson 2 concerns were about the strategies which could have been employed to facilitate student understanding, such as, language support through scaffolding and appropriate group dynamics for collaborative learning.

"If I'd been not so ill I would have managed better," Jay said about her lesson delivery, indicating this was not her planned intention. In particular, she referred to her perceived low level of engagement with the students and the working relationships of some groups as unsatisfactory. Yet, this did not affect her overall positive impressions of the lesson. She believed that the "intro went quite well", because she modelled the steps for an investigation by researching and retrieving information. In this instruction period, her opinion was that she

was “driving everything really.” Her expectation of Peta, when asked by the researcher, was that Peta would act as a facilitator.

Another example of a different viewpoint Peta had on the success of the lesson was the worth attributed to Kath’s trial and error intervention strategy. This had been endorsed by Jay and mentioned earlier in the description of teachers’ actions and strategies. Peta disagreed with this strategy as she felt that “not a great deal of learning (occurred) ... you don’t keep guessing until you get it right” and in her opinion the investigative process had therefore been lost.

There was an awareness of both teachers on students’ needs, as illustrated in their reflections, though again their perceptions of useful strategies differed. One example demonstrates this. According to Jay, her reason for reading on-screen text was to assist those students who might find some difficulties with understanding some of the vocabulary, as it could be “sophisticated for Year 4”: Peta believed that students would have been “so much more productive in their investigation” if strategies had been devoted to developing understanding of unknown words. In this example, it appeared that Peta’s aim was to attend to individual needs, whereas Jay did not identify particular students’ needs and adopted a whole-class approach.

Though no example has been provided in the table above, both teachers believed the amount of time allocated to lesson segments was a factor in determining the lesson’s success. For example, the quiz section of the lesson was not concluded as planned. As a direct consequence of this and Jay’s absence from school due to her illness, Peta described how she took the initiative and delivered the follow-up lesson with both classes the next day. In her account, she ensured that “(students’) literacy, their problem solving skills

(and) ability to analyse the questions” established the background for successful achievement of planned outcomes. “It was excellent!” she said. By this action, she had seized the opportunity to put into practice those teaching strategies which she felt had been lacking in Jay’s delivery of Lesson 2.

The comparisons made between Peta and Jay in the descriptions and analyses of their lessons are now followed by a concluding overview of common and distinguishing key features of their observed teaching practices.

Key features of lessons

Key features of the observed lessons are summarised in relation to the similarities and differences between Peta and Jay when they had responsibility for their own class and when they were team teaching. Most significant were their team teaching roles, ways in which ICT was used to facilitate student learning, the delivery of lessons, the teachers’ emphasis on concept language and their management of learning activities to promote students’ enjoyment in learning. Comparisons have been made in the following section by referring to the teachers’ pedagogical practices and their stimulated-recall reflections on the lessons.

Both teachers believed that team teaching benefitted their students, though Peta’s comments were more insightful as she referred to the teachers’ different styles and expressed great admiration for Jay’s teaching qualities. There was agreement about the advantages of sharing the responsibilities of delivering lessons, planning programmes and maintaining identical weekly schedules. Attention to detail in planning, Jay felt, was an approach they had in common. This cooperation made efficient use of their time in managing the demands of the curriculum, they stated. However, in practice, there was an

inequality in their roles during the immediate pre-lesson planning and delivering of the observed lessons. Jay took control, while Peta, on her admission, acted as a reluctant observer for most of the lesson and was not in accord with some of the strategies Jay used to facilitate student understanding. No prior planning of their team teaching roles had occurred.

In teaching their own classes, there were many similarities between Peta and Jay as they facilitated students' construction of knowledge. Links to content knowledge through the acquisition of vocabulary was made explicit in their planning documentation across all subjects. A feature of their mathematics lessons was their repetitive modelling of language in context. They embedded concept vocabulary within digital resource activities, provided examples of meaningful experiences for discussion, asked many questions and re-worded students' responses.

Concept representations were varied in the mathematics lessons. Both teachers provided multiple concept representations to facilitate student understanding, though Jay utilised technology to a greater degree. For example, she projected digital images for whole class interactivity and provided a digital resource learning activity for individual students. Other measures she adopted were the construction and de-construction of a number line on the board and by ranking students physically. Peta's concept representations did not include the ranking of students nor individual use of a digital resource learning activity. However, she chose the paired collaborative event card activity as a further strategy to demonstrate understanding.

The provision of multiple representations of concepts also meant that lesson segments were varied in form and duration, ensuring maximum student

engagement. According to both teachers, their purpose was to make their students think, whilst enjoying their learning through doing. This was particularly evident in the enthusiasm generated by the teachers' management of the predictive content of the probability examples which were digitally projected.

Student understanding was of paramount importance to Peta. This was demonstrated by the pace at which she conducted the mathematics Lesson 1, and her assessment of the crime investigation Lesson 2. In the former instance, she spent considerable time on discussion and therefore had to forego the use of the planned individual interactive learning object. With Jay's absence from school following Lesson 2, Peta recounted how she chose to repeat this lesson to ensure, in her view, that every student had a clear understanding of the environmental topic vocabulary and had achieved the desired outcomes. Her comment, "we can't move on until we've got the foundations squared away," encapsulates this aspect of her pedagogical approach. In both lessons, Jay on the other hand, progressed the class as a whole according to her time plan and lesson segments, gave students time deadlines to complete their tasks and was sometimes frustrated with students who were not keeping pace with the lesson as she delivered it. For example, in Lesson 1, she said she was vexed by some students who couldn't log on, and that one student "spent most of the lesson doing her homework and not doing the lesson which was also frustrating."

The preceding sections on the similarities and differences between the practices of Peta and Jay in their own classroom and team teaching settings have now been concluded. This method of comparison is continued as their pedagogical frameworks and their perceptions of ICT are explored further in the following paragraphs.

Pedagogy, student learning and ICT

The pedagogical frameworks of Peta and Jay were underpinned partially by their beliefs about student learning. Peta's delivery of learning activities, she said, was guided by her view that successful learning stemmed from "our own belief in ourselves." For students to "see it and do it themselves," said Jay, was the basis upon which she managed her teaching and learning environment. Both teachers felt that technology enhanced student learning. However, digital resources and tools did not appear to be an integral component of Peta's plans and Jay indicated she chose technology whenever she believed its use was the best method to facilitate learning. A comparative analysis of these pedagogical beliefs, the teachers' interactions with students and their feelings about ICT now follows. The analysis is supported by the informal and formal observations of lessons, the interviews and the teachers' reflections.

Teaching and learning frameworks

Both teachers asserted that the rationale for their curriculum planning was largely driven by their trialling of the National Curriculum content, particularly in the areas of Mathematics and English. Peta believed that this was made easier for both teachers because they were new to teaching at the Year 4 level and therefore did not have to re-learn curriculum material they had taught at previous levels. In the implementation of the curriculum, language played a central role in the teaching practices of Peta and Jay, as described previously in the analysis of lessons. This took the form of questions, with or without the use of ICT, teacher summaries and discussion.

The significance of language was accompanied by the emphasis the teachers placed on active engagement as an optimal requirement of the learning climate. Peta's view of engagement and student learning was centred on discussion. The Lesson 1 observations confirmed this, as did some of her opinions gained during interviews. "Talking is super-important... for girls to discuss the topic from their level of understanding is always relevant," she said. Furthermore she maintained that she was "very much into self-discovery, self-questioning... how and why questions by the teacher," which could build confidence in their abilities and therefore facilitate the growth of students' self-esteem. Jay's emphasis was somewhat different. A variety of engaging activities was demonstrated in her Lesson 1 confirming her pedagogical assertions that "doing (was) fundamental" to her practices. She elaborated by saying, "if the kids aren't doing it themselves I don't think it's going to be as powerful as it could be." Thus the hallmark of assessing the success of active engagement for Peta was the quality of discussion, while for Jay it was the act of doing.

Strategies which provided for cooperative learning in pairs or small groups were employed by both teachers, as described previously. In these examples, students were placed in situations where they had to explain or justify their learning. There was no evidence to indicate that the cooperative learning environments included the teachers as learners, even though Peta said that "we enjoy the learning journey with the girls." This seemed like an expression of enjoyment, rather than the teachers' own learning being made explicit.

There was awareness by both teachers of differing students' needs. It appeared that Peta's approach to catering for her students' differing levels of knowledge and styles of learning was founded on her belief that "(we) all learn very differently... every student can bring something to the table". For example, it was observed that in Lesson 1 she provided multiple representations of concepts as described previously, Furthermore, in both Lessons 1 and 2, she listened to students' contributions and identified those individuals who needed support She also indicated that she was willing to seek support from the school's literacy and numeracy specialists to assist in her differentiation planning. Jay however, professed that differentiation was not a strong point of hers and explained how she tended to move through the lesson even if she was aware that all students were not keeping pace with her instructions. This aspect of her pedagogical approach, with an example, has been detailed previously. Nevertheless, Jay did cater for differing achievement levels by using the stages of the *Rain Forest* digital resource during Lesson 1. Her encouragement of peer support in this lesson, she said, also enabled her to attend to weaker students.

Features of teachers' interactions with students

The teachers' energy and lively delivery of their lessons was reflected in the enthusiastic engagement of their students. However, there were some differences in the apparent rationale for the methods they chose for interacting with their students.

Peta appeared to have a more relaxed manner and share a joke with her students. It was also observed that she was prepared to follow a particular line of discussion which interested her students even if it deviated from her initial

plan and took additional time. “I always believed that if you give kids an opportunity they can do it. I don’t put a cap on anybody,” she said.

On the other hand, Jay was quite workmanlike in her manner. In her words, this enabled her to “take them from point A to point B.” She expected students should “know they’re here to do a job”, as she was to do her job, she believed. Control was a word she used a number of times in her interviews, though on the first occurrence she tempered her use of this word by an elaboration of her intended meaning. She referred to her expectations of students in terms of class rules and explained that the students had devised these, with the most important being “Try our hardest and have fun.”

Conclusions can be drawn from these examples of the differing rationales the teachers had in creating the learning environments in their classrooms. For Peta, it would appear that through an enquiry approach and discussion, she fostered an environment where boundaries to learning were limitless and only defined by the capabilities of her students. On the contrary, it could be inferred that Jay seemed to be task oriented and orchestrated a learning environment which had defined boundaries within which both teacher and students had clear roles and expectations of one another.

Beliefs and feelings about ICT

Peta and Jay shared many common beliefs and feelings about the use of digital resources to benefit student learning. Of most importance, was their enthusiasm for constant use of technology in their teaching, which was influenced strongly by their students’ high levels of engagement, obvious enjoyment in the learning process and awareness of the world in which they lived and learned. Teachers made statements such as “kids engage

easily...they love it... one reason to keep going with it.” However, Jay’s practice, according to her, was governed by finding “opportunities to use it.” This could be an indication of her lack of knowledge or experience about technology-supported teaching as defined by this research study.

Both teachers were of the opinion that using technology should enhance a lesson. For example, Peta said it “enhances learning experiences of students” and Jay said she would “use the technology to enhance what they’re doing in a better way.” Furthermore they both believed it should be used to meet lesson objectives, that is, purposeful use or if they deemed it to be a better choice of tool than other available methods. Therefore, it could be concluded that the teachers did not believe that students’ access to technology tools was always essential to the success of their lesson deliveries.

According to Peta, instant feedback for students and her perception that proficiency in the use of technology was desired by her students, were further advantages. In the latter instance, she held a similar view to Jay, who also maintained that the development of students’ skills should be woven into lessons as required. The PACE lessons illustrate this approach. In addition, both teachers provided details of how they developed students’ skills and knowledge of particular computer functions when they were engaged in using digital resources, for example, teaching students to use the menu bar competently.

Peta also felt the plethora of digital-based resources made her planning much easier as she didn’t have to conceive and create scenarios. Her programme of work illustrated this organisational benefit. She described many

examples of work-related tasks, such as using spreadsheets for assessment and creating power point presentations for lesson deliveries.

An important aspect which Peta identified as being beneficial to student learning was the potential of technologies to enable her “to address lots of different learning styles.” She quoted an instance, where she connected a variety of technologies to deliver a recent science lesson about flower structures. The lesson began with a short DVD video, followed by a Power Point presentation. She described how she had created a cloze activity related to the presentation and finally students were required to draw a diagram to show their concept understandings. “They’re the things I like to use,” she concluded, “because I’ve covered the topic well.” This report of a lesson also provided evidence of her earlier emphasis on language. It also showed that she used digital resources in the organisation of the lesson, but not for students’ active use.

Technology has “got to be just another tool,” declared Jay. “It’s a fantastic tool for modelling!” Evidence of this use was observed in her mathematics and crime investigation lessons. For example, she used a digital resource to simulate a range of probability events, which made efficient use of her time. As students predicted outcomes she modelled their responses utilising the same resource while summarising verbally the subsequent visual images. Students were then able to use these strategies later when they worked alone on their *Rain Forest* activity. Her goal, she stated, was for students to develop a competent computing skills base and adequate decision making strategies to choose when and how to employ technology tools within a learning activity.

Another dimension to the beliefs and feelings Peta and Jay held about technology was explored through the Experience of Change instrument (Ainscow et al., 1995). Details of this instrument and its administration are to be found in Appendix L and the *Methodology* chapter. The following analysis was based on the feelings they often experienced when using ICT with their students. A summary of their explanatory comments can be found in Table 7.7.

Table 7.7

Feelings often experienced when using ICT with students

Feelings	Teachers' explanatory quotes
Committed	<i>because of value in it</i> <i>Definitely committed to using technology with the kids ...not something I'm going to forget about</i>
Enthusiastic	(card chosen, but no comment made by Peta) <i>like using it ... keen to know more ...keen to see where we can go</i>
Exhilarated	(card not chosen by Peta) <i>I find it exciting and enjoy using it with the kids</i>
Optimistic	(card chosen, but no comment made by Peta) <i>I'll start (here) ...I just hope it works ...can all get (logged) on ...not wasting time ... time spending to log on almost hindering their learning (that) on the whole they'll get better (technically)</i>
Confident	<i>using new programmes, doesn't scare me ...</i> <i>in using technology ... don't have any worries</i>
Stimulated	<i>in what they (students) are doing</i> <i>something I find engaging ... engaging too for the kids</i>
Supported	<i>By (Kath) particularly ...ask for something (you) generally get it</i> <i>(Kath) is fantastic ...for resources ... technical guys' response is quick</i>
Valued	(card chosen, but no comment made by Peta) <i>I think (it's) valued that I'm using technology</i>
Comfortable	(card chosen, but no comment made by Peta) <i>I'm comfortable trying new things</i>
Pleased	<i>Generally pleased with outcomes, though sometimes frustrated with outcomes ... not enough time</i> <i>With what I've done in the past</i>
Interested	(card chosen, but no comment made by Peta) <i>always had an interest in technology to enhance what they're doing</i>
Satisfied	<i>when I can see students are interested</i> <i>mostly satisfied ...some things frustrate me</i>
Pressured	<i>maybe it's my perfectionism. I'd like to achieve more, no one puts pressure on me, I put it on myself</i> (card not chosen by Jay)

Key. Peta =



Jay =



From a possible total score of 20, Peta scored 18 and Jay 20; scores which endorsed their very positive feelings and comments, referred to previously, concerning their beliefs about technology benefits. Other beliefs and feelings about ICT were illuminated upon examination of some of their comments. For example, it can be seen from Table 7.7 that both teachers expressed high degrees of confidence. Their own levels of confidence corresponded with their feelings about the value of technology in the teaching / learning process – student interest and engagement being paramount in their practice. A contributor to the quality of their practice was the support they attributed to Kath, the ICT curriculum leader. In considering Peta's feelings of pressure, it would seem that she was consistently reflecting upon her teaching performance with a goal of self-improvement. Jay's optimism appeared to align with her feelings of confidence, not only about her own skills, but revealed also her desire for improvement of students' skill levels.

This confident attitude to the use of technology in their teaching was found to have originated in their early, though different, experiences. The next section describes these experiences, the motivational factors which affected their choice of teaching as a career and their perceived influences on its growth.

The growth of experience

Different pathways led Peta and Jay to teaching. Although two decades separated them in age, they each had taught for a period of five years up to the period of this research. A further similarity existed in their choice of commerce as a career upon graduating from high school. However, the arrival at a similar point in their current teaching role and development of their ICT skills, followed dissimilar experiential pathways. These are compared in the following

paragraphs, as well as the changes they made to progress their professional growth.

Teaching as a career choice

Peta chose accountancy as a career which she pursued for about 20 years, before deciding she was no longer enjoying it and was bored. Although Peta gave no further reasons, it seemed that for her, teaching provided the prospect of a very different environment, offering the excitement of challenge and change. Her emphatic comments about the wisdom of this choice were mirrored in her observed enthusiasm for teaching.

Jay deferred her university choice of commerce study and undertook a gap year working for about 7 months in Canada with children as a babysitter, originally because she needed the money. This experience with children had a strong influence on her choice of careers, she explained. On her return to Australia she resolved to become a teacher, explaining that commerce was not the profession she wished to follow because she believed it would keep her desk-bound and inactive.

Teaching role development

Few changes had occurred in the teaching careers of Peta and Jay. Both had made only one change in the schools at which they had been employed. Peta had some previous experience in the state's education system before moving to her current school in the private sector, thus giving her exposure to two different education systems. Jay's only experience was in the independent school system, as her previous employment was at the independent school which she had attended as a student. Nonetheless, both teachers sought

change in their current school by requesting a different year level, as well as, a change in their teaching roles, that is, from an independent classroom teacher to that of a team teacher.

Significant influences on teaching

From Interviews 1, 2 and 3 which had been conducted by the researcher, some data was gathered about the possible events and experiences which had influenced each teacher's professional growth. The information was written on two set of cards by the researcher (see *Methodology* chapter for further details of this data collection and analysis process). The teacher placed one set of cards in chronological order and the second set in rank order of importance. Table 7.8 below shows the ranking accorded by the teachers, accompanied by some of their explanatory quotes.

Table 7.8 shows, in the first instance, there were two influences which they did not have in common, namely, professional development and contextual learning as a teacher. Professional development, that is, the experience of teacher training, was nominated only by Peta. It seemed that this knowledge of theory contributed to her desire to gain a deep understanding of individual differences and the confidence to put this into practice, as noted earlier in the lesson analyses. From interview data it had appeared that Jay would rank her university studies as a significant experience when she made remarks such as, "absolutely loved it... different to the way I was taught...a lot of student-centred... taught us how to teach ...did a lot of things on cooperative learning." Furthermore, during the interviews she had proffered details of the opportunities afforded her at her current school for professional development, the encouragement she was given to attend such courses and the considerable

benefits she had gained. However, she chose to discard these experiences in her final ranking of perceived significant influences on her professional growth. She may have viewed them as expected and ongoing contributors to her teaching practices, rather than viewing these experiences as unique in their importance to her growth.

Table 7.8

Perceived significant influences on teaching role

<i>Influence</i>	<i>Experience</i>	<i>Explanatory quotes by teachers as benefits to growth</i>
Guiding career principles	Desire for career change	<i>I thought ... good idea ...best thing I ever did ...I love it ...I really do</i>
Contextual learning	Embracing technologies	<i>I needed to be doing something more interactive and with kids ... seemed to come naturally</i>
Professional learning	Training as a teacher	<i>fell in love with it ... gaining knowledge of value</i> <i>it's part of their world ... bring that into the classroom ... these girls will need these skills at Uni and to go into their chosen field of expertise</i>
Collegial	Sharing ideas Working as part of a team	<i>as a student ... school ...was very much technology forward</i> <i>always been a big part of ... how to get things done</i> <i>it's the world they live in, so I need to be presenting information in that way because they are so used to it</i>
Contextual learning– as a teacher	Utilising advantages of one-to-one laptops in classroom	<i>I can really understand different learning styles and different approaches that way because of the theory.</i> <i>(being) part of a really good team</i> <i>...teachers here are fantastic</i>
		<i>(advice to) take on a learning area for that year, do that really well</i> <i>we are working really well as a team</i> <i>you've got two heads writing programs, planning</i> <i>sometimes work really well on my own (at previous school) teaching in Year 6 which was one-to-one</i>

Key. Peta =



Jay =



Another category in which the two teachers differed was contextual learning, as distinct from professional development which referred to training undertaken in a formal way through seminars or courses of study. It could be

concluded that Jay's experiences with laptops for every student had not only given her the knowledge and skills to manage learning activities with digital resources, but also a desire to push the boundaries of this type of technological support for student learning. Her ideal environment, she explained, would be to have an interactive whiteboard and a tablet where student learning was made more visible to others as a shared, cooperative experience.

Peta and Jay held similar perceptions about their reasons for embracing technologies, as noted in Table 7.8. Their adherence to utilising technologies in their teaching programme was not only due to their own enjoyment, but also to their awareness of its importance in students' everyday lives.

Although both teachers had listed collegial experiences as being significant, their examples differed. As volunteered team teachers it was expected that they would refer to the cooperative value of working with one another. Certainly Jay did, but tempered her comments with an expressed desire to also work alone at times. This was not the case for Peta, who did not mention being influenced by Jay, but acknowledged the value of the support and sharing of ideas found in the broader teaching community of the school.

Strategies for developing ICT skills

As described previously, the two teachers attributed their confident management of technology to their extensive use over a prolonged period – Peta from the beginning of her career in accountancy and Jay from her high school years. In their teaching, this knowledge was broadened firstly by their use of technology tools for work-related tasks. These encompassed electronic forms of their programmes and extended to such tasks as using spreadsheets for assessment, organising digital resources into zip files for ease of location /

sharing and managing students' work through shared drives. Secondly, they described how they sourced a raft of digitally-based learning objects by spending large amounts of time searching Internet sites, such as *Scoutle*, and seeking ideas from Kath, the head of curriculum ICT. As Peta said about Kath, "(I go) to someone with more experience than I have."

Their account of one particular learning strategy provided more insight into how they actually spent time increasing their technology skills. Confidence to learn alone and master unknown resources was a strategy they had in common. As Peta explained she was comfortable to "investigate by myself...go to the Help button...I play, I play...I'm curious I guess...I love to learn new things." Jay said, "if I want to look for something, try and find it for myself first."

Given their lengthy use and knowledge of technology tools, it was expected that the teachers would obtain high scores in the computing applications and equipment checklist (ISTE, 2000b). From a possible total of 44, Peta scored 40 and Jay 38.

Peta self-reported high levels of competence in using word processing, spreadsheets, databases, slideshow software, email, computer file management, the Internet and image editing. Her proficiency in digital photography and video photography and editing she rated almost as highly. The only exception was web page authoring because she said she had "never tried to build a site." Practical examples she gave to illustrate her proficiency were putting together Power Point presentations for science, graphing in Excel, using spreadsheets for checklists and the school management system. Currently she was focussing on mastering the school's *Study Whizz* program which was in the

early stages of school implementation. It aimed to allow teachers to put all student assignments online and make them accessible from home.

Jay self-reported levels of competence in the use of computer applications and equipment were similar to Peta. Skill in digital photography, Jay said, had been gained through a close friend whose profession was photography. She cited an example from her previous class where her students had taken photographs of 3D unifix models in mathematics to facilitate close examination of the different faces. Jay described how it was important for her to have her digital resources well-organised by using desktop shortcuts and the control panel to connect to networks. She made a further reference to her use of technology tools to assist in the organisation of her programming. It was common practice for her, she said, to use spreadsheet functions, including conditional formatting for recording assessment data and organising this information to assist in her planning.

The pathways and strategies which Peta and Jay chose in promoting their professional knowledge and ICT skills, together with the influences they believed had impacted upon their current levels of expertise, have been described in this section. An examination of their professional self-esteem in their journey towards excellence and a final summary of findings conclude this case study.

Professional self-esteem

The professional self-esteem of both teachers differed in the perceptions they had of themselves as teachers. Peta focused on the range and depth of her affective qualities tempered by recognition of her teaching prowess. Jay

seemed more concerned with the credibility of her performance as a competent teacher.

“I judge myself,” stated Peta as she evaluated critically her own performance. This comment was later illuminated by her introspective approach to understanding the reasons for her teaching performance when she said, “if you know your way of thinking ...” Other descriptions of herself included remarks such as “I’m a perfectionist”, asserting that she was enthusiastic, passionate and “an absolute expert on all the theory”. In addition, it appeared her self-esteem was also nourished by external judgements of her teaching qualities. Two examples are cited. Firstly, she described how school awareness of her expert knowledge and love of science had enabled her to mentor other teachers, whom she believed had a high regard for her as a teacher. “I think, they think I’m pretty good,” she commented. Secondly, at the conclusion of her interviews she asked the researcher if she was “doing a good job”. Critical analysis of herself in these ways indicates the strength of her self-efficacy beliefs. These were evident in her in-depth self-analysis revealing her high levels of confidence and motivation to achieve excellence in her teaching (Pajares, 2002; Stoeber & Rennert, 2008).

“Every year I’ve felt like I’ve been more competent,” said Jay. She elaborated upon her self-perception as she explained how she had focussed on gaining proficiency sequentially in one learning area at a time. This advice had been given to her early in her career. Using this approach as she gained experience and knowledge, she felt “a bit more in control...not the right word, but competent...doing the right thing.” She also expressed a desire to appear confident about her work when addressing her colleagues in a professional

setting. For example, most recently during the absence of the school's ICT curriculum leader, Jay was given the responsibility for technical support. She appeared to be proud of this role and believed the appointment was because of her level of technical knowledge. Her positive feelings about her ability to fulfil the role were confirmed, she felt, by the ease with which her colleagues approached her to help solve their technical problems. These remarks appear to imply that her expectations of external standards and how others viewed her performance were factors which contributed to Jay's levels of self-esteem.

In summary, it seemed both teachers held strong self-efficacy beliefs, that is, judgements made about themselves to direct their performances (Pajares, 2002). Peta's focus was founded on her affective state, that is, an intrinsic awareness of her characteristics which motivated her desire to achieve. On the other hand, Jay's frame of reference appeared to emanate from social persuasions, that is, a desire to gain mastery of her performance as judged by others (Pajares, 2002).

It was apparent that both teachers regarded themselves as highly proficient and confident, not only in the use of technology, as described previously, but also in their overall performances. The following paragraphs provide further insights into these characteristics through an exploration of their professional goals and their motivation for seeking professional excellence

Professional goals and teaching excellence

A desire to engage in continuous learning, particularly with and through technology, epitomised the approaches adopted by the teachers in their aspirations for excellence. Both Peta and Jay voiced a commitment to improving their skills and knowledge with a clear aim of benefitting student

learning. Their striving for teaching excellence, they believed, would never cease.

Curiosity and the challenge of new ideas, according to Peta, were motivating factors in her learning. To be “a good teacher” and “see that I’ve made a difference” were her considered aims. In pursuit of these aims, she said, “I never switch my brain off from work,” and asked herself “am I good enough?” or “is there a better way?” This attitude was reflected in her expectations of students and her creation of the learning environment. She reported that she constantly sought ways of encouraging students to value learning as an intrinsic motivator. In this regard, she vowed that her “biggest goal (was for students) to finish the year with a really strong belief in themselves.” Self-esteem, according to Peta, was critical in the learning process. Therefore her stated aim was to acknowledge often the individual achievements of her students and provide learning experiences where success was likely. It appeared then that her goal of generating students’ self-esteem and thereby progressing their achievements had a reciprocal benefit for her of sustaining her own beliefs in the quality of her teaching.

In summarising her professional goal of improving her teaching, Jay affirmed she wanted “to be the best teacher I can be” and declared “I don’t think I’m ever going to get to a point where I think Yep! I’ve got it.” It was a practice of hers, she said, to constantly learn new things. An example she gave was her current focus on learning how to cater for the differing needs of her students, by tailoring her planning. Participation in professional development courses appeared to be a useful learning strategy for her, as mentioned previously.

This case study compared and contrasted the teaching frameworks of two teachers working as a collaborative team within the context of their uses, attitudes and beliefs about ICT. The following summary is based on the findings of this investigation which revealed the similarities and differences in the interconnectedness of their professional knowledge and practices, their approaches to professional learning, and the influences of their personal characteristics. Examples of these have been given throughout the case study and will not be cited again. Of importance however, is that this summary is also informed by Appendices M and N, and Table 3.14 on teacher pedagogical practices, learning experiences and personal characteristics respectively.

Summary

As a professed collaborative team, Peta and Jay appeared to have different forms of trust and confidence in one another's capabilities. Planning and writing term programmes of work for their respective classes and agreement on learning outcomes from their joint first-time exposure to the curriculum for this year level was a valued cooperative task by both. This extended to sharing identical and detailed weekly schedules, the creation of test material and selection of some ICT resources, all of which contributed to their efficient use of time.

Although they reported that they liaised in the delivery of lessons when both classes were combined, this was not evident to the researcher. Jay took the leading role and dominated the instructional process. Perhaps she perceived herself as the content expert (Piechura-Couture et al., 2006), particularly in Lesson 2, and was desirous of colleagues and the researcher observing her teaching prowess, given her acknowledged expertise with

technology. Peta on the other hand was mainly an observer and only shared the facilitation roles when students were working in pairs or groups. Her decision to re-teach Lesson 2, in her view, was due to her dissatisfaction with the students' non-achievement of the original learning outcomes. Nevertheless, both teachers stated that their decision to work together and their working relationship was advantageous to them and their students.

Commonalities existed in the strategies used by both teachers to facilitate learning, develop student understandings and accommodate different learning styles. Foremost was their constant use of language, which was embedded in the teachers' multiple representations of concepts across learning areas of the curriculum. Representations included digitally projected pictorial and text images, oral examples from teachers and students, diagrammatic physical illustrations and active engagement of students responding to online quizzes. Within these representations, language was consistently an integral part of the teachers' repertoire of strategies, for example, repetitive modelling, discussions, summaries of students' responses, activation of students' prior knowledge, questioning and explanations.

Few strategies for meeting the differing needs of students were dissimilar. Peta drew upon learning theories from her teacher training and was confident in providing open-ended tasks for her students, for example, the events card activity in Lesson1. Recognising her limited skill in catering for students with differing abilities, Jay used her knowledge of digital resources to assist her in this aspect of her Lesson 1 delivery. She chose a learning activity which consisted of varying levels of difficulty and matched the progression of students according to their achievement levels.

Cooperative learning by sharing responses and the monitoring and assessment of student learning by observation were pedagogical practices the teachers had in common, though they differed in their rationales. In Peta's case, because non-judgemental discussion of topic exploration by teacher and students was a critical component of her lessons, learning was seen as a shared process. A show of hands indicated to her that students were confident to respond. Thus the provision of tolerant learning environments where all responses were valued, and confidence promoted, were manifestations of her beliefs and practices about the pivotal role played by self-esteem. She believed it determined success in learning for students and for her progress towards excellence in her professional journey. For Jay; a show of hands in response to a teacher question meant knowledge of a correct response. Responses to specific teacher questions also indicated to her whether students' depth of conceptual understandings had enabled them to transfer their knowledge to different contexts, for example, the Lesson 1 chance activities. In addition, she often chose to use a pair-share activity to observe and listen to students' explanations to one another as a measure of their learning. These examples confirm that her practices are founded in her beliefs that learning is progressed by the students' active engagement of *doing*.

Prolonged use and practice of ICT over time by both teachers had led to their high levels of confidence in using digital resources and tools for a broad range of work-related tasks. This background, their knowledge of the curriculum and pedagogical strategies had established their firm beliefs that their selective use of technology benefitted the learning environment. Peta and Jay recognised that technology was an integral part of their students' worlds and provided

authentic, challenging and visually engaging experiences, for example, the environmental crime activities.

Strong commitment to the achievement of high standards in their teaching and a love of their chosen profession were characteristics shared by Peta and Jay. Both teachers were highly motivated to continuously improve their performance and did not place limitations on the time they spent learning. They enjoyed the challenges of new technologies and what these had to offer in their teaching / learning environments. Even though some of their pedagogical practices and the rationale for successfully achieving learning objective aims differed, they appeared to have mapped out a mutually acceptable collaborative approach to team teaching.

CHAPTER EIGHT

CROSS-CASE ANALYSIS

The decisions which the five teachers in the preceding four case studies made about the growth of their expertise in technology-supported teaching were influenced by, and had an influence upon, their pedagogical practices, their learning experiences and their personal characteristics. The structural and cultural characteristics of the school played an important role in their decision-making and in support of their practices, experiences and characteristics. Data from informal and formal observations, pre- and post-lesson observation interviews, planning and policy documents were used to investigate these three dimensions and the school characteristics. Data collection was conducted in two stages over a six-month period, with Stage 1 methods repeated in Stage 2 to observe Lesson 1 and Lesson 2, respectively. With teacher and researcher access to video and audio footage of lessons, a stimulated-recall strategy uncovered teachers' pedagogical reasons for their actions and identified their perceived significant events or experiences influencing their growth.

All the teachers believed technology was a valuable tool to be used in the engagement, facilitation and enhancement of student learning. They expressed a commitment to using ICT in their teaching and were confident, competent users. There were similarities in their teaching strategies, but noticeable differences in the structure and pace of their lessons. Although pedagogical and curriculum knowledge seemed to account for many of the similarities, teaching practices appeared to be influenced by the depth of this knowledge and how their beliefs about student learning were manifested. Their reported learning experiences impacting upon their growth were varied. Yet

common to all, were the benefits of collegial interactions and support. Above all, teachers were highly motivated to strive for excellence in their practices and shared many characteristics in their approaches to learning.

In presenting the research findings about teachers' similarities and differences, the following cross-case analysis aimed to highlight descriptors of their practices, learning experiences and characteristics which differentiated their qualities in their journeys towards expertise. Three areas were selected for this purpose, namely, 1) the scope of the teachers' pedagogical, curriculum and technological knowledge, 2) their technology-supported teaching strategies, and 3) the influences on their desire for excellence.

Scope of pedagogical, curriculum and technological knowledge

Teachers' different backgrounds in their teaching and experience with technology did not affect their positive attitudes towards ICT, their perceived benefits of cross-curricula learning activities, their many commonly-held beliefs about how students learn and their goals in constructing the learning environment which incorporated shared processes.

Background of teachers

All teachers reported high levels of competency in their technology skills and use of computing applications, yet their length of experience with technology differed (see Table 3.1). Kath was first enthused by technology through educational simulation games early in her career because she said, "It was such fun!" Although Tonia, Peta and Jay also had lengthy periods of exposure to technology, their experiences varied. The two young teachers, Tonia and Jay, had used ICT since they were at school, which could be

expected given the widening use of computers in schools for more than two decades. This would not have been part of Peta's schooling and her experience was gained in her previous business career. This was in contrast to Laura, who like Kath, had a wealth of teaching experience, but embraced technology when a laptops-for-students project and IWBs were introduced at her previous school.

Common to all teachers, as seen in Table 3.1, was the experience they had gained as leaders, though differing in the length of time they had held these positions. At the time of this research study, Kath had been ICT curriculum head since her appointment 8 years ago. Laura had been acting assistant principal and the middle school manager at her previous school. Tonia was given a management role for a numeracy project in her second year of teaching. Peta began her teaching career in a merit position and was recognised in this current school as a curriculum leader in science. Jay acted in the role of ICT curriculum head during Kath's absences. Although the length of time in which the teachers held these positions and levels of responsibility differed, it is evident that school managements had regarded the practices and characteristics of these teachers as worthy of leadership roles.

With the exception of Jay, the other four teachers all had experience teaching in different education systems, such as the catholic and government systems. Kath, Laura and Tonia also had experience outside of Australia. Kath's experience was limited to her online project work and communication with teachers in other countries, but Laura had taught at an orphanage in Thailand, while Tonia's previous teaching experience was in New Zealand. It seems reasonable also to infer that their exposure to different systems, curriculum and teaching methods would enable them to make comparisons

about teaching practices, add scope to their reflections and contribute to the breadth of their professional knowledge.

Peta and Jay, had spent their first two years at this current school, teaching Year 6 and in this their third year at the school, with its support, had elected to team teach at the Year 4 level. According to them, they made this decision on the basis of their similar pedagogical viewpoints and beliefs in the value of ICT to facilitate student learning. They shared resources and ideas, prepared lessons, identical programmes and schedules together, shared subject area responsibilities and the delivery of some learning activities. The advantages, they felt, were that team teaching saved them time, utilised one another's strengths and exposed their students to two different styles of teaching. As newcomers to the school and from different systems, Laura and Tonia had decided to plan their teaching programmes together, shared resource ideas and organised their timetable in order to share the one bank of Mininotes available to the Year 6 classes. For the purpose of this research study, Kath worked with a group of three classes in Year 5 and was supported by their class teachers.

When using ICT with their students, all teachers said they often felt confident, enthusiastic, comfortable, committed, pleased, interested and satisfied. Three of the teachers also added negative comments about their feelings, which they often had. Kath was irritated and cynical, because in her view "people (teachers) don't trust the benefits" and many would never do so. Tonia's frustration was levelled at the "lack of resources", especially if they were not reliable and as one set of 24 Mininotes was shared among three classes, she said. On the other hand, Peta directed her criticism toward herself, saying

she felt pressured because “maybe it’s my perfectionism --- I’d like to achieve more, no one puts pressure on me, I put it on myself.”

Although these comments from the teachers are quite different, nevertheless, their reasons appear to stem from a common motivating influence on their approaches to using technology with their students, that is, quality of practice. For Kath, this came from her perspective as a leader and perhaps a desire to change the practices of other teachers. The school infrastructure, as an external barrier, was seen by Tonia to affect the improvement of her practice. In contrast, Peta’s self-reflection on the standards she expected of herself was a mitigating factor in her desire for excellence. Nevertheless, these honest, though negative feelings, revealed the high expectations they had of themselves and others, and appeared not to deter them from seeking improvement in their practices, as they all professed a desire for learning.

Influences of goals and beliefs about student learning in curriculum delivery

The school’s strategic goals and initiatives for ICT were detailed in its policy and planning documents. These advocated the integration of technology within enquiry-based cross-curricula activities, particularly in English, science, humanities and social science. The underlying principles about the use of technology were stated in terms of the value it added to learning. Scope and sequencing of skill development was listed for each year level.

The school’s leadership team promoted these goals through their support for teachers and beliefs about how ICT should be used to benefit all students. The Junior school principal, who had been at the school for more than nine years, believed that ICT should be embedded in the curriculum by using it as a

tool to enhance learning and at the point of need. In her view, ICT should be used to encourage students to explore and take risks in their learning, as well as to support their differing needs, for example, those of more capable students. She had a preference for staff professional learning opportunities to be undertaken in-house, hence her decision to employ Kath in the dual role of librarian and as deputy head of curriculum ICT. This, she felt, would act as a catalyst for ICT integration, be a role model and support staff in the design and delivery of learning activities. She hoped that all her staff would benefit by this initiative, yet be prepared to spend time themselves through play / trial and error to progress their learning. These beliefs about ICT and her goals were reflected in the practices of the study teachers

Without exception, all the teachers believed that cross-curricula learning activities were more relevant for students, multiple outcomes could be achieved and time saved in meeting curriculum objectives. A model which had fostered their beliefs and inspired them to learn was an innovative program, Providing Academic Challenge for Everyone (PACE), designed and led by Kath. It exemplified the aims of the school's goals, encouraged enquiry through the use of digital tools and resources, and facilitated learning through student collaboration, discussion and critical analysis. Technology skills were integrated with authentic learning activities, such as the creation of a multi-media product of audio and video material to support a persuasive argument about caring for the local river catchment area.

Teachers' beliefs about how students learned underpinned the choices they made in creating and managing learning environments, as evidenced by their convictions about the use of technology as a tool for student learning. The

important advantages which teachers perceived to support or enhance student learning differed in some ways (see Table 8.1).

Table 8.1

Teachers' perceived advantages of technology to support student learning

Advantages for students in using technology for learning	Kath	Laura	Tonia	Peta	Jay
Relevance to students' everyday lives	x	x	x	x	x
Motivation to learn	x	x	x	x	x
Learning more cohesive when integrated with curriculum	x	x	x		
Learning empowered e.g. students choose to seek information	x	x	x		
Learning opportunities enhanced for visual learners	x	x	x		
Versatility to produce work of professional appearance	x				
Power to influence students' self-esteem	x		x		
Instant feedback				x	x

As can be seen from Table 8.1, all teachers believed technology was relevant to students' everyday lives, typified by this comment from Laura: "That's how kids are wired these days. If you're not using it in the classroom, then they're behind already." Furthermore the teachers had firmly stated they could not envisage teaching without technology.

Common to all teachers was their belief that students were motivated to learn through the provision of experiences which were interesting, fun, engaging and interactive. The creation and management of student learning activities exemplified these beliefs as demonstrated by the teachers' choices of topics related to curriculum objectives and the actions of all students. For example in one of Kath's lessons, students' interests were acknowledged and curriculum objectives addressed in the persuasive argument topic of issues surrounding the wearing of school uniforms. Similarly, Laura chose the topic of bathroom science to develop students' understandings of advertising ethics as they created a range of products for their personal design of a bathroom. Obvious

fun was demonstrated by students in Peta's lesson on chance in mathematics when they enthusiastically shouted, "Yes!" in response to the display of their predictive correct answer. Interest in the activities was sustained throughout all lessons, as it was noted that all students approached their tasks with eagerness and stayed on-task without prompting from the teacher. Teachers showed and maintained this positive attitude by their own enthusiasm.

Differences in teachers' beliefs are also indicated in Table 8.1. The beliefs of Peta and Jay about technology providing instant feedback were reflected in their decisions to select particular digital resources for students to use. These consisted of examples with closed multiple-choice items. Student practice and consolidation of concept understanding to aid learning, therefore, seemed to be the reason for their choices. The other three teachers, Kath, Laura and Tonia, showed a more profound understanding of technology's potential to enhance learning at a deeper level, again reflected in their selection of tasks and digital resources for frequent student interactive use. These were open-ended and allowed for student understanding, construction and demonstration of their own knowledge in the creation of a product. This evidence also substantiated their stated beliefs that learning was more cohesive in a technology-inclusive curriculum, unlike Peta and Jay, who gave many examples of using technology often as a productivity tool for administration and lesson preparation. It would seem that the need to design a variety of interactive tasks within learning experiences not only reflected teachers' beliefs about the importance of understanding to students' concept development, but also demonstrated teachers' technological, pedagogical, content and knowledge known as TPACK (Koehler & Mishra, 2009). It could be inferred, therefore, that

the TPACK scope of Kath, Laura and Tonia was analogous to that of an expert in technology-supported teaching (see Appendix M).

However, Peta and Jay, had particular beliefs about student learning that were not necessarily transferred to their practices with technology but were important nevertheless. “See it and do it!” was a belief Jay had about students developing concept understanding, for example, by students physically arranging themselves to represent a sequential progression of chance terminology in her mathematics lesson. Both teachers emphasised the importance of concept language as an integral part of students’ learning experiences to develop understanding. Peta believed that constant use of language, particularly through discussions was critical, her belief explained as “we can’t move on until we’ve got the foundations squared away.” Her decision to re-teach Lesson 2 to both Year 4 classes, in Jay’s absence, because of her dissatisfaction with the outcomes, demonstrated her belief that she needed solid evidence of students’ understanding of concepts to progress lesson plans.

There are other aspects of teachers’ inherent beliefs about student learning and how these are reflected in their practices which have not yet been addressed in this analysis to date. Beliefs about learning being a shared process and the creation of learning environments to cater for diverse needs of students are incorporated in the next two sections which follow.

Beliefs about learning being a shared process

On many of occasions throughout the interviews with teachers, they expressed their beliefs that the provision of shared learning opportunities for students was a critical part of their lessons. A range of different strategies used by the teachers attested to these beliefs. These are described in Table 8.2.

Open discussion was a frequent occurrence in the lessons of all teachers. This took the form of factual, closed, open-ended and evaluative questions, to which teachers listened and responded, usually accompanied by praise. All teachers expressed a belief that learning was a shared process between students and teachers. Laura was the most articulate in explaining why she valued this form of sharing when she said, “I like listening to the discussions... their answers...they gave me much more than I gave them.” It is likely that for all the teachers, their beliefs about the value of discussions provided them with ways of monitoring student understanding, directing the flow of their lessons and encouraging a tolerant learning environment.

Table 8.2

Types of shared learning strategies used by teachers

Shared learning strategies	Explanations	Kath	Laura	Tonia	Peta	Jay
Open discussion	Teacher & students listening & responding	x	x	x	x	x
Structured	Students engaging in set format e.g. think-pair-share	x	x		x	x
Peer collaboration	Students working in pairs on a task	x	x		x	x
Peer collaboration with technology	Students working in pairs on a task	x	x			
Group collaboration with technology	Students working in small groups on a task				x	x
Critical analysis with technology	Students appraising the work of peers	x	x	x		
Learning processes with technology	Teacher explaining own learning & processes		x	x		
Personal experience	Teacher recounting own experience		x	x		

Two teachers, Tonia and Laura, made explicit their beliefs about students and the teacher having shared or common learning experiences when they explained their own learning processes. Using a think-aloud strategy, Tonia described her thought processes as she modelled each ICT task she expected the students to undertake, for example, the reasons for the decisions

she made in creating an image to exemplify text. The reason Laura gave for modelling her own learning was “so they (the students) can use it in their own learning...(and) how I use ICT to teach them.” By modelling their learning with digital tools and resources, this pedagogical practice of the teachers indicated their expert professional knowledge (see Appendix M). Furthermore, the beliefs of both teachers about this shared form of learning were reinforced when they recounted relevant personal anecdotes, acknowledging everyday-life common experiences.

In comparing the strategies used by the teachers it can be seen from Table 8.2 that Kath, Laura and Tonia made particular use of technology to encourage critical analysis when students appraised the work of their peers. Opportunities were created by the teachers for students to learn from each other during the course of the lessons when they viewed, or were shown, incomplete tasks of their peers to assess, discuss or provide feedback, and relate to their own work. This strategy of facilitating student self-assessment as it relates to their use of digital resources and tools is a further example of their expert professional practice (see Appendix M).

A further descriptor of expert professional knowledge is concerned with differentiation in technology-supported teaching, that is, catering for diverse needs of students (see Appendix M). The next section presents the findings on the different ways the teachers used technology for this purpose.

Learning environments meeting diverse needs of students

All teachers employed a range of strategies and selected digital resources and tools which showed their levels of understanding and commonly

held-beliefs of providing for the differing needs and characteristics of their students.

These teachers facilitated student understanding by representing curriculum content concepts to the whole class, as shown in Table 8.3. It does not include the strategies used by the teachers to demonstrate, explain or model the use of tools such as navigation procedures, menu functions or ICT skills needed to complete a task. All the teachers wove those particular strategies into their lessons where appropriate.

It is evident from Table 8.3 that all teachers chose to represent concepts in many ways, both with and without the use of technology. Visual images, use of text, diagrams and pictures supported by authentic situations were common to both these forms of representations. Except for Peta, who spent a prolonged amount of time on discussion in her mathematics lesson, researcher observations revealed that the teachers frequently interchanged technology and non-technology representations of concepts to achieve learning objectives. The variety and combination of representations not only illustrates their cognisance of the differing needs of students, but also the scope of their pedagogical knowledge, particularly in the maintenance of student interest in their tasks.

All the teachers made constant use of relevant vocabulary in conjunction with their other representations of concepts. However, their differentiated tasks for their students were not similar. Kath, Laura and Tonia provided open-ended tasks for students to undertake with technology, culminating in their creation of a product. This type of task allowed for differing characteristics of students, as outcomes would be a demonstration of each student's distinctive concept knowledge. Tonia showed additional expertise in her curriculum differentiation

tasks. She modified the task for a small group of students with special needs by selecting a different starting point to the remainder of the class, set objectives for the majority of the students and encouraged her more able students to vary the task. It was her belief that digital resources and learning activities should be selected and designed to accommodate all these differing needs and student choice.

Table 8.3

Teachers' representations of concepts with and without technology

Representations of concepts	Kath	Laura	Tonia	Peta	Jay
With technology					
Visual images manipulated by the teacher		x	x		
Visual images manipulated by a student		x			
Visual images accompanied by voice-over	x			x	x
Text, diagrams, pictures projected	x	x	x	x	x
Authentic situations / images portrayed	x	x	x		
Quiz with multiple choice items	x			x	x
Without technology					
Visual images shown as teacher read book	x				
Text, diagrams drawn on board				x	x
Text, diagrams, pictures from reference material		x	x		
Authentic situations described or examined by questioning	x	x	x	x	x
Acting out - role play scenario by teachers	x				
Acting out – students physical modelling of concept					x

On the other hand, Peta and Jay, appeared to prefer a teacher-directed approach when selecting digital resources, which were structured to offer students closed responses to questions. The *Rain Forest* resource used by Jay did contain differing levels and she was able to move students forward according to their success in responding to the given questions. The teachers' choices of particular resources, which provide instant feedback, are in keeping with their beliefs, referred to earlier, that ICT is advantageous to student learning.

Findings and interpretations have been presented about the influences of teachers' goals and beliefs on student learning and the impact of those beliefs on the strategies they adopted to share learning and to cater for the individual needs of students. Teaching strategies are further analysed in the following section where lessons have been examined.

Technology-supported teaching strategies

A comparison of the technology-supported strategies used by teachers is preceded by a background summary of 1) the settings in which the lessons were conducted, 2) the main purposes for which digital resources and tools were used by teachers and students, and 3) the lesson topics. This section concludes with a cross-case analysis of the strategies teachers used to deliver and manage learning activities, and to engage students.

Settings for technology use

Lessons were observed in a variety of settings where students worked alone, in pairs or with a group. The school's computing laboratory, in an adjacent open area of the library, was used by Kath for students to work in pairs, and by Tonia for her students to work individually. In the library space, Kath began her lessons with the Year 5 students, where work-tables and Mininotes were used by Peta and Jay to combine their classes in group-work. Peta and Jay each had access to a bank of Mininotes in their classrooms. However, during the researcher observation periods, this facility was only utilised by Jay's students on an individual basis. Laura and Tonia shared a common bank of Mininotes, for individual or paired use.

Main purposes for technology use by teachers and students

Teachers each had a laptop computer and data projector in their classrooms, including the library, which also had an interactive whiteboard.

Teachers used these facilities mainly for:

- Managing organisational and administrative tasks,
- Searching for resources and learning activity ideas,
- Staying up-to-date with ICT practices and knowledge,
- Demonstrating computer functions and facilities e.g. navigation, applications,
- Modelling concepts,
- Engaging students e.g. motivation, maintenance of interest, and
- Promoting shared learning opportunities.

Students used computing facilities mainly for:

- Developing computing skills and applications knowledge integrated with concept knowledge,
- Building concept knowledge,
- Practising concept knowledge,
- Demonstrating concept knowledge within structured digital resources, and
- Constructing and demonstrating concept knowledge by creation of a digital product.

Lesson themes and the curriculum

Teachers' choices of lesson topics and the structure of learning activities were based on the Achievement Standards set out in the learning areas of the

Australian National Curriculum. Activities were designed by teachers to integrate learning areas, such as, English, mathematics and science. The advantages to this integrative approach, according to the teachers, have been referred to earlier in the sections on their beliefs about student learning and their time management demands. A summary of the curriculum themes, lesson topics and the curriculum learning areas are listed in Table 8.4 about lessons which were observed by the researcher. Two lessons for each teacher are shown, except for Tonia who joined the study in its second stage of data collection.

Table 8.4

Lesson themes, topics and curriculum learning areas

Teacher	Theme	Topic	Curriculum learning area
Kath	Persuasive arguments	School uniforms	English, humanities & social science
	Persuasive text / visual literacy	Conservation of local area	English, science
Laura	Ecosystems	Food webs	Science
	Visual literacy	Bathroom science	English, science
Tonia	Visual literacy	Picture book messages	English
Peta	Chance and probability	Chance language	Mathematics, English
	Environment	Ecosystems	English, science, mathematics
Jay	Chance and probability	Chance language	Mathematics, English
	Environment	Ecosystems	English, science, mathematics

As can be seen in Table 8.4, the curriculum areas of English and science dominate, indicating their importance in the school curriculum and in the latter case, in accord with the school goals on providing affordances for enquiry. Laura and Tonia had collaborated in planning the theme of visual literacy, though they prepared and delivered their own lessons. Also evident are the identical themes and topics, which Peta and Jay had planned. The first lesson, on chance language, was conducted by each teacher, in her own classroom,

with her own class. In the second lesson, which was held in the library space, both classes were combined, as teachers had said this was to be a team teaching approach.

Underlying the theme of visual literacy chosen by Kath, Laura and Tonia, was their objective to expose students to the power and influence of media advertising in everyday lives, they said. Kath selected the promotional images and text on the school website to stimulate critical discussion on her topic of school uniforms. Laura's students analysed advertising material from the internet on different styles of bathrooms and products, in her belief that many students would have experienced either newly constructed or renovated bathrooms, because of the area in which they lived. Similarly, Tonia's students modelled her construction of an ideal bedroom as an example of messages conveyed by images. Each of these lessons affirmed their beliefs of the importance of familiar experiences to engage and stimulate the interests of students.

Strategies for teaching and student engagement

The teaching and questioning strategies used by the teachers and the ways they chose to engage students had many similarities, but differences were apparent in the structure and pace of their lessons. These differences appeared to be influenced by their own learning experiences and their knowledge in differentiating students' needs. Table 8.5 shows an amalgamation of the main stages of the lessons they conducted using technology. The stages, as illustrated, were derived by the researcher from perceived segments in the development of the lesson. In the introduction stage the teacher employed strategies to begin the lesson with the whole class grouped together. During the

body stage of the lesson, which occupied most of the lesson time, students were largely engaged in tasks. The conclusion stage was short and ended the lesson.

Table 8.5

Sequential structure of lessons and teaching strategies

Lesson stages and teaching strategies	Kath	Laura	Tonia	Peta	Jay
<i>Introduction</i>					
Lesson tasks stated	x		x		x
Learning objectives stated			x		
ICT instruction, explanation, demonstration e.g. navigation, tools, tasks	x				
Modelling of concept				x	x
ICT modelling of concept		x			
Topic concept language e.g. introduced, reviewed, understanding developed	x	x	x	x	x
<i>Body</i>					
Lesson tasks stated	x	x	x	x	x
Learning objectives stated	x	x	x		
ICT instruction, explanation, demonstration e.g. navigation, tools, tasks	x	x	x		x
Modelling of concept	x				x
ICT modelling of student examples	x				
ICT modelling of concept	x	x	x	x	x
Topic concept language e.g. introduced, reviewed, understanding developed	x	x	x	x	x
Prior knowledge activation, scaffolding, summarising, facilitation, questioning, monitoring	x	x	x	x	x
Praise / feedback	x	x	x	x	x
Learning assessed – formal e.g. rubric			x		
<i>Conclusion</i>					
Lesson summary	x		x	x	
Praise and feedback			x		
Task continuation / completion requirements	x	x			
Learning assessed - informal e.g. reflective questions,		x	x	x	x
Learning assessed – ICT concept models					x

All the teachers, except Kath, had prepared detailed written documentation of their lesson plans and learning objectives, which their practices reflected. It was clear from Kath's practices and explanations, however, that the learning pathways she had designed for students and teachers alike were grounded in her extensive technological, pedagogical and curriculum knowledge. It seemed that this foundation had given her an intuitive feel for achieving her objectives. This meant that she readily monitored the lesson development to decide if a change in direction was needed. As she

explained “you can’t plan ...it’s always a work-in-progress with IT.” Furthermore, her flexibility to change, by assessing and responding to the teaching / learning environment, was confirmed by her assertion that she needed always to think on her feet. Laura made an identical comment when reflecting upon changes she had made during her lessons, indicating a similar flexibility and scope of her knowledge.

In their pre-observation explanation of the second lesson, Peta and Jay made no reference to their planned roles of responsibility as team teachers. In this interview and subsequent lesson observation, Jay played a dominant role and teaching tasks were not shared. Peta chose to support students only in the later stages when students were working in their groups. Later, Peta expressed her disappointment in her lack of participation in the lesson, particularly about the strategies used by Jay to monitor student understanding. She also gave an explanation of her decision to re-teach the lesson in Jay’s absence the following day. Her conclusion was that the planned outcomes of developing and confirming students’ literacy and problem solving skills, necessary to their understanding in accomplishing the online quiz, had been successful.

From Table 8.5 it can be seen that there were differences in how the teachers introduced their lessons. The aim of the PACE lessons, according to Kath, was to incorporate the development of students’ ICT skills within their curriculum content objectives. Therefore, as shown in Table 8.6, she stated lesson tasks and explained these by ICT demonstrations in conjunction with a review of curriculum concept language. On the other hand, Laura said she wanted to motivate and excite students by technology use, and chose to model the concepts she intended to pursue in her lesson, without reference to the

lesson objectives or tasks. They were made overt during the body of the lesson. A different approach again was adopted by Tonia. She outlined lesson objectives and a series of tasks, summarised the step-by-step process the lesson would follow, explained her role as the teacher and that of the students in accomplishing those tasks. The re-iterative process of constructing the content delivery and managing concept development in chunks as teacher demonstrations and explanations, followed by a task for students, was maintained throughout. This strategy seemed to be attributable to her background experience as she learned to work with students who had special needs, where it is likely she would have met with success using this structured model.

Throughout the main part of the lesson Kath, Laura and Tonia referred frequently to the learning objectives of the lesson accompanied by the high expectations they had of the quality of students' completed products. For example, Kath said to the students that she expected they would all achieve high levels in their finished multi-media product, as she referred to the rubrics of the conservation competition. Tonia made her expectations clear, for example, when she said, "I'm looking for creativity and I'm looking for originality." These examples illustrate the teachers' intentions to challenge students to strive for excellence in the quality of their work, without being constrained or directed along a teacher-devised learning pathway. In contrast, while Peta and Jay had given praise frequently to student responses as encouragement of effort, the digital resources they had chosen for students to use had prescribed end points. For example, in the *Rain Forest* mathematics resource, Jay's

expectations were that her students would practise their new knowledge about probability.

The technology-supported strategies of the teachers differed when they were monitoring the progress of the lesson outcomes in relation to the pace of the lesson. Their decisions appeared to be influenced by their pedagogical knowledge, their beliefs about student learning or their own performance self-efficacy characteristics. According to Kath, assessment was the responsibility of the class teachers, as she said, “I just throw it all out there...only at the beginning... drive it during the progress of the topic...manage it by being there... teachers really have to run behind me sometimes and tie up all my loose ends.” Nevertheless, she closely monitored student understanding through questioning, listening to student responses, making over-the-shoulder observations and changes to the lesson pace and the flexibility of concept representations, as she deemed necessary.

Mixed influences impacted upon Laura’s management of lesson time. Her pedagogical professional knowledge in practice was evident in her stated belief that technology afforded opportunities for students to learn faster. This she accomplished, firstly, by setting time limits on lesson tasks with the expectation that these would be met accordingly. Secondly, she asked questions and repeated anticipated learning outcomes while students were working, seemingly with the aim that students would multi-task.

Similar to Laura, Jay also issued time deadlines and kept moving the class forward, even though she revealed that one of her students spent the entire mathematics lesson doing her homework. Assessment was not her strong point, she admitted, but it was one of her goals for improvement in the

coming year. Her explanation and practice explains in part the reason why she chose a built-in multi-level digital resource for students to use.

Like Kath, Peta adjusted the pace of her lesson to accommodate her perceptions of student understanding, which was in keeping with her pedagogical belief that understanding was critical to learning. Equally important to her, she said, was to foster a learning environment which facilitated “our own belief in ourselves.” However, unlike Kath, she did not expand her planned concept representations, but conducted a lengthy discussion of concept vocabulary. Therefore, she abandoned her plans to use a similar digital resource to Jay, as she had insufficient time, and decided instead to engage students in a paired activity with probability event cards.

Similar to Kath were Tonia’s questioning strategies and monitoring of students’ work. In addition, Tonia assessed students’ work formally throughout the body of the lesson, by using a checklist to record their acquisition of specific computing skills, which were an integral part of her planned lesson objectives. Her detail in record keeping about student achievements appeared again to reflect her previous experiences with special needs students.

One semi-formal assessment strategy common to all teachers, except Kath, was that of reflective questioning (see Table 3.10) at the conclusion of the lesson, although there were different forms. Peta and Jay asked students to sit in pairs, knee-to-knee, and tell one another what they had learned during the lesson, that is, students were engaged in think-pair-share interpersonal reflections. The two teachers would have been able to make some informal assessments on an incidental basis as they walked amongst the students during this very brief period. Laura and Tonia adopted a strategy that gave more

visibility to the teacher and to all the students in the class, as they shared their learning experiences as a group. The teachers gave prompts to their students to assist them in reflecting upon what they had learned and how they had learned. Laura called this a *community circle* and said she ended all lessons in this way.

In concluding this section on technology-supported teaching it is apparent that Kath possessed many attributes of an expert in pedagogical practices and those of a lead teacher (see Appendix M). Her TPACK was comprehensive as she demonstrated and supported other teachers. Her range of modelling strategies, multiple representations of concepts and selection of digital resources and tools were extensive. Learning activities exemplified her knowledge of student interests, levels of engagement and diverse characteristics of students, as she constructed and managed learning pathways. She made known her expectations of high achievement levels as students demonstrated their learning in the creation of a product of their own choosing. Laura and Tonia had many similar attributes, though had not demonstrated such a wide range of modelling strategies, concept representations or knowledge of digital resources and tools. The pedagogical practices of Peta reflected her knowledge of how students learn, with a particular emphasis on discussion and language. She directed her technology use towards the modelling of concepts and appeared to mainly use digital resources and tools for organisational purposes. Jay was more versatile in her use of technology, which she demonstrated through modelling concepts and providing opportunities for students to be actively engaged. Distinct from all the

other teachers was the professional knowledge Tonia displayed in catering for diverse needs of students using digital tools and resources.

This next section of this cross-case analysis summarises and interprets influences, other than teachers' beliefs about student learning, on the decisions they have made about their professional growth.

Influences on desire for excellence

All the teachers expressed a passion for their chosen career and a strong desire to continually seek excellence in their practices. Their visible enthusiasm for teaching and the attainment of these professional goals appeared to be influenced by their performance self-efficacy characteristics. An analysis of the influences on their learning experiences augmented a clearer understanding of their professional growth. All these aspects are summarised and compared in the following two sections.

Career choices and professional goals

There were different reasons given by the teachers about why they chose teaching as a career. Three of the teachers, Kath, Laura and Tonia, began their teacher training after completing their secondary schooling, though their reasons and pathways differed. Kath felt she had no other alternative except teaching. However, her enthusiasm for the profession was ignited when she became excited and challenged by technology influencing her decision to continue her studies in this field. Laura approached her training with a different perspective. She chose variety in the subjects she studied and has maintained this philosophy in learning and experiences since then, as according to her, she wanted to avoid boredom and to "try something different." Her course of action

was to take significant breaks from teaching and travel overseas, for pleasure and work, as well as change to different education systems and school levels in her teaching. Tonia had wanted to be a doctor, like her older siblings, but upon failing secondary schooling and pursuing supplementary study, her grades were not high enough. She completed a general degree and embarked upon teacher training. Her decision, she explained was due to the quality of a couple of the lecturers, who had also counselled setting failure aside by directing energies to current tasks. For Peta and Jay, teaching was not their first choice of a career upon concluding their secondary schooling. Both had decided upon accountancy. In this profession subsequently, Peta had 20 years' experience, before embarking on a teaching career, which she professed was the best decision she had ever made. Jay said she realised an accounting career was not for her when she had a year's experience overseas working with children, believing that working in an office would not suit her.

The decisions the teachers made about entering the profession, maintenance of their enjoyment or satisfaction in the job seem to indicate common characteristics. In all cases the teachers chose to make changes which directed them along a fulfilling pathway. Reasons for their willingness to embrace change were perhaps a desire for challenge, a need to be engaged in risk-taking activities and to test the boundaries of their capabilities. Inherent in their decision-making, subsequent plans and achievement of their professional goals were their well-developed skills in self-reflection on their practices, experiences and characteristics. During the interviews all the teachers were highly articulate, honest and detailed in their self-appraisals.

The teachers' self-appraisals also included the perceptions and high expectations they had of themselves as teachers. These ranged from Kath saying she was good because she was canny, to Laura that she was good at some things and Peta referring to herself as a perfectionist. Kath, Laura and Tonia carried these high expectations into their teaching practices, when they overtly made known to their students similar expectations about the quality of the work that was produced.

Desire for excellence in teaching was a common goal expressed by all teachers: Kath set herself apart from the class teachers by emphasising that she wanted to make a difference. Given this goal, her practices within the school indicated her intentions to facilitate the learning of other teachers and promote change in technology-supported teaching. In contrast, the focus of the other four teachers, in pursuit of their professional goals, was on the benefits to their teaching quality.

Findings about the characteristics and learning experiences which influenced the teachers' attainment of their goals and growth of excellence are summarised and compared in the next section.

Influences on teaching role and professional growth

All teachers were highly motivated in their desire for excellence, evidenced by their attitude towards their own learning. Their skills in using digital tools and resources gave them confidence to learn alone and progress their technological knowledge, a strategy they all preferred, to participation in organised courses. Without exception, they wanted to stay up-to-date with new materials and teaching ideas with technology. They explained how lengthy periods of time were spent exploring, experimenting, searching the Internet,

practising skills and, in their words, by playing. Uniformly, they declared their commitment to continuous learning.

Characteristics of performance self-efficacy and motivation explain many of the influences on their perceptions of the quality of their teaching and their approaches to professional growth. Other self-report influences are included in Table 8.6. These are not listed according to the teachers' ranking of important influences, however, they are inclusive of all significant influences and learning experiences proffered by them.

Table 8.6

Perceived significant influences on teaching role and growth

Categories of influence	Kath	Laura	Tonia	Peta	Jay
<i>Guiding life principles</i> e.g. formulating and establishing life goals			x		
<i>Guiding career principles</i> e.g. choosing and maintaining career in teaching		x		x	x
<i>Professional recognition of excellence</i> e.g. receiving grants / scholarships / awards	x				
<i>Leadership role</i> e.g. appointments to leadership roles within a school		x	x		
<i>Role models</i> e.g. pedagogical practices of other teachers	x	x	x		
<i>Contextual learning</i> e.g. learning about and with technology as beneficial to education				x	x
<i>Contextual learning – as a teacher</i> e.g. how to use ICT in the classroom.	x	x	x		x
<i>Contextual learning – self-directed</i> e.g. choice to spend time alone	x				
<i>Collegial</i> e.g. sharing and learning from other teachers	x	x	x	x	x
<i>Professional learning</i> e.g. professional development courses, teacher training	x		x	x	

All teachers felt that their professional growth was influenced by sharing ideas and resources with their colleagues. According to Kath, these experiences occurred when she participated in national and international conferences, where she also shared her work. This wide access to colleagues and their practices would have contributed to her success in working with colleagues at her current school. Laura, Peta and Jay, believed that working as

a team was beneficial. This is understandable given the decision of Peta and Jay to team teach, while Laura's experience working with a team was gained at her previous school. By observing their colleagues at work, Laura and Tonia were inspired to become better teachers, they said.

As shown in Table 8.6 contextual learning was also important to all the teachers, though this type of learning differed. Kath firmly believed that the amount of time she devoted to learning by herself was invaluable. On the other hand, Peta and Jay felt that their experiential awareness of technology stimulated their desire to learn about the benefits technology offered to their teaching practices and how to provide students with experiences relevant to society. Four teachers, with the exception of Peta, considered contextual learning, as a teacher, to be a valuable experience, that is, when they used new technologies and teaching ideas with their students.

Exposure to role models influenced their growth of expertise, said Kath, Laura and Tonia. They felt that the pedagogical practices of other teachers impacted upon the decisions they made about their own practices. The negative experiences Kath described in her own schooling and her observations in a school where she was teaching, both of which she said were not fun, had made her determined to construct learning environments which were enjoyable.

Two teachers gave disparate reasons for their perceptions of the influences which had most impacted upon the current quality of their teaching. These were unlike any of the other teachers. Tonia's reason for setting short and long term goals as her guiding life principle, she said, was that she wanted always to achieve something new. Her goal-setting resonated with her motivation to keep abreast of new technologies and demonstrated her flexibility

to change or improve her practices. Kath's experiences in winning a scholarship, her prolonged participation in research projects and as a recipient of national awards for outstanding and innovative practices in ICT were categorised by the researcher as professional recognition of excellence. In Kath's view these experiences provided her with skills to work in groups, skills which she transferred readily to the collaborative programs she had incepted at the school.

Pedagogical practices, learning experiences and personal characteristics

The findings reported in this cross-case analysis have drawn attention to the similarities and differences in the teachers' pedagogical practices, their learning experiences and their personal characteristics, with some emphasis on their connectivity. It has also highlighted a range of influences on these dimensions. Comprehensive details of these dimensions and their interacting influences can be found in each of the four preceding case studies.

As the intention of the research study was to investigate the aforesaid dimensions of growth in their journeys towards expert technology-supported teaching, the analysis concludes with judgements made about the extent of teachers' expertise. A list of descriptors in tabular form was compiled (see Figures 8.1, 8.2, 8.3 and 8.4). The influences of teachers' beliefs about student learning and their perceptions of experiences, which contributed to their development, are incorporated within the summary paragraphs relative to each table. Each figure is a modification of the reference tables on teacher pedagogical practices, teacher learning experiences and teacher personal characteristics which had been created to assist in the analysis of the data

(Appendices M and N, and Table 3.14). Modifications in the accompanying figures were made to account for only the descriptors which had been revealed, and discovered, as a result of the findings from the data analysis. The findings reported in this cross-case analysis and the detail in the four case studies informed the judgments made by the researcher about the extent of each teacher's expertise.

Teacher pseudonyms were replaced with codes T1-T5 (see Table 3.1) for ease of interpretation. Five ratings were given for each descriptor, from *No evidence* to *Strong evidence*, in order to place a teacher according to the research findings. However, this process was considered to be placement on a continuum, as an indication of continuing growth in expert technology-supported teaching.

Pedagogical practices

This section on teachers' pedagogical practices is divided into two parts. The first part summarises the descriptors about teachers' professional knowledge – see Figure 8.1. A similar process was adopted in the second part on professional practice – see Figure 8.2.

In each of these four descriptors, Kath's overall professional knowledge distinguishes her from the other teachers. The main differences were in their comprehensive TPACK and knowledge-creation strategies and processes. These were evidenced by the scope and depth of knowledge Kath had about digital resources and tools, her support for school goals in the creation of innovative projects and the variety of strategies she used to accumulate and use this knowledge to engage in research projects. The knowledge which Laura

and Jay had about how to cater for diversity of students' needs, they both proffered, was an area they wished to improve.

Professional knowledge	No evidence	Strong evidence
Cater for diverse needs and characteristics of students	T2,T5	T4 T1,T3
Know what and how technology used by society & students in their everyday world		T1,T2,T3, T4,T5
Possess comprehensive TPACK	T4, T5	T2,T3 T1
Model learning, knowledge-creation strategies & processes using digital resources & tools	T4, T5	T2,T3 T1

Note: Modification of Appendix M: Teacher pedagogical practices
Kath = T1, Laura = T2, Tonia = T3, Peta = T4, Jay = T5

Figure 8.1 Descriptors of expert teacher pedagogical practices: Professional knowledge.

Only one descriptor of teachers' professional practices was common to all and that was their maintenance of safe learning environments, which the school policy clearly delineated and the teachers reinforced in their lessons.

Unlike the other three teachers; Peta and Jay chose structured digital resources for students to use which were either for concept practice or multiple choice responses. Although some problem solving was inherent in the design of the learning activities, challenging objectives and students' self-assessment strategies, as in digital resource feedback, were only partially visible. Except for Peta, who had allocated a limited time to modelling a concept accompanied by brief questions in her mathematics lesson, students were given a range of tasks to interact with technology. Kath's usage of interactive experiences were more frequent and varied than the other teachers.

Professional practice	No evidence	Strong evidence
Set challenging objectives	T4,T5	T3 T1,T2
Set high expectations of students	T4,T5	T1,T2,T3
Present diverse range of concept representations	T3,T4	T2,T5 T1
Facilitate student self-assessment strategies in technology settings	T4,T5 T2,T3	T1
Engage students In interactive tasks with and without technology	T4	T2,T3 T1,T5
Plan and implement open-ended, collaborative, problem-based & student-centred tasks facilitated by use of digital resources & tools	T4,T5	T2,T3 T1
Select & use variety of technologies for broad range of differing tasks & purposes within lessons	T4	T2,T3,T5 T1
Construct fluid delivery of learning activities	T3	T4,T5 T2 T1
Maintain safe learning environments		T1,T2,T3 T4,T5
Share relevant personal experiences with students	T1,T4,T5	T2,T3

Note: Modification of Appendix M: Teacher pedagogical practices
Kath = T1, Laura = T2, Tonia = T3, Peta = T4, Jay = T5

Figure 8.2 Descriptors of expert teacher pedagogical practices: Professional practice.

The biggest range of differences among the teachers was evidenced by their approaches to lesson preparation and delivery of learning activities. Kath had no written records, but seemingly the extent of her knowledge base allowed her to plan intuitively, whereas the other teachers had prepared detailed written lesson plans. Both she and Laura made quick decisions to change the flow of their lessons according to their perceptions of student interest, they declared. Peta and Jay blended their lesson components, particularly in their mathematics lessons. Tonia linked her lesson stages and used a structured step-by-step process, a method she said was her preference.

A further difference was the conscious decision made by Laura and Tonia to share personal experiences with their students as a means of maintaining rapport and a sense of having similar experiences, thus supporting the teachers' beliefs about learning being a shared process.

Learning experiences

The following comparative analysis is an overview of the teachers' learning experiences explained by a set of descriptors about their professional engagement actions – see Figure 8.3.

Professional engagement	No evidence	Strong evidence
Commit to continuous learning and challenges afforded by ICT		T1, T2, T3 T4, T5
Stay up-to-date with change in technology-supported teaching practices		T1, T2, T3, T4, T5
Accommodate change in technology-supported teaching practices	T3, T4, T5 T2	T1
Share own learning processes with students	T1, T4, T5	T2, T3
Collaborate and learn from colleagues		T1, T2, T3, T4, T5
Act as role model for colleagues	T2, T3 T4, T5	T1

Note: Modification of Appendix N: Teacher learning experiences
Kath = T1, Laura = T2, Tonia = T3, Peta = T4, Jay = T5

Figure 8.3 Descriptors of expert teacher learning experiences: Professional engagement.

Many examples supported the endeavours of all teachers in the decisions they made about their learning experiences and technology, namely, their commitment, desire to stay abreast of new ideas and the benefits of collaboration with colleagues. With her breadth of TPACK, Kath stood apart in

the variety of ways she acted as a role model for her colleagues and her adaptation of her teaching practices to new ideas. Upon her introduction to technology, Laura made a conscious decision, she said, to change her practices from a teacher who delivered content knowledge, to one who was a facilitator of student learning. Only Laura and Tonia shared their own learning processes with their students. As they explained, this was planned, because they wanted students to know teachers and students alike belonged together in the learning environment.

Personal characteristics

The dimension of personal characteristics has been divided into three sections, namely, performance self-efficacy, motivation and positive affective qualities, with accompanying descriptors – see Figure 8.4.

Although planning intuitively has been mentioned in relation to pedagogical practices, it is included here as part of teachers' performance self-efficacy, because it helps to explain why teachers' perceptions of themselves influence the acquisition and use of their professional knowledge. Kath's statement that she was good at her work and unafraid to take risks demonstrated not only her confidence in her abilities, but an intimate awareness of her profound knowledge base, the source of her intuitive planning.

In all other aspects of their personal characteristics, except for evidence obtained about their skills in responsive listening and communicating, there was ample confirmation of the teachers' abilities and motivation to succeed. During their interviews, they all reflected deeply and honestly upon their own performance, were emphatic about their desire for excellence and the ways they chose to achieve goals of excellence. Above all, they exuded enthusiasm

and affirmed their passion for teaching, attributes which infected the climate of the learning environment.

Personal characteristics	No evidence	Strong evidence
Performance self-efficacy		
Plan intuitively	T2, T3, T4, T5	T1
Monitor, analyse and reflect upon own performance		T1, T2, T3, T4, T5
Take risks with confidence	T2, T3, T4, T5	T1
Set high achievement goals for self		T1, T2, T3, T4, T5
Motivation		
Motivated / inspired to learn		T1, T2, T3, T4, T5
Willing to learn		T1, T2, T3, T4, T5
Desire to be an expert		T1, T2, T3, T4, T5
Believe strongly in power of technology to improve own performance		T1, T2, T3, T4, T5
Decide to spend long periods of time to practice, explore, experiment		T1, T2, T3, T4, T5
Positive affective qualities		
Enthusiasm		T1, T2, T3, T4, T5
Passion for teaching		T1, T2, T3, T4, T5
Responsive listener and communicator	T5	T4 T2, T3 T1

Note: Modification of Table 3.14: Teacher personal characteristics
Kath = T1, Laura = T2, Tonia = T3, Peta = T4, Jay = T5

Figure 8.4 Descriptors of expert teacher personal characteristics.

Summary

In concluding this cross-case analysis, it can be seen that there was strong evidence in almost every descriptor about technology supported-teaching for Kath to be considered an expert. She had a position of influence in the school and used her comprehensive TPACK to inception innovative programs. The biggest range of differences among the teachers lay within the descriptors of their pedagogical practices, where it could be inferred that there was potential for growth in their journeys towards expertise. Variations in the teachers' practices were most notable, for example, in the range of concept representations they employed with and without technology, and their affordances for shared learning. The personal characteristics, which most of the teachers displayed, are testament to their expert qualities, particularly in their desire for continuous learning and to strive for excellence in their work.

The next chapter draws upon the findings of this analysis and the four case studies to discuss three themes which emerged about expert technology-supported teaching. These are 1) patterns in pedagogical practices, 2) adaptive learning experiences, and 3) motivating influences on pursuit of excellence.

CHAPTER NINE

DISCUSSION

Expert teachers' pedagogical practices are exemplified by their comprehensive knowledge of curriculum content, their knowledge of the diverse needs of their students and the depth of their teaching strategies when they use digital tools and resources to design, deliver and manage learning activities (Appendix M). This assertion, however, is but observable evidence of practice. The reasons underpinning teachers' decisions to employ particular pedagogical strategies are complex. Their origins exist in teachers' pedagogical beliefs, learning experiences, their personal characteristics and critical events or episodes leading to their development of expertise (Appendix N, **Error! Reference source not found.**⁴ on *Teacher Characteristics* and Table 3.12 on *Influence Items and Descriptions*). While these descriptors assist in describing features of expert technology-supported teaching, they do not explain inter-related or inter-dependent influences on the growth of pedagogical practices. Progress was made in this research in uncovering these influences and differentiating the extent of expertise, as presented in four detailed case studies of five female teachers. They shared strong beliefs that ICT could enhance student learning, they were passionate about teaching with technology and sought constantly to seek improvement in their practices, yet their teaching experiences and their learning experiences differed.

Experience alone does not necessarily lead to the development of expertise in teaching (Goodwyn et al., 2009; Hattie, 2003). A similar position can be argued for expertise in technology-supported teaching. Two of the case study teachers, Kath (head of curriculum ICT and teacher-librarian) and Laura

(a Year 6 teacher), had extensive teaching experience, but Kath's length of technology use in teaching and her competency levels of skill in the use of computer applications and equipment was markedly greater. The other three teachers, Tonia (a Year 6 teacher), Peta and Jay (both Year 4 teachers), like Kath, had similar high levels of skill and knowledge of technology use. They had developed these technology competencies over a lengthy period of time. Tonia and Jay, both young teachers in their mid-twenties, had used technologies since their early school years, while Peta had gained extensive experience in her former career. However all three had employed technology in their teaching for only five years – the same length as their teaching careers.

According to Berliner (2004), who categorised five stages of growth toward expertise, it is likely that a teacher could reach the fourth stage, proficiency, after about five years of teaching experience, prior to attainment of expert, the final stage. In these terms, the three teachers with this level of experience could have been labelled as proficient. However there were other aspects of their qualities which explained in greater depth their pedagogical practices, experiences and characteristics. Similarities and differences were uncovered through the building of descriptors across three domains. Broad and rich pictures of the practices of all five teachers were created to explain the similarities and differences in the growth of their expertise.

The differences among the teachers' experiences and extent of expertise were evident in their particular qualities of practice, such as, utilising diverse and flexible strategies drawn from deep contextual knowledge to meet student and task needs, setting challenging student goals and responding opportunistically to learning environment changes. Berliner (2001) and Hattie

(2003) found similar qualities about expert teachers only; their studies were not about teachers employing technologies. The choices the study teachers made about their learning experiences, how that learning occurred and the environments in which those decisions were made impacted upon their technology-supported teaching.

Decisions made by all the teachers in this study about their learning experiences, their teaching practices and the quality of their teaching were influenced strongly by their highly developed abilities for self-reflection. Self-reflection is a critical attribute in decision-making which affects growth and change in practice (Ericsson, 2008; Orlando, 2014). According to Bandura (1991), the ability to observe one's self, explained as part of a self-regulatory process, allows individuals to map their own progress in relation to the pragmatic goals they have set for improvement. To achieve these goals, Bandura asserted that individuals are motivated by performance feedback and their successes. In addition, they have high aspirations for their performance, display qualities of commitment and by diligent efforts are prepared to overcome challenges. There is a resonance here for expertise in the context of technology-supported teaching and the teachers in this study.

Personal characteristics of these teachers fell into three broad categories, namely, performance self-efficacy, motivation and positive affective qualities (Table 3.14 on *Teacher Characteristics*). Not only did all or some of these affect their practices and learning experiences, but dimensions of these categories impacted upon one another. Pajares (1992), citing a contention of Bandura, asserted that "self-efficacy beliefs – individuals' judgments of their competence to execute a particular task – are the strongest predictors of human

motivation and behaviour” (pp328, 329). All participating teachers held strong beliefs about their abilities, which were evident in the extent of their expertise in managing students’ learning environments and their diverse range of teaching strategies. They were forthright in reflecting upon their practices, which motivated them to continually strive for excellence. Change in practice was therefore part of their teaching repertoire, often facilitated by learning from their colleagues in collaborative environments.

The school environment in which this study was conducted had all the features of a culture conducive to engendering expertise in technology-supported teaching. Led by the management team, the school policies together with technology and personnel resources provided a setting which nurtured teachers’ practices and learning experiences. The positive benefits of a technology-supportive school culture as it relates to change and professional learning has been well documented and researched (Ertmer & Ottenbreit - Leftwich, 2010; Schnellert & Keengwe, 2012; Tondeur et al., 2009; Tondeur et al., 2008). In such an environment, teachers are more likely to be encouraged to view their pedagogical practices unencumbered by obstacles or restrictions, enabling them to engage in successful learning experiences, explore new ideas and seek ways to improve their teaching.

Fostering in-house professional learning opportunities to bring about change in pedagogical practices was integral to the culture of the school. The school motto, with its emphasis on lifelong learning, appeared to embrace both student and teacher learning experiences. Students’ active engagement in concrete and authentic experiences embedded in an ICT environment was facilitated. Collaborative and social interactions were encouraged enabling

experienced teachers to overcome challenges and solve problems (Senjov-Makohon, 2006).

Learning with, and from colleagues, through differing forms of collaboration, was an enriching experience according to all the teachers. A regular form of this experiential process, which was supported and encouraged by the school, was through observing other teachers at work. A particular influence affecting growth in practice and valued highly by all classroom teachers, was observing, and having access to, the wealth of pedagogical and technical knowledge of Kath. Fullan (2007) argued that a significant component of successful collaborative learning, which must be embedded in the culture of the school, is a willingness of teachers to expose their practices to other teachers and learn through being observed, and by observation.

There was a commonality to critical experiences which teachers believed had affected their growth of teaching expertise and how they had learned, though there were some differences from teacher to teacher. The experiential learning influences proffered and described by teachers fell into four broad categories (Table 3.12), namely,

- Principles guiding careers,
- Recognition of teaching excellence,
- Role models of other teachers, and
- Engagement in contextual learning experiences.

The preceding summary has served to draw attention to the multi-faceted influences, which can impact upon the growth of expert pedagogical practices in technology-supported teaching. The bases on which decisions are made about

teaching strategies, learning pathways and career choices were linked in this study to teachers' personal characteristics and their reported significant experiences, which impacted upon their practice. Discussion of the following three themes serves to illustrate the relationships among these influences and the features of growth in expert technology-supported teaching, namely,

- Patterns in the sequence, purpose and management of student learning activities are typified by strategies which show differing forms of expertise in teachers' pedagogical knowledge in practice.
- Flexible strategies chosen by teachers to manage the curriculum can benefit their professional learning, when they access the support of an expert resource teacher, work collaboratively and control their own learning.
- Attitudes to change, risk-taking challenges afforded by ever-changing technologies and recognition of teachers' proficiency influence their self-efficacy and desire to increase their individual qualities of expertise.

Each theme has a particular focus to address the research questions about the dimensions of teachers' pedagogical practices, learning experiences and aspects of personal characteristics. The three themes do not stand alone and are interconnected by the influences of each one upon the other. Pervading influences on all three dimensions are teachers' pedagogical goals and beliefs, and their self-efficacy, which are inclusive of their professional agency.

Patterns in design and delivery of learning activities

Pedagogical approaches and practices of experts can be described by variations in the way a lesson is introduced, developed and concluded, the kind of active engagement opportunities provided for students and how diversity of students' needs are managed (Schempp, Tan, & McCullick, 2001). Equally important distinguishing features can be found in the modelling strategies used by teachers and the representations of concepts to facilitate learning (Hattie, 2003). Similar features were discovered in this study about the practices of expert technology-supported teaching. References to these practices of teachers in this study are made in this theme which discusses 1) pedagogical approaches, 2) lesson delivery, 3) expectations, 4) dynamic authentic activities, and 5) diversity of learners.

Blending pedagogical approaches

There was considerable variation in the pedagogical approaches adopted by the study teachers in the construction and flow of learning activities for their students. However, they all elected to use technology to support the teaching / learning environment as an essential ingredient, affirming they could not imagine teaching without it. Despite their differing methods of instruction and facilitation of learning, all teachers were satisfied that their lessons met curriculum objectives. Furthermore, in their view, students had demonstrated understanding of content and concepts while enjoying active participation in their learning experiences.

Decisions which teachers make about what pedagogical approaches to use in their practices with technology, can be related to their knowledge and understanding of learning theories. They can also be influenced by the beliefs

they hold about the value of technology to education and to student learning. Research literature has identified these factors as forming a foundation for the delivery of a technology-inclusive curriculum in an educational environment believed to improve the quality of teaching practices, promote change and stimulate innovation (Hine, 2011; Kozma, 2011a; Webb & Cox, 2004). These researchers advocated the facilitation of a student-centred learning environment, based on constructivism and enquiry learning, where the emphasis is on students to explore, discover and construct their own learning

The pedagogical practices of the teachers in this study, however, revealed a blend of many approaches. They ranged from teacher-led instruction which was content driven, to prescribing specific steps in students' acquisition of concept knowledge or providing opportunities for students to be innovative in constructing and demonstrating their own knowledge through the creation of a product. Other studies have found similar combinations of pedagogical approaches used by exemplary teachers using technology (Hunter, 2014; Ritchie & Baylor, 1997; Woodbridge, 2004). This blending of learning theories and pedagogical approaches to facilitate active learning and promote independent learning has been described as a conversational framework (Laurillard, 2013). Laurillard described how good teachers would structure learning activities to incorporate student inquiry and acquisition of concept knowledge through discussion and sharing ideas with peers, by practising and collaboration, and by producing tangible evidence of that knowledge. Embedded within this framework would be a teacher's questioning strategies and intrinsic feedback for students.

All of the teachers provided frequent feedback to their students either to the group as a whole or to individuals. Meaningful feedback aims to reinforce learning, guide or scaffold learning, motivate students to learn, provide evidence for students of their achievements or strengthen the self-belief of students in their ability to learn. In managing these strategies successfully, teachers need to be responsive to the answers students provide to questions. They need to possess the pedagogical knowledge to convey and make judgements about task achievements. Praise and respect for student responses or ideas is further evidence of a teacher's skill and knowledge in giving feedback. Feedback was a significant attribute of an expert teacher, reported by Hattie (2003), in making a difference to student performance. Experts in technology-supported teaching have the added advantage of using the technology to support and extend these feedback strategies, for example, in the features and forms of feedback in the chosen digital resource or tool.

Other strategies present themselves when a teacher takes on a facilitation role, as Laurillard's framework implies. All the teachers in this study perceived themselves as facilitators. Laura was acutely aware of the role she had previously adopted before embracing technology, as she explained how her teaching had been transformed, from that of being content-driven, to one of facilitation. Activities where student learning is facilitated, embody teaching strategies, such as, activating the prior knowledge of students to build new knowledge, giving demonstrations to provoke discussion, explaining and modelling new concepts, all of which have been found in another study of expert primary teachers (Gipps et al., 2000). The UNESCO ICT Competency Framework for Teachers (2011) set high standards for teachers as facilitators

and learning models in its knowledge creation module. It advocated the use of pedagogical approaches and learning environment designs where students use a variety of digital tools, their higher order thinking skills are promoted and they take responsibility for their own goal-setting and learning. Although Kath, Laura and Tonia supported an environment where critical analysis was encouraged, there was no tangible evidence of students setting their own goals. Students did make their own plans but these were in response to the tasks and goals devised by the teachers.

The practices of the teachers in this study reflected the features of a conversational framework and facilitation strategies in the sequential phases of their lessons, but with variations in scope and differing emphases.

Sequencing lesson delivery

Decisions made by teachers about the sequential stages of a lesson begin with preparation and planning. Comprehensive written programmes of expected learning outcomes derived from curriculum learning objectives within a theme is one example, which all the teachers except Kath, had recorded. She had no written records, yet was well able to articulate all of these lesson features, which demonstrated her comprehensive technological, pedagogical and content knowledge, known as TPACK (Koehler & Mishra, 2009). An ability to draw upon extensive knowledge structures, enables expert teachers to routinise aspects of lessons and makes them appear as though they are acting intuitively (Berliner, 2001; Borko & Livingston, 1989). Therefore, written plans could be unnecessary. If the teacher was confident in her flexibility to deviate from conceived plans, as a consequence of constant self-monitoring, teaching strategies could be altered in response to perceived student needs, as the

strategies of Kath and Laura indicated. Practice of the lesson before its delivery may also occur, particularly, if a teacher has high expectations of herself and is desirous of managing the technology in a capable manner, as Laura had done for one of her lessons. This before-lesson practice of an expert teacher, although without technology, was also a quality found in another small study of ESL teachers where novice and experts were compared (Tsui, 2009).

There were variations in the timing of lesson segments and pace, at which the teachers conducted their lessons, as a consequence of their aims and achievement of planned objectives. Decisions on successful accomplishment of lesson intentions can be influenced by teachers' pedagogical knowledge, beliefs about student learning, perceived value of using digital resources and tools, and self-reflection qualities. One or more of these influences may predominate within a lesson and therefore determine how that lesson is paced, its adherence to planned delivery intentions, deviations to make or plans to abandon, when and if technologies are used and for what purpose. Hattie (2003) found that expert teachers did not plan the pace or timing of their lessons and depended on their judgements about student understanding to make decisions about lesson development

The purposeful selection of digital resources and tools at a perceived point of need or as an advantage to learning can also influence how student learning is supported (Haydn, 2014). This was a decision and discerning use of technologies made by Jay, who established lesson beginning and end points to meet her planned intentions, yet without confirming the understanding of all students. Her strategy was to monitor the learning of the group as a whole,

rather than each individual student. According to Hattie (2003), experienced teachers use this strategy, which distinguishes them from expert teachers.

In contrast, Peta's lesson delivery exemplified some of what could be expected from an expert teacher. She believed every student should demonstrate understanding at different points of a lesson, before progress could be made. Therefore these beliefs about student learning dominated the delivery and timing of her lessons. As a consequence she decided to discard her planned intention of using a digital resource for students' individual learning and practice, in one of her lessons, and re-taught another lesson which had been delivered by Jay when team teaching. Her teaching strategies incorporated questioning, responsive listening, praise and feedback within a discussion framework, but without technology; strategies which have been described as practices of expert primary teachers (Gipps et al., 2000)

Discussion to ascertain students' prior knowledge by conducting interactive dialogues, either through demonstrations, reviewing or introducing topic concept language and to then scaffold their learning, were strategies used by all the teachers. Other research studies about expert teachers, though without the use of digital resources and tools, have found similar evidence during the introductory stages of a lesson (Borko & Livingston, 1989; Gipps et al., 2000; Schempp et al., 2001).

Timing of lesson sequences does not seem to be an identifiable feature of expert teachers' planning (Berliner, 2001; Borko & Livingston, 1989). Yet their practices can tell a different story in their achievement of objectives and the flow of their lessons. When teachers are responsive to students' levels of interest and activity, as Kath indicated, or as in Laura's opinion, believe that by

immersion in a learning environment supported by technology, students learn faster, then they orchestrate the pace and timing of lesson segments accordingly. Expert teachers accomplish this by a flexible approach, due to confidence in their pedagogical knowledge, and their constant monitoring and reflections on their performance (Berliner, 2001). Kath and Laura referred to this adaptability as “thinking on your feet.”

Pedagogical strategies adopted by teachers to introduce and commence the beginning stages of their lessons may be influenced in part by their own learning experiences and beliefs about student learning. Experiences such as observations made of role models or colleagues, the excitement and enthusiasm of students engaged in technology use and the success with a particular pedagogical approach in another setting, can impact upon teaching strategies. Strategies previously used by Tonia in an instructional setting, where she had been teaching students with special needs, were reflected in her step-by-step enunciation of the lesson task, outcomes and plans for the lesson. Conversely, negative experiences can be transformed into a positive teaching strategy by a self-reflective teacher. Avoidance of boredom was a reason Laura gave for introducing her lessons with technology to motivate and excite students.

Setting expectations for student performance

Teachers in this study made students aware of the expected learning outcomes for each lesson, in different ways and at different times. Expected outcomes may be conveyed in different forms. They may be stated as structured tasks, as learning objectives about content and concept knowledge, and understanding to be demonstrated, or in the case of technology, as skills to

be developed or practised for a particular purpose. Common to all the teachers, were statements made by them about lesson tasks, either in the introductory or main parts of the lessons. However, this was not the case for learning objectives. They were not made visible to the students by Peta and Jay, perhaps because of the young age of the students. Tonia enunciated objectives in specific terms. Lesson objectives were gradually unfolded as part of the lesson flow by Kath and Laura. Lesson flow can be maintained in this way, as a unified context for learning is presented to students. To achieve this, teachers need to embed objectives within the lesson content, concept understanding and technology skill development. Purposeful uses of knowledge and skill are then visible and link parts of a whole rather than in segmented parts.

Teachers may not be satisfied with only making students aware of learning outcomes, but set expectations of performance quality, which Kath, Laura and Tonia did throughout their lessons as students worked on their products. Teachers considered to be experts, also set high standards or challenging goals for their students (Hattie, 2003). One method used by Kath, was to provide all students with a copy of rubric levels related to their multi-media product and make known her expectations that she believed all students would reach the higher-end levels. This personal characteristic of teachers' professed desire for excellence in their own performance, a quality of expert teachers (Berliner, 2001, 2004), seems to be a transferred belief that students could also be encouraged to have high expectations of themselves. In the same way, when challenging objectives are set for students, this could be an expression of teachers' beliefs about the challenges afforded by technology to all learners, teachers and students alike.

Assessment methods of student learning varied among the teachers. Students' achievement may be judged on the quality of a product according to stated objectives or rubrics, their responses to digitally projected images for the whole group, their success levels within a digital resource-based task or their responses to specific questions. All the teachers used monitoring strategies to assess student understanding during lessons, particularly through questions directed at the whole group or on a one-to-one basis as a student worked. Hattie (2003) also found these qualities in expert teachers.

Reflective questioning at the conclusion of a lesson is a more targeted strategy where students are required to share their learning with a partner or with the whole group. Peta and Jay used the former strategy and relied on students to share relevant content or concept knowledge. On the other hand, Laura and Tonia gave specific prompts, aligned with their lesson objectives, by selecting volunteers to respond, and often associated these with brief critical analyses. Strategies such as these have been identified as those which an expert teacher would use and teachers capable of meeting high standards in designing knowledge creation and technology-supported environments for their students (Gipps et al., 2000; Schempp et al., 2001; UNESCO, 2011).

Constructing dynamic activities

All the teachers designed and implemented interesting, engaging and varied activities within a lesson for students, none of whom were reminded to stay on-task. Sustained on-task performance can be attributed to the selection of teacher-devised themes related to students' everyday lives and to the excitement of stimulating, interactive challenges afforded by technology. Dynamic lesson delivery accompanied by enthusiasm for the subject content

are qualities found in expert teachers (Berliner, 2001; Schempp & Johnson, 2006). A lesson consists of a myriad of segments and student tasks within it. Technology-supported teaching allows for constant variation in those segments and tasks to maintain students' interest, active engagement and continuous learning. There is a continual interplay between teacher demonstrations, modelling or explanations and student activity. Simultaneously, fun and enjoyment in learning can be facilitated, a belief held by all the teachers. A persuasive argument topic about school uniforms constructed by Kath and delivered through a variety of mediums to provoke debate and solicit students' opinions, contained all of these features. Using digital resources and tools, the challenge for pairs of students was to collaborate in convincing an audience of their stance on the statement *children should be able to wear what they like to school*. Activities such as these can provide students with authentic experiences which have been advocated as contexts for purposeful learning (DEST, 2002; Hartnell-Young, 2003; Herrington & Kervin, 2007; ISTE, 2008; UNESCO, 2011; Woodbridge, 2004).

In the construction and delivery of authentic experiences all the teachers used scaffolding strategies to support student learning and created opportunities for students to collaborate, share and reflect upon their learning. These are some of the principles of authentic learning described by Herrington and Kervin (2007) about how technology can be usefully integrated within learning contexts. One of the principles, particularly pertinent to this study, refers to strategies used by expert teachers to demonstrate their performances whilst explaining their thinking. Laura and Tonia described their thinking to students as they provided reasons for their actions and modelled these while

undertaking specific tasks. This strategy is indicative of teachers' beliefs that learning with digital tools and resources can not only be shared between teachers and students, but that learning processes can be common to all. Other research has also identified collaboration, modelling and shared learning strategies as powerful supporters of learning and a feature of quality teaching in technology contexts (Haydn, 2014; Laurillard, 2013; UNESCO, 2011).

One teacher, Kath, also provided affordances for pairs of students to display and demonstrate their work. This is another example of collaboration and shared learning, which has been explained as articulation in authentic learning settings (Herrington & Kervin, 2007). In a tolerant climate managed by the teacher, constructive shared learning can be facilitated as students critically appraise the work of others. Submission of work to a wider audience outside the school for evaluation, such as participation in a national forum as Kath organised, is another form of making public the products which students have created (Hunter, 2014). In a climate where excellence is encouraged (the school in which the current research was undertaken), strategies such as these can have a strong influence in motivating and challenging students to excel. Similar suggestions were made by Hunter (2014) in her study about innovative learning practices of exemplary teachers using technology. She posited that where students' work is made visible to a wider community, then their quality of work is of a higher standard.

Catering for diversity of learners' needs and characteristics

The teachers in this research study made decisions about their selection and use of digital resources and how they implemented lesson plans to cater for the diverse needs and characteristics of their students. Resources can be

chosen for their design and purpose, for example, for concept practice, concept construction knowledge or demonstration of ability range. Teachers can design different starting points within a task. Students can be paired or grouped according to differing ability levels and roles assigned or adopted for each individual within the group. Teachers' pedagogical knowledge and beliefs about differing learning styles determine how content and concepts are represented to students. Thus the display of visual images accompanied by the teacher's insightful questioning and responsive listening strategies accommodates differences in the higher order thinking skills of students. In any of these scenarios, the teacher has the responsibility of supporting the perceived needs of individual students. Success in providing for differing needs and characteristics, therefore, may be influenced by the scope of the teacher's pedagogical knowledge and practices.

Different ability levels of students can be catered for by teachers choosing digital resources which have built-in multi-level tasks or are designed with multiple choice answers, each with specified end points, options chosen by Peta and Jay. These types of tasks enable students to monitor their own learning and progress by receiving instant feedback to their responses. Conversely, when students are required to create a product, as Kath, Laura and Tonia had decided, the quality of the end product determines the achievement levels of a student and allows for diversity of abilities. The task of creating a product allows for further differentiation of student needs when a teacher constructs different starting points and establishes expectations, as Tonia did. She provided the first step of the task for a small group of special needs students in her class. There was an expectation that the more able students

would be challenged by the task and demonstrate the extent of their knowledge in their creative or innovative final products.

Apart from choosing multiple representations of concepts within a lesson to sustain students' interest, the intentions of all the teachers were to provide for the differing ways in which their students learned. With technology, a variety of static and interactive digital images, problem-posing scenarios or stories can be selected by teachers in their endeavours to accommodate student differences. These visual images may be accompanied by text or voice-overs, which in the latter case assist students with limited reading skills. In providing affordances for discussion and critical analysis of these images, teachers are able to further account for student differences in their styles of learning, for example, through the introduction or reinforcement of concept vocabulary and the promotion of higher order thinking skills. Important too is the appeal, relevance and authentic settings of visual images to students' everyday world, as exemplary practices of teachers have shown (Ottenbreit -Leftwich, 2007). Peer appraisal of students' work and explanations by them are also useful to students in understanding how learning was achieved. All the teachers interspersed these forms of representations without using technology, such as diagrammatic representations, students' physical representations and reference material. Other studies have also found that expert teachers are adept at presenting content and concepts in multitudinous forms (Hattie, 2003; Schempp et al., 2001). Technology affords another dimension for such opportunities, as the teachers in this study demonstrated in their practices.

Each teacher had her own unique way of designing and delivering student learning activities, yet there were features common to all. Their

approach to teaching was exemplified by their enthusiastic interactions with the students and passion for their chosen profession, attributes which Berliner (2001) also found in expert teachers. All the teachers believed that by using technology to support student learning they were creating a highly motivating learning environment and one which had relevance to students' everyday lives. These beliefs resonate with the findings of other studies (Ottenbreit -Leftwich et al., 2010). Three of the five teachers also believed that when technology was integrated within the curriculum, this made learning more cohesive. Further benefits to students, this group believed, were the empowering qualities which technology could provide for students, that is, students could manage their own learning, which would give them a sense of control. Another advantage which the group stressed, were the means technology offered to visual learners.

It is not only beliefs about the benefits of technology to student learning which can influence the construction of learning activities. Teachers' own learning experiences, the scope of their pedagogical knowledge, particularly in differentiating students' needs, and the purposes for which they use technology also have an impact upon practice. In this study, although these experiences and knowledge differed, considerable insight was gained into the numerous strategies used by the teachers and in distinguishing the practices of experts.

The next theme discusses learning strategies of teachers in relation to 1) management of the curriculum, 2) collaboration and 3) developing knowledge.

Professional learning adaptive strategies

Teachers in this study adapted their professional learning strategies to manage delivery of the curriculum and to maximise the efficient use of their time. Lack of time has been often cited as one of a number of extrinsic, or first

order, barriers to successful integration of ICT into teaching practices (Chen, Tan, & Lim, 2012; Divaharan & Lim, 2010; Ertmer, 1999; Hew & Brush, 2007; Keengwe, Onchwari, & Wachira, 2008). Reasons abound. Teachers need time to learn about, and with, new technologies, keep up-to-date with changes in technology developments, search for teaching /learning digital tools and resources, make changes to lesson planning and manage computing equipment in lesson delivery. Underlying these reasons, however, are teachers' beliefs about their capabilities to master new skills and to successfully acquire new knowledge (Morgan & Kennewell, 2006).

The study teachers were not deterred by the inherent problems of time constraints in the choices they made about accessing their learning experiences. They had adopted a number of positive measures which were aimed at using their time in the most efficient way, namely, to manage curriculum delivery, to seek learning opportunities and to work collaboratively. In these ways, like experts in teaching, and with technology, they sought to find ways of understanding difficulties and to be creative in their analysis of solutions to problems (Goodwyn et al., 2009; Hattie, 2003; Tsui, 2009).

The teachers' willingness to learn, their strong desire to be experts and to spend long periods of time in practice, exploration and experimentation with digital tools and resources were motivating influences associated with their decisions to improve and change their practices. Undertaking changes to teaching practices, changes which can occur over time, entails commitment to learning and growth - a feature of all the teachers' attitudes to improvement. Kath's choice of strategies, for example, through participation in action research projects with other schools, involved finding ways to develop new knowledge

about the delivery of a technology-supported curriculum and applying different pedagogical approaches to student learning (Orlando, 2014). To a large extent, the professional learning of all teachers was gained by collaborating with their peers in planning, delivering, sharing experiences or reflecting upon learning activities, in addition to observing colleagues modelling teaching strategies using technology (Ertmer, 1999; Fullan, 2007; Warwick, 2007)

Managing curriculum delivery

Led by the valued and respected expert knowledge of Kath, all the classroom teachers in this study used a time-saving strategy in the delivery of a technology-inclusive curriculum. The difficult task of achieving a multitude of objectives within each of many learning areas was addressed by learning how to design cross-curricula activities for students. In practice, this meant that planning could accommodate multiple learning outcomes across subject areas within single lessons.

To attain these goals, teachers who are expert in the integration of digital tools and resources to support their pedagogical practices need to have acquired extensive related knowledge (Goodwyn et al., 2009; Kozma, 2011b). The acquisition of comprehensive curriculum knowledge and knowledge of content, pedagogy and technologies, as a foundation for practice, is one aspect of that knowledge which demonstrate these capabilities (Koehler & Mishra, 2009; Pierson, 2001). Participation in external professional development courses is a medium in which teachers can engage for this purpose. However, where courses are designed to meet group learning objectives, teachers often find there is little relevance to their own unique needs and pedagogical knowledge bases (Ertmer & Ottenbreit-Leftwich, 2010; Orlando, 2014).

Teachers in this study drew similar conclusions even though the school was supportive of these courses and the teachers attended them regularly. None of them believed that this type of learning had been a significant influence in their growth as a teacher. Jay had recounted the many learning advantages of her teacher training course, but chose not to include this in her final selection of influential experiences on her current level of teaching quality. In Tonia's opinion, inactive participation on a course was not necessarily an advantageous use of her time. It could be concluded that awareness of specific needs, and therefore course relevance, develops with professional growth. Teachers then become more discerning in their selection of learning experiences and useful strategies.

Provision of professional learning strategies where teachers choose to access expert knowledge according to their own perceived point of need can be far more beneficial to facilitating growth in practice (Mayer & Lloyd, 2011). This provides them with control over their learning. A professional learning model, which the school had instigated eight years earlier to influence the growth of technology-supported teaching, was the appointment of Kath as a resource teacher. Her role was dedicated to the integration of ICT within the curriculum (Tondeur et al., 2009; Tondeur et al., 2008). This role was unencumbered, that is, although Kath was able to supply some technical knowledge, the school had a separate technical support system. The teachers could choose to learn by observing the modelling of pedagogical-influenced strategies (Fullan, 2007). These incorporated students' use of computing skills and applications within the context of concept development of curriculum content objectives. Teachers regularly observed Kath's teaching strategies and frequently sought her advice

and recommendations in the design of learning activities for their students. The teachers' range of choices also extended to learning about, and accessing, the store of curriculum- relevant resources, student learning pathways and activities which had been recommended and modelled by Kath, as the expert in technology-supported teaching. These decisions of the teachers enabled them to minimise their time in searching for, and selecting resources, and in their creation of learning activities for their students.

Success in this type of learning pathway to advance teachers' cross-curricula knowledge is also dependent upon the perceptions teachers have of the role model and the characteristics of that person to communicate effectively with other teachers. Kath not only lead by example but demonstrated her comprehensive professional knowledge and practices (AITSL, 2012a). Teachers need to acknowledge and respect the knowledge of a role model if they are to believe that their own practices could be enriched. Practices, such as showing strategies which engage students, catering for diverse needs, empowering students to seek information and enabling them to construct products to demonstrate their learning, must be easily accessible and transparent to facilitate teachers' professional learning. In addition, good communication skills, showing an awareness of colleagues' needs can inspire them through modelling of practices, as Kath demonstrated. The research of Berliner (2001, 2004) also identified these qualities as those of an expert teacher.

While this section has focused on learning strategies which teachers can adopt to manage the curriculum, the next section discusses experiences of working collaboratively which can promote professional learning.

Working collaboratively

Depending on teachers' choices of collaboration to advance their professional learning, working collaboratively can save teachers' time or require considerable expenditure of their time, as this investigative study highlighted. All the teachers believed they benefitted from their chosen forms of collaboration, which were demonstrated by their practices, as they worked towards a common goal of excellence within their school community. Goals of excellence were evident in the school's policies and plans for a technology-inclusive curriculum, and were reflected in the pedagogical practices of the teachers.

Pedagogical practices, however, can be influenced by teachers' learning experiences and characteristics, as teachers in this study demonstrated. Integral to their collaboration were their characteristics, such as those Berliner (2004) described about experts, namely, passion for teaching, motivation to succeed, strong desires to excel and meet high achievement goals. Teachers' learning experiences as collaborative activities were supported by the school as it generated and encouraged such opportunities. These cultural characteristics of a school, that is, teacher attitudes, shared goals, leadership support and common values, are influential in providing an environment conducive to successful technology-supported teaching as other studies have shown (Divaharan & Lim, 2010; Fu, 2013; Tezci, 2011; Tondeur et al., 2009).

All teachers declared they felt part of a team which gave them a sense of community. They valued collegial sharing, as a means of improving their knowledge, practice and skills. Working together as a team in this way, to direct the design and creation of learning activities for students, indicated that expert teaching in a supportive environment can also be encouraged and fostered

when the voice of teachers is valued. This is manifested in the shared vision of leadership and teachers as they make decisions about the goals for a technology-inclusive curriculum.

The decisions teachers make about the form of collaboration, in which to engage, appear to be linked to their intentions, their learning needs for professional growth and their perceptions of the efficient management of time. According to Cook and Friend (2010), collaboration is a style, which they described as being “based on mutual goals; parity; shared responsibility for key decisions; shared accountability for outcomes; shared resources; and the development of trust, respect, and a sense of community” (p.2/3). Others have used this comprehensive description as a basis for explaining different models of collaboration (Haydn, 2014; Piechura-Couture et al., 2006; Weindling, 2005)

Collaborative models adopted by the teachers in this study were varied, though their decisions were in part influenced by their positive problem-solving approaches to find solutions to a perceived lack of time or resources in their delivery of the curriculum. In part, this was the basis for the decision of Peta and Jay to team teach, with the support of the school. Compatible beliefs about pedagogical practices and the benefits of ICT to enhance student learning had enabled them to adopt an efficient management approach by sharing many aspects of their planning and curriculum delivery. This included combining their classes on a regular basis. Their model of collaboration would be deemed a form of co-teaching (Cook & Friend, 2010). Laura and Tonia engaged in a limited form of this model. Faced with limited hardware facilities, being new to the school and believing strongly in the value of collegial experiences, they chose to support one another by planning their themes and teaching

programmes together, as well as scheduling the sharing of resources. Other studies have also found that co-teaching, paired or team teaching, benefit the management of classroom practices and professional learning (Piechura-Couture et al., 2006; Rytivaara & Kershner, 2012).

Another collaborative model is one where coaching and mentoring are specifically embedded within professional learning experiences (Haydn, 2014). Not dissimilar to this model were the innovations, Providing Academic Excellence for Everyone (PACE) program and the visual literacy project, created and partially led by Kath. As a leader, she designed learning pathways and modelled technology-supported teaching strategies to encourage collaboration with, and among, the class teachers. All the teachers valued these collegial experiences, declaring that their professional learning and time management benefitted. Similar advantages were reported by Haydn (2014) in his study of expert teacher training practitioners and student teachers, where peer tuition and collaboration by the student teachers were suggested as being an effective approach to learn about “subject-specific pedagogical applications of ICT” (p.464). Student teachers were able to contribute their specific skills and content knowledge to a group project, while learning new skills and knowledge in a time-saving manner.

Yet another model of collaboration providing group learning opportunities is that of online communities of practice (Beach, 2012). Kath, for example, was the only teacher to participate in collaborative activities within online communities; experiences which she believed had made an important contribution to the development of her expertise and subsequently the professional learning of her colleagues. Other researchers and educators have

recommended communities of practices as a professional learning medium and an effective collaborative approach in technology-supported teaching to increase teachers' knowledge and skills (European & Schoolnet, 2013; Schleicher, 2012).

A commitment of time, however, is an important factor influencing successful development of collaborative skills. In learning to share and model practices, Kath was prepared to spend considerable time within and outside her normal teaching schedule (Beach, 2012; Weindling, 2005), to build on her skills of good communication, responsiveness to listeners and critical analysis of her performance – some distinguishing attributes of expert technology-supported teaching (Appendix N and Table 3.14).

According to Cook and Friend (2010) skills in collaboration are not necessarily acquired naturally but need to be learned, a process which requires reflection about teaching practices. This was demonstrated by Kath within her varied and successful collaborative activities. On the other hand, even though Peta and Jay were able reflective practitioners, the collaborative strategies they had adopted in their team teaching model lacked parity. As this was their first year of team teaching, their collaborative skills could still be developing. Teachers may need to develop an awareness of a need to develop these skills, gain knowledge about effective collaboration or be exposed to specific experiences. Growth in collaborative skills could benefit from learning about specific strategies, for example, responsive listening, interactive dialogues and how to manage role responsibilities, accompanied by self-reflection when working with colleagues or with the help of a mentor.

It is suggested that effective collaboration in all its forms requires skill in self-reflection, or as this study proposes, to monitor, analyse and reflect upon performance. Reflection on that performance can be viewed from two perspectives in collaborative models. The first is where the teacher reflects upon her own performance with reference to her own practices when choosing to participate in any model of collaboration. This form could be termed independent self-reflection. The second is where self-reflection is focused on appraising her performance when it involved her interactions with colleagues, for example, her role in the experience or lesson and how that liaison was managed. This could be known as associated self-reflection. It is suggested that to demonstrate the collaborative style defined by Cook and Friend (2010), that both independent self-reflection and associated self-reflection need to be present.

Self-reflection on their capabilities and knowledge of digital tools and resources is also needed when teachers make choices about how to improve their technology skills and keep abreast of new knowledge. These latter goals require commitment in order to build skills and knowledge.

Building skills and knowledge about digital tools and resources

The teachers' desire for improvement towards their goal of attaining excellence was one of the critical motivating influences on the growth of their digital skills and knowledge in this study. Equally important influences were the beliefs they held about the value of ICT to their teaching repertoires and the benefits to student learning environments. Attainment of these goals requires spending long periods of time seeking new knowledge along with building and practising their skills. This commitment also extends to continuous learning to

enable self-imposed high standards of teaching to be maintained. Teachers' decisions to undertake learning experiences which would enhance skill expertise can be linked to confidence in their abilities, performance self-efficacy characteristics and therefore appraisals of personal need. These characteristics and commitment to learning describe qualities of expert teachers and those who are expert in technology-supported teaching, as reported by other researchers (Berliner, 2001, 2004; Brown & Johnson, 2008; Goodwyn et al., 2009; Ottenbreit-Leftwich et al., 2010; Tsui, 2009).

All the teachers in this study were confident users of technology, indicated by their high scores in the instrument used for them to self-rate their own capabilities in computing skills and applications. This was matched by their attitudes when using technology with their students, for example, they reported they were often confident and comfortable in this teaching environment. Expert teachers are confident in their domain of expertise (Berliner, 2001; Ericsson, 2008), and similar conclusions could be drawn when considering the use of technology as one of the domains describing expert technology-supported teaching.

Teacher's confidence in their technological abilities is one motivating factor affecting their engagement in learning experiences to promote growth of expertise. Confidence and self-efficacy are associated, that is, beliefs about one's capabilities to accomplish tasks and reach goals. A perception by all the teachers of being good at their work was manifested in their confident approach to technology. As competencies grow with prolonged periods of use, it follows that confidence levels also rise. Aligned with these confidence factors are strong beliefs in the value of ICT to facilitate and enhance teaching/learning

processes, which in turn influences levels of commitment to direct teachers' choices of learning experiences.

With the goals of building and sustaining their skills and knowledge of digital resources applicable to their practices, teachers can adopt a number of different approaches to their learning, dependent on their learning preferences. For example, they can elect to undertake ICT skill development courses or workshops with a focus on technological knowledge, take part in online communities and attend conferences. Kath was the only teacher who stated that her learning had been influenced and her knowledge advanced through these latter two forums. All of these preceding approaches are designed for group participation with group objectives and provide exposure to resources from both commercial and Web 2.0 sources. The structure of these approaches for some teachers is the opportunity to learn by observation. Laura, for example, was the least experienced with technology (although her exposure and use amounted to 8 years), yet emphasised that, by observing new graduates at work, taking copious notes and practising, her learning was strongly influenced. Her commitment to practice in isolation also indicated that this was a learning strategy which facilitated the growth of confidence in a non-threatening situation. Time spent alone to deliberately practise, experiment, explore and refine their skills and knowledge about digital tools was a feature of the learning strategies adopted by all teachers. These strategies are all features of the level of professional engagement demonstrated by experts in technology-supported teaching (see Appendix N).

Learning without help also extends to searching the Internet for appropriate resources which will support the objectives of teachers' lessons and

have the potential to reflect their beliefs about student learning. On these grounds, resources must be carefully evaluated with selection relying on their relevance to the curriculum. Although Kath, with her background as an ICT curriculum leader, was able to make recommendations and teachers availed themselves of her knowledge, nevertheless, they all chose to independently spend considerable lesson preparation time in research on the Internet. This suggests that the teachers' reasons for this course of action illustrate one of the characteristics associated with expertise. It is known, for example, that experts and expert teachers strive constantly for excellence (Berliner, 2001; Ericsson, 2008). Motivation and perseverance are needed to pursue such aims. These qualities inform the teachers' decision-making processes of how to spend their professional learning time. In staying up-to-date with new technological knowledge, teachers have the opportunity to extend their pedagogical knowledge. Furthermore, the advantage of an increase in knowledge is ownership, making accessibility at their discretion and dependent upon their memory storage and retrieval systems (Ericsson, 2008). Both outcomes would reinforce their decisions about their learning experiences and add to confidence in their capabilities.

An interesting description given by three of the teachers about how they learned using the Internet was through play. Play has connotations of fun, enjoyment and being absorbed in an activity that holds a special appeal. Play has no external time restrictions, there is no pressure to excel and therefore mistakes can be made. When there is a pre-determined goal of searching for new ideas and the stimulation of growth or change in practice, then play activities have purpose. Skill and knowledge levels determine play strategies

and success of outcomes. Play does not seem like work. Rather play can be seen as a vehicle in which enthusiasm and passion for teaching are reinforced giving teachers freedom to manage their own learning environment without the responsibilities of managing student learning environments. It has been argued in a study about student teachers and the role of their play with technology, that play is an activity undertaken by choice, the pace of the activity is determined by the learner and the experience is more important than the outcome (Morgan & Kennewell, 2006). Similar explanations were given by three teachers as reasons for their strategy of learning through play. However, the outcomes were important to their learning as they wished to increase their knowledge.

The attainment of the goals teachers set for themselves in working towards excellence in technology-supported teaching are in part explained by their choice of particular learning strategies. There are other influences on their success which impact upon their attitude to growth and therefore change. The focus of the following theme is on 1) teachers' attitudes to change, 2) the influence of these on career pathway decisions, and 3) their risk-taking behaviour associated with the challenges of technology.

Attitudes to change, challenge of excellence and risk-taking

All the teachers in this study had sought challenges as they undertook different roles within their teaching careers, in using technology to support their teaching and in their desire for professional excellence. They not only valued the use of technology to enhance learning, but possessed considerable technological, pedagogical and content knowledge and confidence to succeed in challenges presented to them in technology settings. Other researchers have also concluded that the latter characteristic, teachers' confidence in their

abilities, is a particularly critical factor in affecting the decisions they make about changes to their practices with technology (Ertmer & Ottenbreit-Leftwich, 2010; Wozney, Venkatesh, & Abrami, 2006). Constant technological changes and innovations present teachers with ideas which may be unfamiliar or difficult to grasp. Yet expert teachers are prepared to take risks and are motivated to meet challenges beyond their existing knowledge to progress their professional growth (Berliner, 2001, 2004; Hattie, 2003; Schempp & Johnson, 2006; Tsui, 2009). The following discussion provides some insights into how decisions about change are influenced by teachers' professional goals and by the characteristics and experiences which enable them to reach for those goals.

Choosing change and the challenge of risk-taking

Teachers in this study gained experience in different education settings and with differing groups of students, in addition to making changes in their career pathways. Variety of experiences like these can broaden teachers' knowledge and increase their skills, affordances where confidence is gained in experimenting and testing new knowledge. Four of the five teachers had experience in other countries working with young children, students or teachers. The exception was Peta, who after many years as an accountant, had embarked on teaching as a second career, asserting it was the best decision she had ever made. Recognising and grasping opportunities like these also require being flexible in adapting to different professional environments, as the study teachers showed. According to Hattie (2003), it is their flexibility "not merely the knowledge/experience of possible scenarios that made the difference" (p.6) between expert teachers and experienced teachers.

Changes expert teachers choose to make to their career pathways may be influenced by their desire for a fulfilling professional life and their perceptions of the teaching genre per se. This may lead them to choose challenging environments, where their existing knowledge is questioned, motivating them to extend or modify that knowledge. It is suggested that perhaps expert teachers, wishing to maintain satisfaction in their work, need challenges, and therefore seek change and variety. For example, one teacher in this study, Laura, who had extensive teaching experience, expressed her guiding career principle in terms of wanting always to continue doing something different and to avoid boredom. Therefore, she chose some subjects non-related to teaching during her study; throughout her career, she had participated in adventurous activities and other experiences by putting aside teaching for periods of time. Each time she returned to the profession she loved, she felt rejuvenated by these experiences.

There is a difference between choosing to change and responding to change, as the attitudes of the teachers in this study illustrated. They chose to make changes not because it was imposed upon them, as responsiveness to change implies, but to decide on change as a result of reflection upon their practices. They were stimulated by a desire for constant improvement in their practices, because they were not satisfied with their current levels of pedagogical and technological knowledge. Similar influences on educational change have been described as professional agency, that is, decisions teachers make about their practices, their attitudes to change and their professional identity or perceptions of themselves as teachers (Vähäsantanen, 2015).

If teachers seek change and challenges in their practices, then ever-changing technologies are a medium in which these can be found. All the teachers in this study were enthused by technologies as a tool to support and enhance their pedagogical practices. Technologies present teachers with new information and ideas. This can excite dedicated teachers to commit to continuous learning and challenge them to solve problems they encounter as they endeavour to incept innovative learning pathways for their students or manage authentic contexts and settings with technology. According to Berliner (2001), the level of challenge emerging expert teachers choose to pursue, rests with their awareness of their own growth. This was affirmed by the teachers in the study. Insights provided by Kath indicated her intentions to focus her professional growth at a leadership level, as her goals were the improvement of quality in all technology-supported teaching. On the other hand, the four classroom teachers appraised their growth in terms of their own specific needs.

Expert teachers are able to ascertain their level of need, and therefore challenge themselves to understand and improve their practices, through their skills in self-monitoring (Webster & Schempp, 2008). For example, within Laura's level of technical knowledge and her desire to utilise technology in changing and improving her practices, she took on the challenge of adapting her IWB software to design learning activities for her students. Her actions and decisions were based on her previous experience with IWBs and the lack of this equipment in her current classroom. At a leadership level, Kath was challenged by adapting new knowledge to design and introduce the PACE and visual literacy programs in the school. In the construction and implementation of these programs it seemed that her intentions were to challenge the students and

herself (Loughran, 2007), as she sought to find ways of challenging other teachers to learn about and adopt different pedagogical practices with technology.

Innovations within a school not only present challenges to teachers, but in practice they also involve teachers taking risks (Ertmer & Ottenbreit -Leftwich, 2010), especially when new or different strategies are attempted. School cultures, which are supportive of technology innovations accompanied by possible risk-taking actions, can be an encouragement to teachers (Ertmer & Ottenbreit -Leftwich, 2010). In this climate, schools would then countenance both successes and failures from their teachers, as teachers would, of their students. The outcome for both could be according to Clifford (1990), that “risk-takers learn something about their skill and choice of strategy, and what they learn usually prompts them to seek another risk-taking opportunity” (p.24). There are some similarities to the concept of a design cycle for teaching with technology proposed by Laurillard (2013), insofar as a risk is taken to test out a strategy (test component of her cycle), the result is evaluated or reflected upon (re-design component) and an adaptive action taken (test again). Technology-supported teaching is a medium for such an opportunistic cycle while simultaneously motivating teachers and students to advance their learning. To achieve goals such as these, the teachers in this study collaborated with one another, they modelled and facilitated learning, and valued students’ contributions to the learning environment. All of these strategies were used by teachers in another research study about educational risk-taking, where specific schools were concerned with changing and fostering learning by providing technology-supported experiences for students (Wehrli, 2009).

Technology contexts can be especially forgiving of failure when teachers experiment with ideas and explore teaching strategies for lesson construction alone, without fear of performance appraisal or making mistakes. All the teachers in this study had a preference for learning about, and with technology in this way, due it seemed, to their strong belief in their capabilities and self-confidence. However, a teacher describing herself as a perfectionist and because of an attitude towards the attainment of excellence, as Peta had, may be stressed by the challenges she chooses to face in a technology context. For a perfectionist to be undeterred by challenges, and indeed manage them successfully, this approach can be an indication that the teacher has found suitable strategies to achieve her desired goals (Stoeber & Rennert, 2008). In this case, perfectionist attitudes are then reinforced and would be maintained.

Strategies chosen by teachers within a supportive school culture can explain risk-taking behaviour or activities, but there are other factors influencing outcomes. According to Brazeau (2005), a teacher's passion, commitment and learning from failure are critical to success. The study teachers were passionate, committed to their profession, and determined to make a difference to the learning experiences and outcomes both for themselves and their students. With this attitude it could be inferred that teachers would be willing to take risks. New staff members, as Laura and Tonia were, for example, are often a source of fresh ideas, and because of their knowledge and confidence may already possess a propensity for risk-taking. If teaching excellence is desired by schools, then leaders need to be sensitive and responsive to qualities like these and not dampen enthusiasm. As Brazeau (2005) said, "perhaps risk-taking is what in the end distinguishes a good teacher from a great teacher" (p.542).

Acknowledging qualities of excellence

Acknowledgement of teachers' qualities of excellence in technology-supported teaching can be a motivating influence on teachers' professional growth and contribute to their self-efficacy. Recognition takes different forms and is gained from different sources. Some examples are 1) professional bodies conferring formal awards/ scholarships for excellence, 2) successful grants for projects, 3) appointments to leadership roles by school managements, 4) judgements made by respected colleagues about accomplishments, and 5) research project participation. Any of these forms send a message to teachers that their work is valued and they have important contributions to make to their school and education. The excellence of each of the teachers in this study had been acknowledged in one or more of these forms.

During the professional careers of the teachers in the study, their qualities of excellence had been recognised by school managements. Three of the teachers had been appointed to leadership roles directly concerned with supporting technology integration or innovations. The specialised knowledge of the other two teachers had led them to roles where they were able to support colleagues. Interestingly, upon the nomination of Tonia and her acceptance to participate in the second stage of this research study, the rise in her self-esteem was most noticeable, according to Kath, the ICT head of curriculum. Kath reported that her own professional growth was considerably influenced by her experiences in winning grants and scholarships, and participating in national and international conferences.

These forms of recognition or feedback suggest that teacher self-efficacy beliefs are influenced positively as a form of social persuasion (Pajares, 2002).

In these instances, the judgements about a teacher's achievements or performance, having been made by others of some professional standing, are valued and an encouragement to those desirous of growth. Hattie (2003) has asserted that expert teachers "are greater seekers and users of feedback information about their teaching" (p.6), than experienced teachers, indicating the importance of feedback on performance. Laura, for example, commented after one of her observed lessons that she wished the principal had been present to witness its success, voicing her obvious desire for acknowledgement of her creative use of current technology resources.

For teachers, feedback on their performance is also received from their students. The enthusiasm for technology which all the teachers generated during their delivery of learning experiences for their students was matched by the enthusiasm of the students undertaking their tasks. This reciprocity is another motivating influence on teachers' commitment to continually improve their knowledge and skills in the effective use of digital tools and resources.

An unexpected avenue of the value of recognising excellence in technology-supported teaching to influence performance came from comments volunteered by Kath at the conclusion of the research study. This research could have been perceived by the teachers as a commitment to a significant additional workload and as a one-way process of benefit only to the researcher. However, choice of the school by the researcher and, according to Kath, each participating teacher by the leadership team of the school, benefitted the school and the teachers. The focus of the study motivated the school to appraise the progression of its goals for technology integration. It encouraged the teachers to

reflect deeply in explaining and examining their pedagogical practices with technology as a stimulus to professional growth.

Summary

Three themes about expert technology-supported teaching have been discussed in this chapter. The first theme focussed on patterns in learning activity sequences, lesson objectives and management relevant to teachers' pedagogical practices. The second theme illustrated the adaptive strategies chosen by teachers to manage their professional learning experiences through working collaboratively and accessing the knowledge of an expert resources teacher. The third theme considered teachers' attitudes to change, risk-taking and the challenges afforded by ever-changing technologies, in addition to the influences of external acknowledgement of excellence on their self-efficacy beliefs. Within each theme the discussion highlighted the interdependent influences of profile descriptors and the impact of these on teachers' decision-making. It did not derive a definitive portrait of expertise in technology-supported teaching. Rather, it drew attention to qualities of teachers which not only distinguished attributes of experts in a technology context, but in doing so, indicated their differences as a progression along pathways of expertise.

Blending differing pedagogical approaches appears to be one distinguishing feature, when teachers adopt combinations of teacher-led instruction, facilitation and constructivist practices, according to their perceptions of the learning environment needs. Choice of digital resources, the range of concept and content representations, the intended learning outcomes and how these are interwoven into the management of student tasks and delivery of lessons provide insights into the scope of their TPACK and relative

growth of expertise. Distinctions can be made between experts using technology and experienced teachers in their strategies for planning and managing learning activities to facilitate and monitor student understanding. Similarly, other influences are apparent in their selection of topics relevant to students' experiential world and construction of lessons. This knowledge also seems to account for decisions made by teachers in the variations of pace and sequencing of their lessons when using technology, influenced too by their intuitive feel for lesson flow. These decisions can reveal teachers' own enthusiasm, enjoyment and beliefs about the value of learning with technology, together with an understanding of how to cater for students' differing needs. For example, affordances may be recognised to utilise technology for motivating, engaging and challenging students in their learning, for task differentiation or expectations of a quality end product. Expectations which experts in technology-supported teaching have of student performance appear to be a reflection of the high expectations they set for themselves in striving for excellence.

A feature of expert teachers' motivation for using technology is a desire for constant improvement and expansion of their knowledge and skills. Attainment of these learning goals is manifested in their commitment to continuous learning over prolonged periods of time and aided by confidence in using technology and belief in their teaching abilities. Self-reflection provides that awareness of learning needs and enables teachers to make reasoned choices which will foster their professional learning experiences. Collaboration with their peers makes it possible for teachers to learn about, and develop, expertise in the efficient management of cross-curricula student activities. This

is particularly relevant in the achievement of multiple outcomes afforded by careful selection and considered uses of digital resources and tools. The success of collaborative learning experiences for teachers can be facilitated by a supportive school culture. In this environment a curriculum leader, expert in technology-supported teaching, is able to benefit the professional learning of colleagues by assisting with the construction of students' learning pathways and modelling strategies for teachers to observe.

Factors which appear to have an influence on why experts in technology-supported teaching seek and embrace change are professional agency, in the context of the constancy of changes and challenges presented by technologies. Risk-taking behaviours are evoked, for example, when innovative digital projects are introduced, and encouraged by a supportive school culture. Feedback on performance is equally influential, particularly when excellence is acknowledged and made visible to colleagues in local, national and international arenas.

The final chapter of this thesis provides a brief overview of the investigation and its design. Conclusions are drawn about the inter-related influences of teachers' pedagogical practices, learning experiences and personal characteristics upon the growth of expertise in technology-supported teaching. These led to a summary of recommendations for schools and teachers. In recognising the limitations of the study, suggestions are made for further research.

CHAPTER TEN

CONCLUSIONS AND RECOMMENDATIONS

This research sought to increase our understandings of those unique facets which capture the essence and growth of expertise in technology-supported teaching. Its intention was to explore the journeys of teachers and the complexities of expert teaching with technologies, as a means of contributing to our knowledge about progressing the quality of education in our current society. From this premise, a methodology for the collection of data about expert teaching styles with technologies in working classrooms was adopted to construct a relevant research study. An investigation of the acquisition and influences of teachers' background knowledge and their pedagogical beliefs in conjunction with the growth of their practices provided differing perspectives about expert teaching with technologies.

Overview of the study

The aim of this research study was to describe the features of primary teachers' expertise in technology-supported teaching and to discover those influences which impacted upon their journeys of professional growth. To examine their teaching qualities, comprehensive sets of descriptors were created. Dimensions were the teachers' pedagogical practices, their learning experiences and their personal characteristics. Significant experiences or events which they believed had contributed to their technology-supported teaching qualities, were categorised. The research design utilised mixed method techniques, incorporating multiple case studies, cross-case analysis and was *informed* by grounded theory. Observations of teachers at work were

conducted, complemented by interviews and stimulated-recall interviews of video and audio footage of their lessons. The presentation of the data as case studies yielded a source of rich data upon which to synthesise findings and draw conclusions to address the research question and its ancillary parts.

The research was conducted over two data collection stages, within a year, in an independent school with five participating teachers. These were the librarian resource teacher who was also the head of curriculum ICT, two Year 6 teachers and two Year 4 teachers who worked collaboratively. The school was chosen because of its policies towards the use of technology, its infrastructure, its prolonged use of technology and the support of the leadership team. Teachers were recommended by school management, according to the researcher's request for participants, who were known confident and regular users of technology, had adopted a cross-curricula approach in their teaching, believed that ICT was essential to the effectiveness of their teaching program and who were good reflective practitioners. Students had access to class sets of Mininotes, either one set per class or a shared set and a computer laboratory adjacent to the library, which also housed an IWB. In each classroom there was a data projector connected to the teacher's laptop.

Research question

The overarching research question was directed at the features of primary teachers' journeys towards expertise in technology-supported teaching. Supplementary features considered the relationships and influences amongst teachers' pedagogical practices, their learning experiences and their personal characteristics.

In this study, journeys of expertise in technology-supported teaching varied according to the extent of progress teachers made along continuum pathways, which were described by the domains of pedagogical practices, learning experiences and personal characteristics. There were most variations of growth amongst teachers in their pedagogical practices, with fewer differences in their learning experiences and many similarities in their personal characteristics. Progress for all teachers was attributable to the motivating influences of their desire for excellence and on the reasoned decisions they made about their choice of learning journeys and experiences, in order to acquire their technological, pedagogical and content knowledge. Teachers' practices and learning were influenced strongly by the resource teacher, who was dedicated to improving the quality of education through the use of technology.

In a technology context, which was stimulating and challenging to all the teachers, new knowledge was continually sought. Prolonged amounts of time were spent deliberately in pursuit of this and to practise skills - strategies found by other research into expert teaching and expertise with technologies in education (Brown & Johnson, 2008; Goodwyn et al., 2009; Ottenbreit-Leftwich et al., 2010; Tsui, 2009). This approach was influenced by high levels of confidence in their ability to use digital resources and tools, aided by their competence and beliefs in the value of technologies to enhance student learning.

Teachers' highly developed self-reflective skills led to their identification of influences they perceived as having a significant impact on their journeys of growth and the quality of their current pedagogical practices and technology

skills. Important learning experiences for teachers were those of accessing and utilising the knowledge and skills of the resource teacher, sharing and learning from their colleagues, and in the classroom as they monitored and analysed their practices.

Pedagogical practices and influences

Variations of expertise in their pedagogical practices were dependent upon, and influenced by, the depth of a teacher's technological, pedagogical and content knowledge, the availability of digital tools and resources, and how they incorporated these purposefully within lessons. Their pedagogical practices were typified by a blend of pedagogical approaches and learning theories ranging from teacher-led instruction to the implementation of student-centred learning experiences (Miller, 2008).

Contrary to the expectation that a technology-inclusive curriculum would initiate and produce considerable change to pedagogical practices and be exemplified by a student-centred model of teaching, findings in this study suggested otherwise. Teaching strategies embodied features of constructivism, an enquiry approach, discussion, collaboration and practice of skills (Laurillard, 2013), with or without the use of technologies. Teachers had learned to cater for students' differing needs in their choice of digital resources and design of authentic learning activities, which were dynamic and stimulated student engagement. Multiple representations of a concept were used (Hattie, 2003), with and without technology, because teachers believed this approach catered for student diversity and facilitated understanding. Achievement of multiple outcomes in a cross-curricula thematic approach was incorporated within a lesson, not only to provide concept cohesion and meaningful learning

experiences for their students, but to maximise the efficient use of their time. Teachers acted as facilitators, provided constant feedback and monitored learning through questioning. By providing examples and models, teachers made known their expectations and beliefs about their students being capable of attaining high standards – a reflection of their personal goals to always strive for excellence (Berliner, 2001).

Teachers' experiences in different educational settings, their background professional knowledge and their beliefs about student learning influenced the differing emphases they placed upon lesson construction and pace of delivery utilising digital resources and tools. Implementation of lesson construction ranged from a step-by-step modelling approach with teacher instructions and student accomplishment of individual tasks, to a fluid blend of lesson objectives, a variety of facilitation strategies and collaborative activities in student-centred tasks. Differentiating the learning abilities of students was catered for in the design, modification and implementation of tasks with technology. The delivery of fast-paced lessons was influenced by beliefs that technologies had the capacity to increase the speed of learning. When there was a belief that student understanding could best be achieved through discussion, limited use of technology was made. Learning activities, requiring students to create a product, were designed by teachers to demonstrate student understanding and to differentiate outcome levels.

Learning experiences and influences

Decisions teachers made about their learning experiences were influenced by their willingness to learn, to change and their commitment to staying up-to-date with new technologies and innovations. Teachers chose to

spend considerable out-of-school time in searching for teaching resources using strategies they described as learning through play. This attitude of perseverance, a desire to excel and overcome problems, influenced their preparedness to implement and learn from risk-taking activities which they were prepared to undertake with their students.

Teachers asserted that their learning benefitted from working with the expert resource teacher, who was an inspirational role model. She designed learning pathways with supporting curriculum-related digital resources for their students and modelled a range of technology-supported teaching strategies in the inception of innovative school projects.

Observing the strategies of role models and engaging in various collaborative teaching models were valued highly by teachers. There was collaboration between teachers in their preparation and planning, particularly in writing programmes of work and sourcing digital material. Collaboration also extended to models of team teaching, though some skills in successful collaboration were lacking. Each of these experiences were encouraged and promoted by a supportive school environment.

Personal characteristics and influences

Similar personal characteristics of all the teachers, particularly their performance self-efficacy, through self-reflection and self-monitoring, were found to impact upon their desire for constant improvement and professional excellence. Their self-efficacy beliefs were influenced by different forms of respected professional judgments made about the quality of their teaching. Feedback on excellence was valued when peers sought their advice, when school management appointed them to specialised roles, when professional

bodies conferred awards and grants, and when they were selected for participation in projects.

A distinguishing feature of the extent of expertise was found between the resource teacher and the other four teachers in their goals for growth. Goals directed towards raising the quality of education impacted upon the activities of the resource teacher, who had a universal vision and strong belief in the innovative opportunities and benefits to teaching and student learning afforded by technologies. In contrast, the focus of the other teachers was on their own personal journeys of growth.

The teachers' attitude to change was empowering. They actively sought change, rather than only responding to change. They sought diversity in their career pathways, which enabled them to maintain their passion and enthusiasm in their profession, that is, their job satisfaction (Pajares, 1992). Some actively sought or held different roles within a school or worked in different educational settings, including other countries. One teacher chose to engage in creative projects across schools worldwide. For all teachers, their decisions about change seemed connected to their desire for the challenge of confronting new knowledge, an environment which technology so readily supplied.

Research question conclusions

This research into technology-supported teaching has found that the growth of expertise can be described, and is influenced by many factors or inter-related dimensions. One significant dimension is the quality of a school's structural and cultural characteristics. Then a school can provide a curriculum leader as a role model, support scenarios for collaboration, understand professional learning needs as unique for each teacher and foster the

recognition of excellence. Further interconnected dimensions are an expert's desire for excellence and performance self-efficacy characteristics, which are strong influences on teachers' pedagogical practices and professional growth in technology-supported teaching. While it is useful to distinguish between expert and experienced teachers or experts and non-experts in these terms, it is more encouraging to regard distinctions in terms of descriptors, and their related influences, on a series of pathways. Mapping of growth along continuums acknowledges variations in expertise, yet accommodates continuing commitment to improvement. The creation of a comprehensive range of descriptors about expertise in technology-supported teaching across the inter-dependent domains of their pedagogical practices, learning experiences and personal characteristics, makes this possible.

Recommendations for school leadership and mapping of growth in expertise

Influences within the structural and cultural characteristics of a school can determine the levels of support and encouragement given to the advancement of expertise. In a supportive school environment, teachers are valued as team members when they share in its policy planning processes and participate in the achievement of goals which a school has for using technology to facilitate and enhance student learning.

However, a sense of ownership in shared goals does not necessarily mean that teachers will be successful in their attainment. School management and its leadership team should provide practical support for teachers at their perceived and self-determined point of need. A number of strategies are recommended.

Appointment of a curriculum leader expert in technology-supported teaching as a dedicated role within a school has many benefits for the professional learning of its teachers. Critical qualities of a good leader in this role are well-developed communication skills. These skills not only contribute to the successful inception of innovative strategies and projects, but also enable a leader to act as a mentor or coach by providing a trustworthy climate for the needs and ideas of teachers to be heard and respected. A leader should have the time and knowledge therefore to source digital resources, design learning pathways, engage in other learning communities as a source of knowledge, and collaborate with teachers in the delivery of learning activities for students. The influence of a role model in this setting can inspire and motivate other teachers to learn. A teacher librarian would be ideally positioned to undertake such a role.

These forms of sharing the workloads of classroom teachers assist them in the effective management of their time, particularly in the time-dependent context of technological changes and innovations. Sharing can also be a source of mutual satisfaction, as reinforcement of a team approach to the achievement of teaching / learning objectives. Organised shared learning sessions, where teachers feel they can play with technology, could be considered as an adjunct to building team strengths and raising awareness of individual levels of expertise.

When these kinds of support are visible and easily accessible, teachers are able to make choices about their individual professional learning needs within specific teaching contexts. This is in contrast to attendance at organised professional development courses which often may not meet individual needs.

Informal learning experiences can also fulfil these needs, such as, collegial sharing and learning from other teachers

Experts in technology-supported teaching appear not to be daunted by barriers to learning and successful management of the curriculum. Their positive attitudes to the solving of problems, such as limitations of hardware facilities or implementation to a demanding curriculum, challenge them to seek effective solutions. Strong school leadership would encourage these attitudes, listen to suggestions and support strategies such as collaboration, which would foster team work and the advancement of professional learning. Models of collaboration abound and should be investigated. Some examples are the sharing of responsibilities for planning, preparing and delivering learning experiences, searching for digital resources, taking a lead or supportive role, or sharing of roles by combining classes. The latter is particularly suited to technology contexts which are dependent upon resource reliability and management. Shared decision-making is an integral part of successful collaboration.

For collaborative models in teaching with technology to be successful in advancing expertise, teachers need firstly to be aware of the different forms and benefits to their style of teaching. In addition they need to recognise their own collaborative skills. When a lack of useful skills for successful collaboration is apparent, teachers need to have access to learning experiences where these can be acquired. Furthermore, where collaboration exposes teachers' practices to their peers, a trusting and tolerant environment is needed, as teachers' strengths and weaknesses become apparent. This climate has the added advantage of their learning being influenced by the powerful medium of

colleagues' modelling strategies and additionally, building self-efficacy beliefs in their own performance.

Recognition of excellence is another factor affecting performance self-efficacy and one in which schools can have an impact. They can provide and source avenues for recognition of excellence both within the school community and in more public domains. Recognition may take the form of working with colleagues in a specialised support, mentoring or coaching role. Feedback on performance also falls within the sphere of recognition. When feedback is given by respected school leaders, this can be highly motivating for teachers who are continually endeavouring to improve their practices. External forums, such as professional association recognition, online communities and national or international conferences are other avenues of influence, especially where teachers are invited to participate in collaborative projects or give presentations about their work.

By participating in these forums, teachers are being exposed to public scrutiny of their pedagogical practices. This requires a justification of changes they may have made, as a contrast to expected views of working with technology in education. For this purpose, expert teachers would critically appraise their professional identity incorporated within their professional agency (Vähäsantanen, 2015). That is, their level of skill in self-reflection would enable them to have a detailed knowledge and understanding of themselves as teachers, their beliefs about teaching and student learning.

These perceptions influence their decision-making and how they might choose to bring about changes in their practices. A useful tool for classroom teachers in this process could be the descriptors about expertise in this study.

They could gauge their own growth, set their goals accordingly, regardless of whether they had aspirations of leadership, and be encouraged to strive for excellence along continuum pathways.

Limitations and generalisability

This research study has a number of limitations. It was limited to five participating teachers, all of whom were female. The school was located in an affluent region and students were all girls in the observed classes. The data collection periods were limited to two over the course of a year. The study design focused on the qualities of the teacher but did not take into account the effects of expert technology-supported teaching on student achievement.

It could be argued that influences on the teachers' growth over time was also a limiting factor as the data source relied on teachers' identification of significant experiences or events in their careers. Nevertheless, these perspectives of the teachers were beliefs they had about the influences on their quality of teaching and were therefore considered to be valid.

These limitations make generalisability of the conclusions unwise. However, the scope of the case study source data and subsequent detailed analysis provided further insights into expert technology-supported teaching. In particular, were the influences on the decisions the teachers made about their practices and learning experiences, which were further shaped by those factors surrounding their professional agency.

Further research

It is acknowledged that the conclusions and preceding recommendations about expertise in technology-supported teaching originated in the findings of

this case study research. Further research of a broader scope is needed to explore the assertions made here.

Research across genders, for both teachers and students, of varying socio-economic backgrounds and different school systems would be one approach. A longitudinal study would be particularly useful in mapping growth of expertise along continuum pathways and in the impact on student achievements. Supportive school characteristics would seem to be a necessary setting in these forms of research.

Of particular interest, would be an investigation to extend the scope of this study on categories of significant influences on teachers' lives which they believe have contributed to their technology-supported teaching qualities. From a professional agency perspective, this could be a rich source of valuable data about the growth of expertise as journeys in technology-inclusive environments.

Conclusions

Expertise in technology-supported teaching is not a finite destination for professional growth nor is it an achievement stage consisting of separate labelled entities. It is a dynamic and unique journey for each individual teacher along continuum pathways. On those pathways, teachers strive for excellence in their pedagogical practices; practices directed and influenced by their choice of learning experiences and sustained by their personal characteristics. The features of that journey stem from an attitude of passion and enthusiasm for their profession, a belief that the use of technology makes a difference to the enjoyment of student learning and a constant commitment to their own learning and growth. The extent of that journey of growth is dependent upon teachers'

practices, knowledge and experiences, yet influenced by their performance self-efficacy and professional identity.

A distinctive feature of expert technology-supported teaching in this study was the teachers' positive approaches towards change as a way of overcoming problems. They did not wait for changes to be imposed because of technological advances or implementation constraints, but sought change through adaptive and creative strategies. Collaborative teaching models were adopted to support colleagues in curriculum management of digital resources and tools, in addition to providing access to exemplary practices and innovative projects. Curriculum delivery was changed by designing cross-curricula, themed learning activities for students supported by technology to meet multiple outcomes across subjects and maximise efficient use of time. Personal learning experiences were undertaken to acquire knowledge which enabled teachers to make those changes.

A holistic approach to understanding and supporting the growth of expertise in technology-supported teaching is an encouragement to schools and teachers who are excited and stimulated by the challenges afforded by technology to expand the horizons of quality in education.

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APPENDICES

Appendix A

Interview 1 Part A (before Observation 1) - focus of questions

- (i) Gender, qualifications, years of teaching experience, years of experience on work-related computing tasks, years of experience on using computers with students.
- (ii) Rate self on computing skills using the 100 Schools rubric. Invite expanded comment on cells marked by teacher.
- (iii) Target class description e.g. size, age, abilities, experience with ICT
- (iv) Comments about the general school environment (e.g. support, resources, school policy, professional learning), perceptions of self in school and about the school.
- (v) Describe/explain programme of work (aims/goals, strategies, learning activities and planned outcomes).
- (vi) Describe lesson to be observed including reference to any planning documentation, resources, management, role of teacher, role of students, role of ICT.

Appendix B

Interview 1 Part A (prior to Lesson 1, Observation 1)

Date:

1. Name:
2. Gender:.....
3. Age range:
4. Yrs teaching experience:
5. Yrs experience with work-related computing tasks:.....
- 6a. Yrs of experience on using computers with students:
- b. Type of tasks
- c. Training
- 7a. Rating of self on computing skills rubric (see attached).
- b. Invite expanded comments on cells marked
8. Describe perceptions of self:
 - a. as a teacher
 - b. as a member of school community
 - c. what are the things you could do without?
9. Invite comments about general school environment (current and preferred – solicit why):
 - a. Support (inc, leadership).....
 - b. Resources.....
 - c. School policy.....
 - d. Professional learning
 - e. Curriculum
 - f. How does the current curriculum lend itself to ICT integration?
10. Target class description (year group, size, age, abilities, experience with ICT):
.....
11. Explain programme of work (with access to records and focus on ICT):
 - a. Aims/goals
 - b. Strategies (e.g. type)
 - c. Learning activities (e.g. range)
 - d. Planned outcomes
12. Describe lesson to be observed with reference to;
 - a. Planning documentation (with specific reference to points a-d above)
 - b. Resources
 - c. Management.....
 - d. Role of teacher
 - e. Role of students
 - f. Role of ICT (how to be used).....

Appendix C

Interview 1 Part B (after Observation 1) - focus of questions

- (i) Explanation of lesson just concluded, including reference to lesson aims from Part A e.g. the key features of the activity, what was usual or unusual about the activity, the role of the teacher, changes in planned strategies.
- (ii) Reflective comments invited on significant features relating to ICT, particularly teaching strategies, goals of activity and pedagogical beliefs about choices of strategies made by teacher during the activity.
- (iii) Analysis and planning thoughts on the lesson to follow.
- (iv) Use the Experience of Change instrument in relation to how teacher feels about ICT
- (v) Describing self as a teacher, including pedagogical beliefs and goals (general, content/subject specific), and beliefs about how other professionals perceive them
- (vi) Identify / comment on critical times in their learning, learning strategies, their teaching qualities e.g. self as a beginning teacher, changes made to teaching (when, why and how), what is important in professional learning and descriptions of successful learning periods.
Refer also to Interview 1

Appendix D

Interview 1 Part B (following Lesson 1, Observation 1)

Date:

1. Name:
2. Explanation of Lesson 1 including reference to:
 - a. Overall perceptions
 - b. Lesson aims
 - c. Key features of activity
 - d. What was usual / unusual about activity
 - e. Role of the teacher.....
 - f. Role of the students
 - g. Any changes in planned strategies. Why?.....
3. Reflective analysis of ICT significant features and examples:
 - a. Teaching strategies
 - b. Goals of activity.....
 - c. Pedagogical beliefs about choices of strategies
 - d. Comments on plans for next lesson:
4. Administer Experience of Change instrument relating to how teacher feels about using ICT.
(see attached)
5. Describe self as a teacher:
 - a. Teaching goals (general, content / subject specific).....
 - b. Pedagogical beliefs (e.g. effective teaching, students as learners).....
 - c. Teaching approaches in different Learning areas
 - d. Professional goals and involvement in ICT school programs
 - e. Beliefs about how other professionals view her
 - f. Beliefs about ICT
 - g. Understanding of ICT integration
6. Identify and explain:
 - a. Critical episodes / influences on your learning
 - b. Own learning strategies / learning style (changes ?)
 - c. Own teaching qualities (changes ?).....
 - d. Significant professional learning episodes / life events / influences leading to successful teaching and learning
 - e. Perceptions and comparisons of self as a beginning teacher and now
 - f. Changes in teaching style (what/why/how)
7. What is your understanding of an integrated curriculum?

Appendix E

Interview 2 (after Observation 1 and with access to video and audio footage) – focus of questions

- (i) Comments by teacher on video and audio footage including examples which would describe the key features of the activity, what was usual or unusual about the activity, the role of the teacher, teaching strategies or any changes and reasons for changes in strategies.
- (ii) Anything that surprised you on the video about yourself, the activity or the students.
- (iii) The conduct of this activity managed without technology.
- (iv) The current relevance of the curriculum.

Appendix F

Interview 2 (with access to video / audio records)

Date:

1. Name:
2. Comments by teacher using examples to describe:
 - a. Key features of activity
 - b. What was usual / unusual about activity
 - c. Role of the teacher.....
 - d. Role of the students
 - e. Particular teaching strategies and purpose, evidence of outcomes
 - f. Changes in teaching strategies and purpose, evidence of outcomes
 - g. Anything that surprised you (the teacher) on video about self, the activity or the students?
3. What is different about this activity compared to something similar without the use of ICT?
4. Resources
 - a. Where do you find the resources?
 - b. What kind of resources?
 - c. Why would a particular resource be chosen?
 - d. Reasons for choosing particular learning object/s in observed lesson
 - e. Belief about how it / they could be used? Purpose? Value?
5. In your opinion, how well does the use of ICT fit within the curriculum? Why / why not?

Appendix G

Interview 3 – focus of questions

- (i) Stimulate recall, and further exploration, of the critical times in teacher's professional learning and influences on the nature and quality of their teaching. This will be in response to the Timeline constructed by researcher of these significant markers from data collected throughout interviews to date.
- (ii) Use the Becta Self Review Framework (2008) to further explore teacher's content and instructional pedagogy, particularly their beliefs and goals, on those items referring to students' thinking and learning skills, the curriculum, learning and teaching, professional learning and extending opportunities for learning.
- (iii) Final questions dependent on depth of data collected e.g. observed activities, pedagogical beliefs or goals in relation to practice, which may need further exploration or clarification.

Appendix H

Interview 3 (following construction of Journey timeline)

Date:

Name:

1. Timeline review.

Show constructed Timeline and invite discussion on chronological importance of each critical event / influence (e.g. professional learning, other influences on the teacher you are today).

Teacher add or discard labels. Invite ranking of importance and solicit reasons why.

2. BECTA Self Review Framework 2008 (selections from strands) – examples and opinions

- a. Leadership and management – how school monitors and evaluates the effectiveness of ICT
- b. Curriculum – differences in what is planned for and what is experienced
- c. Learning and teaching – examples of innovate use, choice of students to use ICT or not
- d. Assessment – how
- e. Professional learning – examples of shared practices within school
- f. Extending opportunities for learning – beyond traditional use of ICT, learning outside of school
- g. Resources – vision / what would you like to see next?
- h. Impact on student outcomes – students' attitudes to ICT.

3. Any further questions or responses needing clarification.....

Appendix I

Interview with principal

Principal:.....

Date:.....

Informal interview

1. School culture

.....

2. School policy and goals

.....

3. ICT integration policy & goals

.....

4. Leadership management

.....

5. Leadership curriculum

.....

6. Infrastructure

.....

7. Support – curriculum

.....

8. Support - technical

.....

9. Support – team

.....

10. Professional learning

.....

11. Roles of teachers in school

.....

12. Involvement in ICT school programs

.....

Appendix J

Documentation – samples / evidence / explanation

1. Record keeping
2. Assessment frameworks
3. Outcomes based?
4. Forms of reporting to parents

Appendix K

Instrument for computer applications and equipment self-rating of skill levels

Rate yourself on your skill level in using the following computer applications and equipment. For each row TICK THE CELL that best describes your skills.

Word processor	can't do much	can print a document, change fonts, spell check, insert footer and page numbers.	can insert images, create tables, change Page Setup, change margins.	can use columns and sections, set up styles, use mail merge.
Spreadsheets	can't do much	can enter data and calculations, format cells, use Sort, insert and delete rows and columns, create and modify charts [graphs].	can use complex formulae, use absolute and relative cell references, use multiple worksheets.	can use filtering, can use conditional formatting, can import data.
Databases	can't do much	can create simple tables, use simple queries to retrieve data, use wizards to create reports and forms.	can use relational databases, use wizards to create forms, sub-forms or portals, use more complex form design tools.	can create and use parameter queries, create summary reports, use complex functions in queries.
Slideshow software	can't do much	can create a slide show, insert images, change font and layout.	can navigate during a presentation, add animation, transitions, and hyperlinks.	can create a master slide, include sound, print handouts, add navigation buttons.
Email	can't do much	can create send and access emails, can add to and access Address book entries.	can store messages in folders, locate Sent and Deleted messages, add a Signature, can add attachments.	can create a mailing list, set up a discussion list.
Computer File Management	can't do much	can save files in a folder, create and name folders, can navigate between folders, copy, delete and rename files.	can recognise file types, navigate between drives, directories, and into a network, use Help files, install software.	can zip and unzip files, do complex searches for files, create short-cuts, use control panels to connect to networks.
The Internet	can't do much	can navigate to known web sites, can create Favourites, do basic searches.	can use advanced searches, organise Favourites, alter browser preferences, save images and text.	can conduct complex searches, download and install software and plugins, use different browsers.
Web page authoring	can't do much	can create pages and links, insert and format text, insert images, use tables, create external links.	can create a site using naming conventions and folder structure, insert sound, upload files to the web, use alt text.	can build a complex site, insert components such as JavaScript.
Digital photography	can't do much	can take and delete pictures in-camera and transfer images to a computer.	can review images on camera, adjust camera settings such as flash and close-up.	can adjust camera menu options such as resolution and shutter speed.
Image editing	can't do much	can edit images including crop, scale, rotate and delete.	on computer can change file size, resolution and format (eg jpeg, png) as appropriate to purpose.	can undertake complex image manipulation using special effects.
Video photography and editing	can't do much	can adjust camera settings (zoom and replay), transfer file to computer, assemble with minimal editing.	can use basic software to introduce transitions, import and edit sound track, add titles and subtitles.	can use advanced software to apply complex editing and special effects.

Reference: International Society for Technology in Education. (2000b). *National Educational Technology Standards for Teachers*: International Society for Technology in Education.

Appendix L

Instrument for Experience of Change

exhilarated	confused	isolated	irritated
enthusiastic	comfortable	cynical	supported
pressurized	satisfied	disappointed	confident
optimistic	sad	worried	frustrated
bored	pleased	angry	committed
anxious	valued	stimulated	interested

Often	Sometimes
Hardly ever	It doesn't seem relevant

Reference: Ainscow, M., Hargreaves, D. H., & Hopkins, D. (1995). Mapping the process of change in schools: The development of six new research techniques. *Evaluation & Research in Education*, 9(2), 75-90.

Appendix M

Teacher pedagogical practices

Proficient teachers	Highly accomplished teachers	Lead teachers	Teachers expert in use of ICT
<i>Professional knowledge</i>			
Cater for diverse needs & characteristics in engagement of all students, through teaching strategies & support from colleagues facilitated by use of digital resources & tools	Cater for diverse needs & characteristics in engagement of all students, through teaching strategies, assessment, support for colleagues facilitated by use of digital resources & tools	Lead colleagues to cater for diverse needs & characteristics in engagement of all students, through teaching strategies, assessment facilitated by use of digital resources & tools	Cater for diverse needs & characteristics of all students, through teaching strategies facilitated by use of digital resources & tools
Design & implement curriculum relevant teaching / assessment strategies facilitated by use of digital resources & tools	Demonstrate innovative practices & support colleagues in modelling comprehensive content knowledge & teaching / assessment strategies facilitated by use of digital resources & tools	Lead & support colleagues to develop innovative practices, comprehensive content knowledge & teaching / assessment strategies facilitated by use of digital resources & tools	Know what & how technology is used by society & students in their world. Demonstrate comprehensive curriculum knowledge & knowledge of content, pedagogy and technology interaction in design of subject-integrated learning activities Model learning, knowledge-creation strategies & processes using digital resources & tools Contd.

<i>Professional practice</i>			
Set challenging goals for students	Set & model high expectations for student learning	Lead & practice high expectations for student learning	Set challenging objectives
Use effective teaching strategies to engage students, using digital resources & tools in program & delivery evaluation, involvement of significant others	Work with & assist colleagues in selection of effective teaching strategies to engage students, using digital resources & tools for program & delivery evaluation, involvement of significant others	Model & lead colleagues in selection of effective teaching strategies to engage students, using digital resources tools for program delivery, evaluation & involvement of significant others	Select effective digital resources & tools, & from a range of problem-solving strategies to seek understanding of, and analyse creative solutions to, problems
Establish and implement strategies to ensure engagement of all students, safe learning environments & ethical use of ICT	Model and share strategies with colleagues to ensure engagement of all students, safe learning environments & ethical use of ICT	Lead & demonstrate strategies to ensure engagement of all students, safe learning environment policies & ethical use of ICT	Facilitate student self-assessment strategies using digital resources and tools.
Use diagnostic and assessment strategies relevant to student learning facilitated by use of digital resources & tools	Use effective diagnostic and assessment strategies for diverse students facilitated by use of digital resources & tools	Evaluate policies to support colleagues in effective diagnostic & assessment strategies for diverse students facilitated by use of digital resources & tools	Plan & implement open-ended, collaborative, problem –based & student-centred tasks facilitated by use of digital resources & tools
Assess teaching practices and reporting of student achievements facilitated by use of digital resources & tools	Work with colleagues to assess teaching practices and reporting of student achievements facilitated by use of digital resources & tools	Lead, model & evaluate assessment of teaching practices & reporting of student achievement facilitated by use of digital resources & tools	Select and use variety of technologies for broad range of differing tasks & purposes and within lessons
			Maintain safe learning environments respecting needs of all students in use of ICT
			Evaluate policies to support colleagues in effective diagnostic and assessment strategies for diverse students
			Lead, model and evaluate assessment of teaching practices and reporting of student achievement facilitated by use of digital resources & tools
			Routinize some lesson components
			Share relevant personal experiences with students
References: Australian Institute for Schools and Leadership (2012), Goodwyn et al (2009), Berliner (2004), Hattie (2003), Koehler & Mishra (2009), Kozma (2011), Schempp & Johnson (2006), Stough et al (2001), Webster & Schempp (2008)			

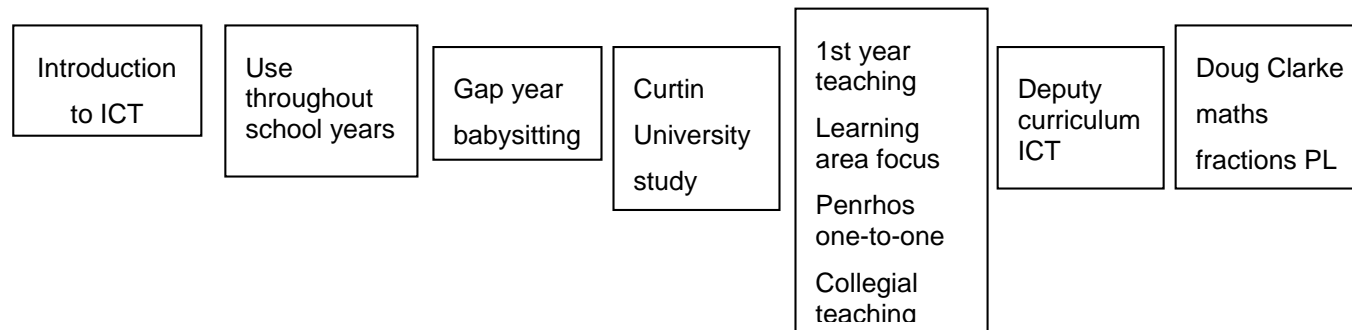
Appendix N

Teacher learning experiences

Proficient teachers	Highly accomplished teachers	Lead teachers	Teachers expert in use of ICT
<i>Professional engagement</i>			
Engage in discussion with online communities & use advice from colleagues to plan professional learning & improve practices in use of digital resources & tools with knowledge of goals for national teaching standards	Plan, engage in & evaluate professional learning opportunities & practices in use of digital resources & tools through research, knowledge of goals for national teaching standards & collaboration with peers	Plan, lead, evaluate & implement professional learning opportunities & practices in use of digital resources & tools through research, knowledge of goals for national teaching standards & collegial networks	Commit to continuous learning & extend competency boundaries by seeking challenges & as a result of challenges afforded by ICT
Demonstrate knowledge of ethical rules and policies	Know ethical rules and policies, demonstrate knowledge & support colleagues in maintaining.	Model ethical behavior at all times, lead development & collegial understanding of policies	Stay up-to-date with & accommodate change in ICT practices
Engage professionally with significant others and the community to improve practice	Engage professionally with significant others and the community	Lead colleagues in professional engagement with significant others and the community	Spend time to deliberately develop, experiment, explore, evaluate, refine & practice high level ICT skills
			View learning with digital resources & tools as shared process between self & students.
			Collaborate with, be coached by, learn from, & act as role model for colleagues in the integration of digital resources and tools
			Undertake additional roles of responsibility
References: Australia Institute for Schools and Leadership (2012), Goodwyn et al (2009), Berliner (2004), Ericsson (2008), Koehler & Mishra (2009), Kozma (2011), Pierson (2001), Tsui (2009), Webster & Schempp (2008)			

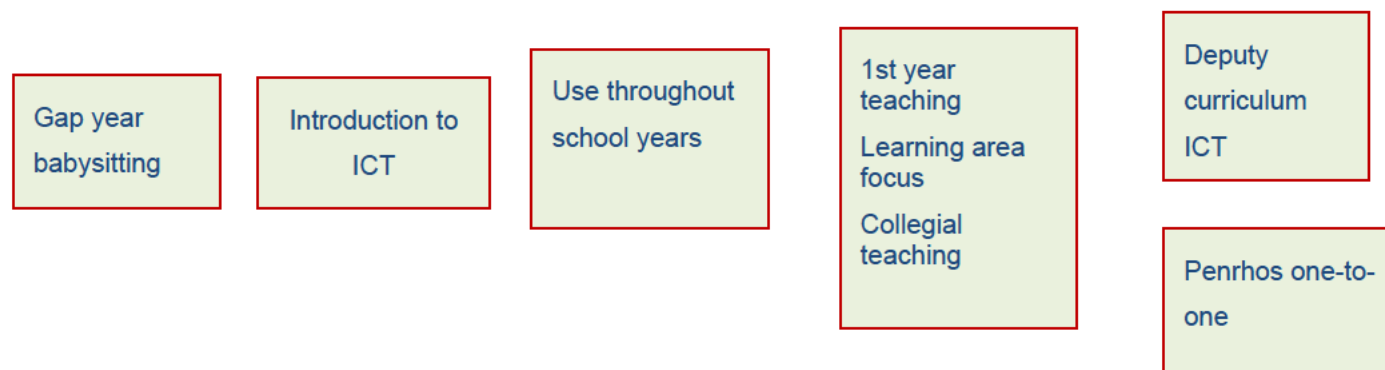
Appendix O

Example of teacher perceived important influences on professional growth – Chronological order



Appendix P

Example of teacher perceived influences on professional growth - Importance ranking



Appendix Q

Example of researcher journal during informal observations

Notes from informal discussion

24/7/11 K
 Tr 4 outside interest in local (re. vegetation) park - key role.
 Was an accountant, decided to change, trained at Murdoch (heavy concentration on theory, should inc. more practical work as you learn on the job). Loves teaching, was merit tchr w/- DETWA, 3 yrs at St H. Believes in active student participant, doing things facilitating learning in fun way loves maths, team teacher (w/- Murdoch (Swindon) but plan everything tog. + classroom identical).
 My impressions:
 Very articulate, obviously highly developed reflective skills, enthusiastic v. +ve about school, students, resource support, gave inv-depth/detailed response.
 C'room: stimulating
 Mini maths books - 5 qu. on board in morning, st. do, gives time to do one on one.
 Has groups.
 Always learning, asks qu.
 Commented about messy c'room.
 Visually stimulating c'room - printed posters, tchr prepared posters, students' work.

Notes from informal observation

Most st. following in own books. 10.3.11
 Qu. "What is a fact?" "What is a falsehood?"
 Info sheet + inst.
 Tchr reading aloud again - whole piece.
 "1 min 30 sec to share a fact" - St. discuss.
 T b'd group ideas about BTL (facts).
 (T reinforce acceptable listening behaviour).
 Rpt Throughout the lesson intr. given + reinforced + checked.
 → Sts given a time frame to complete task.
 There was no talking everyone on task. Count down on time to complete given. Tchr walked around but did not interact.
 Next inst. given w/- timeframe. Tchr explain/help 1 st.
 → Same strategy.
 Sts finished come to floor, swap books, read + mark, others cont. to complete. Tchr checking. Sts finished cont. w/- more F + F.
 Not everyone finished.
 Whole class revise - incl. + leading F / Falsehood.
 Mini Notes out. - Mathematics (mental maths) - st. logged on.

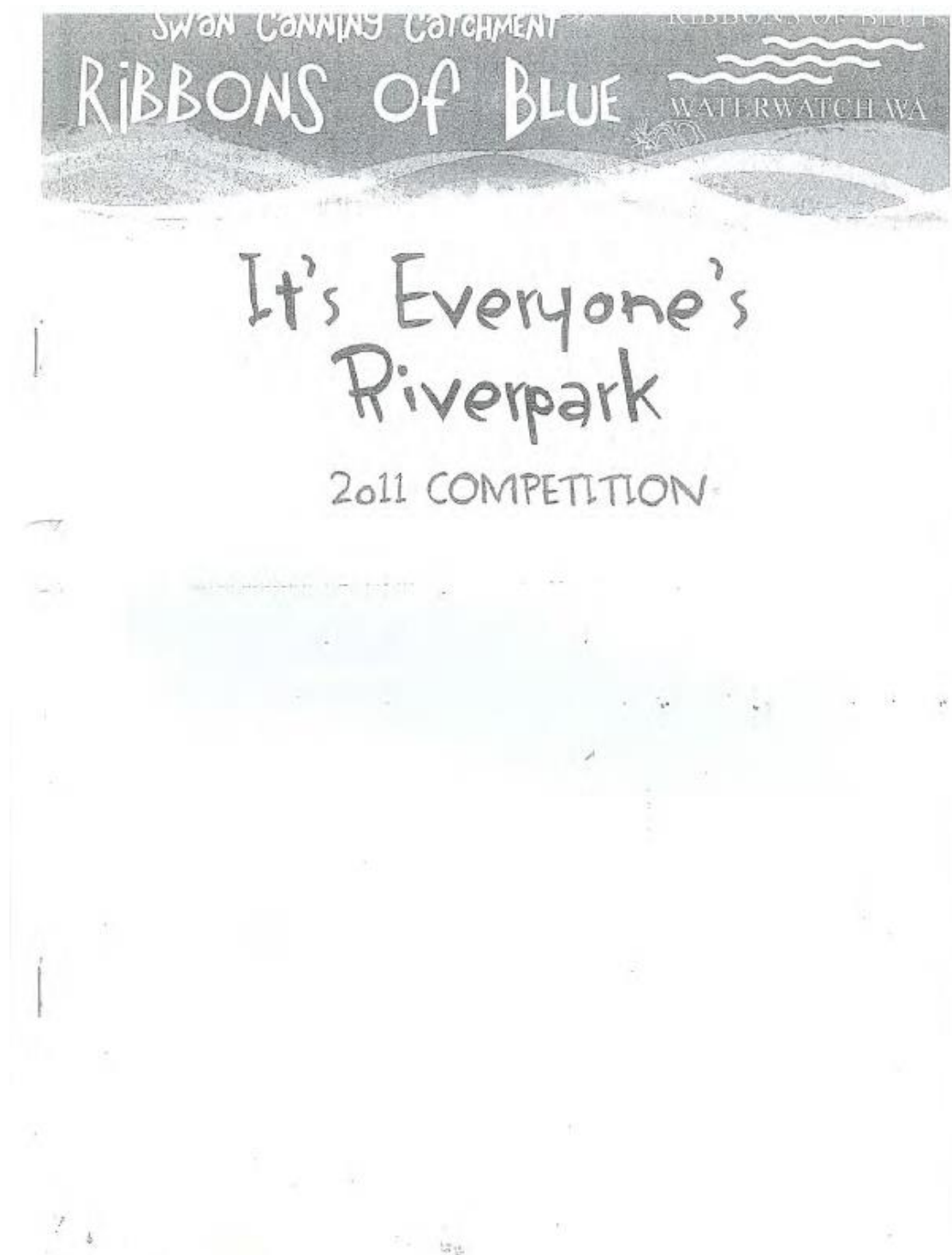
General rules about attention behaviour

F + F min # given as task

task management

Appendix R

Case Study 1 Student Task



Write a Script:

It's Everyone's Waterpark

1. Pick up rubbish - take it home or put it in a bin

Litter on the ground can be washed or blown into street drains and taken to waterways following rain. It can also directly blow into a wetland or waterway if dropped near them. Litter can reduce the aesthetic appeal (natural beauty) of an area and can harm aquatic life. Fish and other animals can eat the litter causing illness and death or can get tangled up in it, reducing the animal's movement or causing it to choke. Plants can be smothered by litter, reducing the amount of light they can receive, eventually causing death.

2. Pick up dog poo - put it in a bin or worm farm

Dog droppings left on the street can wash into our wetlands and waterways through the stormwater drain. If left beside a river or wetland, they can wash directly into the water. Dog droppings contain a nutrient called phosphorous that contributes to algal blooms. Dog droppings can also contain very high numbers of bacteria and viruses. Some of these organisms can cause illnesses, including hepatitis and gastroenteritis in fish and other aquatic wildlife. Take a plastic bag with you when you go for walks and pick up after your dog. Put the faeces in the bin or a worm farm or bury them in the garden.

3. Keep pet fish out of the river

Introduced freshwater fish can affect our catchment in much the same way that feral foxes, cats and rabbits cause damage to the landscape. In particular, exotic fish compete with native species for habitat and food. Many of us are unaware of the problems introduced fish species cause. Small, ornamental fish common in the freshwater aquarium trade cause big problems in our waterways as they flourish, breed and compete with native species. Never release fish from your aquariums or ponds into our rivers, creeks, dams or stormwater drains: even artificial lakes connect to our waterways through drainage networks. You should return unwanted fish to the aquarium dealer from where they were purchased.

For more information visit <http://www.swanrivertrust.wa.gov.au/news/facts/Content/feralfish.aspx>.

4. Don't feed birds

Feeding birds bread can make them and the waterways sick. Bread contains phosphorous. If the birds do not eat all the bread, it is left to rot in the water, contributing nutrients to the water. Bread also makes the birds sick, and they can become reliant on it, not eating their natural food. This can lead to malnutrition and disease.

5. Sweep up leaves and grass clippings

If leaves and grass clippings are left on the lawn, driveway or road they can blow or wash into stormwater drains. Sweep them up and start a compost heap or put them in the bin. Compost is a natural fertilizer for your garden and uses up kitchen and garden waste.

Leaves and grass clippings that wash down the stormwater drain contribute to algal blooms in our waterways. Weeds may also be hiding amongst the clippings and can establish in and around waterways. Weeds can push native plants out, and can also choke waterways if they grow out of control.

6. Wash cars on the lawn

Cars that are washed on the driveway or other hard surfaces can pollute our rivers and wetlands. The soapy water that runs off from the car can go down the street stormwater drains. This waste water contains detergents and dirt which contribute nutrients,

such as phosphorus, to our waterways. Nutrients cause algal blooms which can devastate animal and plant species living in the

waterways and prevent recreational use of the rivers. The detergents can also be toxic to aquatic life.

Wash your car on the lawn where the water and nutrients from the detergent can be used by the lawn to grow. Use detergents

sparingly and make sure they are phosphorus-free – even better, just use water and one of the

many fibre technology cleaning

cloths and some 'elbow grease'. If you don't have lawn at home, then find an alternative location like a friend's or neighbour's

place. Or take your car to a commercial car wash - they treat their water before disposing of it and

many recycle and reuse. The

'do it yourself' car bays use less detergent and less water than the automatic car washes.

7. Grow local native plants

Native plant species require less fertiliser and less water. Local natives are even better, as you will be providing food and habitat

for locally native animals, birds and insects. For more information about growing local natives visit:

www.greatgardens.info.

8. Encourage the use of phosphorus-free detergents

Most household detergents contain high levels of phosphorus. Phosphorus from detergents can find its way to our waterways

when it is used, for example, to wash cars and outdoor furniture on hard surfaces such as driveways, and the soapy water

flows into stormwater drains. You should wash things on the lawn so that the soapy water does not

run on to the road. When

purchasing detergent, look for bottles that have the NP - no phosphorus - symbol on them.

9. Encourage 'fertilise wise'

If you use too much fertiliser on your garden, the excess can wash into the stormwater drain or filter into the groundwater which

ends up in our wetlands and waterways. This is because Perth's soils are very sandy and porous - the

fertiliser just washes away

with rain or over-watering. Fertilisers contain nutrients including nitrogen and phosphorus which contribute to algal blooms.

What can you do?

- Don't use fertilisers at all!

- Plant native species which require less fertilisers and water.

- Use slow release, low phosphorus fertiliser.

- Improve your soil by using compost or mulch, which reduces the need to use fertilisers.

- Only fertilise when there are symptoms of nutrient deficiency (e.g. yellowing).

- Apply fertiliser just before the start of the growing season (e.g. spring or autumn) – but check the

weather report – don't

apply if it's going to rain as it will just wash away.

For more information visit www.fertilisewise.com.au.

Caring for the Swan Canning Riverpark

Competition Details

Task

Students are asked to design and produce a video clip to raise awareness that everyone in the catchment is connected to the river and to inspire young people to do at least one thing to help improve the health of the Riverpark.

The video should:

1. Raise awareness that everyone in the catchment is connected to the river.
2. Inspire young people, no matter what part of Perth they live in, to do one thing to help improve the health of the Riverpark.
3. Be a 'call to action' to do that one thing to improve the health of the Riverpark because everyone's help makes a difference.

We want people to feel motivated to make a change after watching your video, and know how they can make that change to help the Riverpark. This resource pack includes some suggestions of actions young people can take.

Categories

Junior Primary (K-3) Upper Primary (4-7) Secondary (8-12)

Conditions of entry

- Entries must be the students' own work
- Each entry must be accompanied by an entry form
- Video clips must be submitted on disc in AVI, MOV, MP4, MPEG or WMV format
- Video clips must be 30 - 60 seconds in length
- Students may work individually, in pairs or in groups, however only one prize will be awarded to the winning entries (so groups would need to share the prize)
- CDs will only be returned if the sender can collect them and a clear request has been made
- Entries may be used by the Swan River Trust and Ribbons of Blue for website, publication or display purposes. Winning entries will have their name, school and year level published if used in this manner

Send entries to or deliver to

Ribbons of Blue	Swan River Trust
Swan River Trust	Level 1, Fortescue Centre
PO Box 8829	20 Terrace Road
East Perth WA 6892	East Perth WA 6004

For more information

Joselyn Fissloli, Swan Canning Catchment Ribbons of Blue Officer
Phone: 9278 0969
Email: schools@swanrivertrust.wa.gov.au
www.swanrivertrust.wa.gov.au

Entries close
Friday 19 August 2011



Caring for the Swan Canning Riverpark

Judging Sheet

The following criteria and points system will be used to judge entries of the It's Everyone's Riverpark competition.

	Excellent (5 points)	Good (4 points)	Fair (3 points)	Poor (2 points)
Subject Matter - catchment / river connection	Video clearly explains that everything in the catchment is connected to the river; examples are provided	Video clearly explains that everything in the catchment is connected to the river; no examples	Video alludes to the catchment / river connection but the message is not clear	Video does not connect the catchment to the river
Subject matter - call to action	Video strongly communicates a call to action, inspiring young people to act	Video clearly explains actions to help improve the rivers but lacks inspiration for young people	Video lists ways to help improve the rivers but call to action is unclear; lacks inspiration	Video does not explain how young people can help the river and lacks inspiration
Research	Evidence of relevant information synthesised from multiple reliable sources	Evidence of accurate research from a variety of sources	Relevant information and arguments are misinterpreted or not identified; sources appear unreliable	Information is from limited resources and poorly interpreted; information is incomplete, out of date or incorrect
Effectiveness	Video includes all material necessary to comfortably understand the topic; engages target audience	Video includes most material necessary to comfortably understand the topic, but lacks one or two elements; engages target audience	Video is missing more than two key elements; understanding gained is incomplete; does not engage target audience	Video lacks several key elements and has inaccuracies; understanding of the topic is difficult; does not engage target audience
Creativity	Graphics or elements reflect an exceptional degree of creativity	Graphics or elements used in the video reflect creativity	Contains a few creative elements	Little evidence of creativity in the video
Narrative	Sequence of events flow in a clear, logical manner in a way that captures the viewer's attention; scenes have continuity	Sequence of events flow in a clear, logical manner; scenes have continuity	Sequence of events lacks overall continuity but some scenes do flow	Sequence of events are disjointed and confusing, not related to each other and with no clear story or message
Cinematography - visual	Visual effects (framing, lighting, sets, props, costumes) are used to powerfully enhance the video narrative	Video effectively uses visual effects (framing, lighting, sets, props, costumes) for mood creation	Visual effects (framing, lighting, sets, props, costumes) are not appropriate to the narrative	Visual effects (framing, lighting, sets, props, costumes) are not utilised
Cinematography - audio	Audio (sounds and music) are used to powerfully enhance the video narrative	Video effectively uses audio (sounds and music) for mood creation	Audio (sounds and music) are not connected or not appropriate to the narrative	Audio (sounds and music) are not utilised

Total score: / 40



Appendix S

Case Study 2 Student Task

Student Task 1

SCIENCE - YEAR 6

ECOSYSTEMS

COMPUTER TASK

Using your information from Activ Book(that you have done previously), and your knowledge of food chains and food webs. Use Word and the Internet to create your own Food Web which matches either a grassland environment, African Savannah environment, Jarrah Forest or River System.

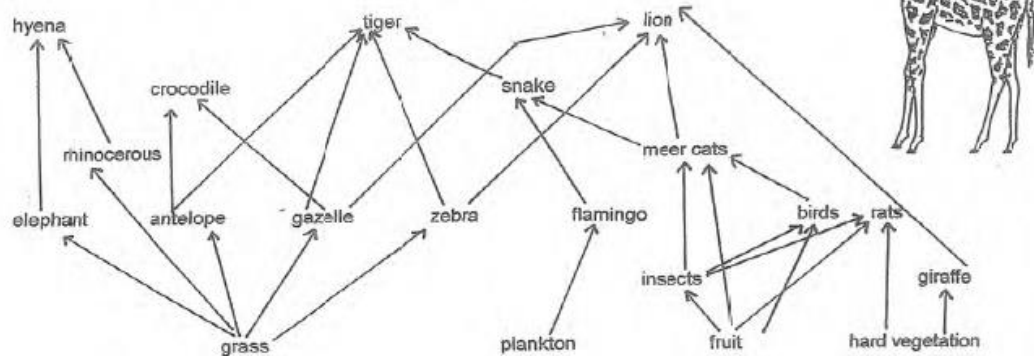
You may need to use the Paint/Draw function. You will also have to cut and paste.

You are to work in pairs.

The African Savannah!

NAME _____

Using the food web below answer the questions that follow -



ANSWER ALL QUESTIONS IN THE SPACE PROVIDED -

- 1.a) What is a producer? _____ (1)
- b) Give 2 examples as shown in the web above. _____ (2)
- 2.a) What is a consumer? _____ (1)
- b) Give 2 examples of a 1st Order Consumer. _____ (2)
- c) Give 2 examples of a 2nd Order Consumer. _____ (2)
- d) Give 2 examples of a 3rd Order Consumer. _____ (2)
- e) Give 1 example of a 4th Order Consumer. _____ (1)
- f) Why can a tiger be considered as a 2nd and 3rd Order Consumer? _____ (2)
- 3.a) What is a herbivore? _____ (1)
- b) List 3 examples of a herbivore. _____ (3)
- 4.a) What is a carnivore? _____ (1)
- b) List 3 examples of a carnivore. _____ (3)



Case Study 2 Student Task 2

Integration of Bathroom Science with Visual Literacy

Students are given pictures of bathrooms from digital media.

Students are to design a range of products that would suit the specific bathroom which they choose from the given selection. Students need to focus on their advertising ethic

- **Environmentally friendly**
- **Sensitive skins**
- **Environmental element – e.g. a tea range or lemon or rose**

When designing their product they need to develop:

- **A brand**
- **A range**
- **A motto or slogan**
- **A target audience**

Before you begin think about the following:

VISUAL LITERACY

Subject Matter

- What is the main subject of this photograph?
- What is going on in this photograph?
- What do you see that makes you say that?
- What do you think interested the photographer about this subject?

Time

- When do you think this picture was taken?
- What do you think happened just after the photograph was taken?
- What happened right before the photograph was taken?

Visual Elements

Light

- Light is an essential element in the making of any photograph.
- Does the light seem to be natural or artificial?

- Harsh or soft?
- From what direction is the light coming?

Focus

- What parts of the image are clearly in focus?

Are some parts out of focus?

Note: The range between the nearest and farthest things that appear in focus define the photograph's depth of field.

Color

- What colors do you see, if any?

Texture

- Do you see visual textures within the photograph?

When you look at the picture of your chosen bathroom....

YOUR BATHROOM PICTURE

Keeping the above questions in mind how does the bathroom make you feel?

Can you see yourself having a bathroom like this one day?

What kinds of products and items would suit this bathroom to be out on display?

What kind of product packaging can you design to suit the bathroom you have chosen?

Appendix T

Case Study 3 Student Task

Year 6 Visual Literacy-The Red Tree-Shaun Tan

Curriculum Outcomes:

- Justify and interpret the use of symbolic devices in Sophisticated Picture Books
- Recognise the symbolic use of colour and lighting to convey a variety of emotions, historical context or cultural awareness eg. When analysing sophisticated picture books
- Recognise that symbolic codes or images are designed to convey messages at an emotional level and have cultural significance

Week One-Lesson 1. Introduce 'The Red Tree' by Shaun Tan. Students to read through and begin to look at pictures. After 10mins see if they notice anything special about the images. Discuss these special features but do not elaborate on these yet. Students to pick 1 image and write what they see, how it makes them feel and what they think the illustrator's purpose is.

Lesson 2. Group students according to the picture they chose in activity one. Students discuss picture and their responses. Break off into new groups so there is a mixture of pictures. Students share their responses with their new group. Do this 2-3 times until they have shared to a variety of others. Gather together as a class and introduce the features of visual images. Students again pick an image and analyse according to the list of features.

Week Two-Lesson 3. Reinforce Week One's learning. Student's pick one piece of text and think about how they can recreate the image to tell the same story. Student's plan how they will recreate their image according to the features of visual images.

Lesson 4. Using Microsoft Word Students import images from Google and manipulate them (using Word tools) to create their reinvented image using a montage effect.

Week Three Lesson 5. Creating Image

Lesson 6. Creating Image

Week Four Lesson 7. Students print image and add any extra details they need. Attach to page with text typed up. Tag image using Ipad Tagging Application-link their tag with a website about 'The Red Tree'.

Lesson 8. Presentation

Appendix U

Case Study 4 Program of Work

Mathematics Program Year 4 2011 Term 1

Objectives		Sample Learning Activities	Vocab	Resources	Assessment
<p>Number and Algebra Read, write, order and give place value of five digit numbers Automatically recall 2, 3, 4, 5 and 10 multiplication facts Use written algorithm to add and subtract three digit whole numbers Refine methods for problem-solving involving four basic operations Multiply two digit numbers by a single digit number Use mental calculation and estimation with four basic operations</p> <p>National Curriculum Number and Place Value Recognise, represent and order numbers to at least tens of thousands</p> <ul style="list-style-type: none"> — read, write and say whole numbers to at least ten thousand, leaving a space between each set of three digits from right to left — to order and locate numbers on a number line — the name and value of places in numbers to at least ten thousand <p>Apply place value to partition, rearrange and regroup numbers to at least tens of thousands to assist calculations and solve problems</p>	Week 1	(N+A) Place Value Diagnostics/ PV & Times Tables Times Tables revision (5-10min daily)	Place value, digit, number, units, tens, hundreds, one-two etc digit number, place, one/ten/hundred thousand more or less, compare, order, size, greater than, larger than, less than, smaller than, before, after, next, first, second, third, largest, smallest	First Steps Math plus 4 Avanti Mental Maths Maths Zone Fundamentals Maths Dictionary Mathletics BBC KS2 MTS Online NSW KS2 Sample Learning Activities Mathletics Workbooks http://www.mathszone.co.uk/	(N+A) <i>Diagnostic</i> Read, Write and Say Numbers pg 143 1 st Steps CB <i>Diagnostic</i> Times Tables
	Week 2	(N+A) Place Value - Read, Write and Say + Give place value Place Value Pack pg 32 Card Capers Wipeout pg 19 Kids, Calculators and Classrooms Trading Games pg 26 Dice Dazzlers First Steps KU4 + 5 NSW KS2 Sample Learning Activities Times Tables revision (5-10min daily)	Lots of, multiply, multiplication, times, product, double, row, column		Formative assessment - anecdotal
	Week 3	(N+A) Place value - Read, Write and Say + Give place value Games as above First Steps KU4 + 5 NSW KS2 Sample Learning Activities Times Tables revision (5-10min daily)	Add, subtract, addition, subtraction, increase, decrease, sum, total, altogether, difference between, take, take away, taken from, leaves, sign, plus, minus, equals, inverse?		Formative assessment - anecdotal
		(M+G) Length - comparisons of length Diagnostic: Broken Ruler			(M+G) Diagnostic: Broken Ruler
		(M+G) Length DM KU 4 E First Steps KU 2			Formative assessment - anecdotal
					(M+G) Summative Assessment - Teacher created

<p>(addition and subtraction)</p> <ul style="list-style-type: none"> recognising and demonstrating that the place-value pattern is built on the operations of multiplication or division of tens <p>Use equivalent number sentences involving addition and subtraction to find unknown quantities</p> <ul style="list-style-type: none"> writing number sentences to represent and answer questions such as: 'When a number is added to 23 the answer is the same as 57 minus 19. What is the number?' using partitioning to find unknown quantities in number sentences <p>Recall multiplication facts up to 10×10 and related division facts (ongoing)</p> <p><i>Measurement and Geometry</i> Choose appropriate metric units for measurement of length, mass and capacity Use standard abbreviations for metric units, capacity, mass and length using standard units Estimate and describe lengths, Estimate and measure length in centimetres and metres <i>National Curriculum:</i> Use scaled instruments to measure and compare lengths, masses, capacities and temperatures</p> <ul style="list-style-type: none"> reading and interpreting the graduated scales on a range of 	Week 4	<p>(N+A) Place value - Read, Write and Say + Give place value Games as above First Steps KU4 + 5 NSW KS2 Sample Learning Activities Times Tables revision (5-10min daily)</p> <p>(S+P) Chance Chance experiments NSW KS2 Sample Learning Activities</p>	<p>Measure, measuring scale, unit, standard unit, metric unit</p> <p>Length, width, perimeter, long, short, longer, shorter, longest, shorter, millimetre, centimetre, metre, kilometre, ruler</p>	<p>Formative assessment - anecdotal</p> <p>(S+P) Diagnostic - individual brainstorm of chance words</p>
	Week 5	<p>(N+A) Place Value - Ordering Three in a Row pg 44 Dice Dazzlers From Here to There pg 46 Dice Dazzlers First Steps KU4 + 5 NSW KS2 Sample Learning Activities Times Tables revision (5-10min daily)</p> <p>(S+P) Chance Chance experiments NSW KS2 Sample Learning Activities</p>	<p>Mass, weigh, balances, weights, heavy/light etc, kilogram, gram</p> <p>Capacity, full, empty, holds, contains, litre, millilitre, container, measuring jug</p>	<p>(N+A) Summative Assessment - Teacher constructed</p>
	Week 6	<p>(N+A) Addition and Subtraction First Steps UO KU 1 First Steps C KU 4 KU 6 NSW KS2 Sample Learning Activities Times Tables revision (5-10min daily)</p> <p>(M+G) Mass + Capacity UU First Steps KU 1 + 2 UU First Steps KU 1 NSW KS2 Sample Learning Activities</p>	<p>Celsius, degrees Celsius, thermometer, warmest, coolest</p> <p>Likely, unlikely, equally likely, chance, equal chance, even chance, certain, uncertain, probable, possible, impossible</p>	<p>(N+A) Diagnostic Assessment MTS Online</p> <p>(M+G) Diagnostic Assessment Which Frog is Heaviest pg 71 1st Steps Pour to Decide pg 96</p>

<p>measuring instruments to the nearest graduation</p> <p><i>Statistics and Probability</i></p> <p>Identify, record and explain the outcomes of simple chance experiments</p> <p><u>National Curriculum:</u></p> <p>Select and trial methods for data collection, including survey questions and recording sheets</p> <ul style="list-style-type: none"> — comparing the effectiveness of different methods of collecting data <p>Construct suitable data displays, with and without the use of digital technologies, from given or collected data. Include tables, column graphs and picture graphs where one picture can represent many data values</p> <ul style="list-style-type: none"> — exploring ways of presenting data and showing the results of investigations 	Week 7	<p>(N+A) Addition and Subtraction First Steps UO KU 1 First Steps C KU 4 KU6 NSW KS2 Sample Learning Activities Times Tables revision (5-10min daily)</p> <p>(M+G) Mass + Capacity UU First Steps KU 1 + 2 UU First Steps KU 1 NSW KS2 Sample Learning Activities</p>			<p>Formative assessment - anecdotal</p> <p>Summative Assessment - Teacher constructed</p>
	Week 8	<p>(N+A) Addition and Subtraction First Steps UO KU 1 First Steps C KU 4 KU6 Times Tables revision (5-10min daily)</p> <p>(S+P) Chance experiments NSW KS2 Sample Learning Activities</p>			Formative assessment - anecdotal
	Week 9	<p>(N+A) Addition and Subtraction First Steps UO KU 1 First Steps C KU 4 KU6 Times Tables revision (5-10min daily)</p> <p>(S+P) Chance experiments NSW KS2 Sample Learning Activities</p>			<p>Formative assessment - anecdotal</p> <p>(S+P) Summative assessment Teacher constructed</p>
	Week 10	<p>(N+A) Addition and Subtraction First Steps UO KU 1 First Steps C KU 4 KU6 Times Tables revision</p> <p>(M+G) Temperature Pg 119 Maths Plus 4</p>			(N+A) Summative Assessment Teacher Constructed

	Week 11	<p>(N+A) Review of concepts covered throughout the term</p> <p>(M+G) Temperature Measure temperature everyday Read temperature in newspaper etc Mathletics workbook Maths Plus pg 119</p>			<p>(M+G) Summative Assessment Teacher created</p>
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Case Study 4 Weekly Planning Sheets

Term 1 Week 6

Week 1

	Outcome	Mental Starter	Main teaching activity	Differentiated Activities			Vocab	Plenary	Observations & Evaluation
				HA	MA	LA			
Number and Algebra	Read, write and say numbers to at least the tens of thousands	Thinking of a number: Greater than - less than.	Place Value Cover Up Games. Page 16 Dice Games with Place Value (Paul Swan)	Three and Four digit Numbers: page 85 Mathematics K-6. Can you read each number out loud? Can you order the cards in ascending and descending order? Can you state the place value of each numeral? What is the largest/smallest number you can make using three or four cards? Can you identify the number before and after one of your three/four digit numbers? Can you find a pattern? How can you describe the pattern? How can you continue the pattern? How many different ways can you represent the number? Can you count forwards and backwards in tens/hundreds from one of your three/four digit numbers? Use of Numeral Expanders Use place value charts and MABs to support.			Place value, digit, number, units, tens, hundreds, one-two etc digit number, place, before, after, next	Counting Races: page 85 Mathematics K-6	
	Understanding of the multiplicative nature between places. I.e: 36 207 the six is worth 100 times more than the 6 in 41 965.	Times Tables revision	Introduction to order of numbers Dice Game: Paul Swan dice Dazzlers page 11	Page 19 Place Value Cover up to Millions using 0-9 dice Dice Games with Place Value (Paul Swan)	Page 18 Place Value Cover up to Tens of thousands using 0-9 dice Dice Games with Place Value (Paul Swan)	Page 17 Place Value Cover up to Tens of Thousands using 1-6 dice Use place value charts and MABs to support.		Play Wipeout. Ask students to reference place value when determining what to do.	
		Times Tables Mathletics Groups of and Dividing	Introduction to the order of numbers	Less than greater than ordering numbers page 86. Higher than Lower Than mathematics K-6.				4 digit Number Hunt, looking for numbers up to 9999, put numerals in ascending descending order.	

		Times Tables Mathletics Groups of and Dividing	Read/Write/Say Place Value Assessment	Teacher Generated Assessment Task: Mathletics tasks for early finishers.		Play Calculator Fish	
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Statistics and Probability	Chance uses specific chance language e.g.: possible/imp possible. The ambiguity in chance language needs to be supported by a measure of probable outcomes. Outcomes from using probability devices such as spinners and dice can be listed and create many combinations.	Math dictionary: what does certain and uncertain mean?	Chance Words Introduction page 103 Mathematics K-6. Mathletics page 1: chance ordering Events	Certain and Uncertain: In pairs students to list under things that they think will happen (certain) at school on the day and then think of things that they are not sure will happen (uncertain) discuss findings. Scootle Activities: Soft Drink Cans to further explore certain/uncertain. Wordle Activity using listed chance words for homework	Possible, impossible, probable, improbable, certain and uncertain, likely unlikely fair biased.	Brainstorm chance words and create a number line from 0-1, positioning chance words and justifying choice.	
		Review Chance Language	Probability is the measure of how likely something is to happen. Mathletics page 3 book E. Chance and Data	Working with Spinners: Scootle whole class activity. Individual Activity: Rainforest maths Yr. 4 chance activities LA/MA HA: Year 5 Chance activities Conclude with whole class re-examining of Scootle spinner activity, would you change your outcomes???		Pegs Activity: Students to predict outcomes using different coloured pegs Page 103 Mathematics k-6	
			Review previous lessons. What do we know now that we didn't know before?	MTS Online Chance Colours (set 5 Activity 275) MTS Online What will Happen? (Set 5 Activity 270) Group Activity using dice. Do you have a better chance of rolling an odd or even number when you roll and add 2 six sided dice. Also refer to Paul Swan activities: Dice Dazzlers pages 38-39: The great car race 2 and 3. Interactive activities on Rainforest maths.		Review: what have we learnt this week about chance and probability?	

