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What are the knowledge needs of teachers to inform the multimodal authoring of their students in years 1–8?

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A thesis submitted in fulfilment of the requirements for the degree of

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Abstract

Pervasive use of communication methods mediated by technology has been a catalyst for a rethink of valued knowledge practices in the teaching and learning of writing. Although widespread in many areas, this way of communicating has been slow to gain a foothold in formal education settings. Teachers appear to lack clarity as to the types of knowledge that are now needed to inform teaching practice in this area, including how technology use is shaped, the types of learning that are supported and, therefore, what aspects are valued for assessment and evaluation purposes. To address this gap, a corresponding body of knowledge requires development in order to inform teacher practice and student learning.

Although teachers are using technology in their personal lives to meet specific communication and information sourcing goals, this use does not necessarily translate to their practice when teaching multimodal authoring. Responses from teachers to changed roles and responsibilities as part of engagement with digitally literate practices reveal that teachers cannot implement technology to enhance teaching and learning through the provision of technological tools alone. Rather, they need enablers including necessary technological infrastructure, a supportive school vision and leadership, resourcing and professional learning that tap into the insight and creativity of all those with an interest in improving student learning, informed by relevant subject knowledge.

This thesis aims to connect with the work that teachers do in teaching multimodal authoring in Years 1–8. It draws on the knowledge and expertise of 15 classroom teachers’ practical subject content knowledge in teaching multimodal authoring and examines their current understandings. Subsequently, a place to begin to deepen and extend what they need to know is suggested in order to debate, engage with, challenge and improve practice in digital literacy. This thesis explores, also, the practices of digital designers engaged in state-of-the-art practice in both media and paper design. They share their experiences of how these practices are operationalised in various settings. Based on these data, a body of content knowledge and a corresponding model of writing instruction are proposed as an introduction and suggested means by which more sophisticated understandings can be developed of the fundamentals of teaching and learning multimodal authoring. These tools may provide insight into what teacher knowledge around multimodal authoring currently looks like, why this practice is not as pervasive in the classroom as would be expected and possible ‘next steps’ to inform teaching and learning.
Acknowledgements

I would like to thank the participants of this study who so freely and generously gave of their time. Both teachers and designers willingly shared their knowledge and experience to help advance the field of teaching and learning writing mediated by technology. Undoubtedly, their experiences will be of great interest and motivation to others.

A very special thank you goes to my supervisors, Professors Judy Parr and Stuart McNaughton whose patient and wise counsel provided me with direction and encouragement during all stages of this project. I also wish to acknowledge the help and support of Dr Rebecca Jesson who was of great assistance to me in the final stages of this thesis.

Thank you also to my friends, family and colleagues, who helped, encouraged and supported me. I would like to acknowledge colleagues in Australia and England who responded so generously to my request for assistance in making sense of my data. They willingly participated in SKYPE conversations at odd hours and kept up email dialogue over the course of my study.

This thesis is dedicated to my late parents, Laurie and Betty Atkinson. Both of my parents taught me the value of education at a time when educating girls was not considered a priority because ultimately, all girls were just going to be housewives.
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## Glossary

For the purposes of this study, clarification is offered around the terminology used in the domain of multimodal authoring. The terminology relates to communicating in online environments using digital technologies. In the literature, terms are applied inconsistently, with some terms used interchangeably, particularly, “multimodal” and “multimedia”. To mitigate any confusion when reading this thesis, the following definitions represent terminology use:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affordances</td>
<td>Attributes, both positive and negative, of particular modes, tools, technology or techniques.</td>
</tr>
<tr>
<td>Cyberspace</td>
<td>A general descriptor for the time and space in which computer mediated and information technologies take place.</td>
</tr>
<tr>
<td>Digital</td>
<td>A descriptor for any action or object related to communication technology use.</td>
</tr>
<tr>
<td>Digital Literacy</td>
<td>Contextually bound, technology mediated reading and writing often combined with other modes of communication (Merchant, 2007, 2009).</td>
</tr>
<tr>
<td>Digital Writing</td>
<td>Technology mediated mainly textual communications for online delivery. A strong focus on audience within and beyond the classroom.</td>
</tr>
<tr>
<td>e-Learning</td>
<td>The use of digital and networked technologies to support teaching and learning.</td>
</tr>
<tr>
<td>Interactive</td>
<td>The ability to participate actively in an online forum or with a software application. Interaction may or may not include the ability to change content or outcome.</td>
</tr>
<tr>
<td>Media</td>
<td>Describes the content forms such as text, audio, still images, animation, video.</td>
</tr>
<tr>
<td>Mode</td>
<td>Refers to the different ways of acting or doing a task, for example writing, viewing, listening, and speaking.</td>
</tr>
<tr>
<td>Multimedia</td>
<td>Combining more than one media choice to distribute meaning.</td>
</tr>
<tr>
<td>Multimodal</td>
<td>Describes using all modes, for example visual, textual, sound; to make meaning, commonly via a computer screen.</td>
</tr>
<tr>
<td>Multimodal authoring</td>
<td>The multimodal, cognitive and socially situated choices made in the process of composing before entering into final production and distribution phases (Lauer, 2009).</td>
</tr>
<tr>
<td>Online Technology</td>
<td>Digital devices that are networked involving the use of an intranet or the internet.</td>
</tr>
<tr>
<td>Technology Integration</td>
<td>The use of digitally mediated technology in the classroom for teaching and learning.</td>
</tr>
<tr>
<td>Technology-mediated writing</td>
<td>Writing achieved using some form of digital technology.</td>
</tr>
</tbody>
</table>
Section 1: Exploring Teacher Beliefs, Knowledge and Reported Skill About Writing Using Multiple Modes.

Chapter One: Introduction

Chapter Outline

Section 1 of the thesis backgrounds the study and explores the beliefs, skills and knowledge that teachers have about writing using multimedia contained in the literature and data collected from teacher participants.

Chapter 1 introduces the thesis and states my interest related to the use of technology in the teaching and learning of writing. I comment on my professional background as an experienced teacher, including personal experience of improved opportunities for student learning facilitated by technology and my desire to support colleagues to improve teaching practices. The trajectory of the study is outlined. A concise review of the literature situates the study; its importance and significance is explained and the main questions that ultimately guided the study are stated. The chapter concludes with an explanation of the format of the thesis and a brief overview of the contents of each section.

Introduction

This thesis focusses on the kinds of teacher knowledge needed to include multiple modes of meaning in the teaching of writing in Years 1–8.

Three main interests prompted this investigation. Firstly, I have personal experience as a classroom teacher observing improved opportunities for students to access learning facilitated by technology. Next, I wish to support colleagues to improve teaching practices and, finally, I wish to contribute to the development of a theoretical and knowledge base around how teachers effect the teaching and learning of writing using multiple modes as an area of enquiry.

Data were collected from a group of 15 purposively chosen participant teachers, identified as having interest and skills in the use of multimodal resources for teaching writing. The purpose of the data collection was to establish the understandings, beliefs, skills and knowledge this group of teachers had about the nature and role of multimodal authoring in their teaching and learning programmes in writing and to examine what issues arise for them when teaching in this context.
The argument I will develop in this thesis will be around three key propositions. First, I propose that, although teachers are using technology in their personal lives to meet specific communication and information sourcing goals, this use does not necessarily translate to their practice when teaching writing using multiple modes. Literature to support this position is reviewed in Chapter 2 describing changed communication and information searching brought about by digital technology. This phenomenon has produced several fields of discourse and inquiry, that continue to be generated, describing changed writer and reader practices, a range of political policies to changed teaching and learning environments because of technology use and emerging teacher and student engagement with multimodal resources and methods. A common thread emerging from this discourse is the changed roles and responsibilities for teachers and learners as part of engagement with multimodal authoring. In responding to changed roles and responsibilities, it has become apparent that teachers cannot implement technology to enhance teaching and learning through the provision of technological tools alone. Rather, they need enablers including necessary technological infrastructure, a supportive school vision and leadership, resourcing, professional learning and teaching practices supported by relevant content knowledge. Engagement with technology and the teaching and learning of multimodal authoring is an important relationship that is explored in the teacher data in Chapter 3.

My second key position is that without an established body of relevant content knowledge to inform the teaching and learning of multimodal authoring, teachers lack clarity as to the types of knowledge that are needed to inform their practice. This knowledge includes how technology integration is shaped, the types of learning that are supported, and therefore, valued for assessment and evaluation purposes. I argue that the crucial role of subject content knowledge, in this case related to multimodal authoring, needs to be prioritised and developed to inform teacher practice and student learning. Both content knowledge and relevant teacher practice are insufficiently articulated and shared to be useful to teachers but a specific focus on teacher practice, although important, is not fully addressed in this thesis.

In an attempt to clarify further the types of knowledge and understanding teachers may require to support the technology-mediated writing practices of their students, I look outside of teaching to another body of professionals, those in digital design who have an established domain of knowledge and practice in the area of multimedia communication. To clarify understandings around the process and fundamentals of technology-mediated communications, I review literature that describes the processes and specifics of making meaning with technology, including aspects of modality and design and how these support user engagement. It is intended that knowledge and understanding of changed literate practices, the principles of design and examining the hallmarks
of a writing task using multimodal methods will, in turn, contextualise and advance the
development of a body of content knowledge to inform multimodal authoring.

This literature review is followed by the examination of data collected from six digital design
professionals who describe skills, knowledge and dispositions that could support the development
of content knowledge to inform writing mediated by multimodal technologies. These descriptions
are then used to identify and detail different types of content knowledge along different
dimensions, to inform teacher practice in this area.

My final key position is that the knowledge practices required to engage with technology are in
tension with those that have traditionally supported the teaching and learning of writing. In line
with established teaching methods of writing in the early years of schooling, knowledge practices
value fixed, specialised knowledge. The latter also governs and regulates evaluation and
assessment in this domain. However, the use of digital technology favours orientations to learning
where the characteristics, disposition of learners and certain ways of learning are valued.
Technology use favours a learner who is, for example, collaborative, working with other learners
both within and beyond the classroom, problem solving and sharing skills and information. I argue
that a disconnect exists between the types of knowledge practices valued in traditional writing
pedagogies and those knowledge practices that facilitate multimodal technology use, making the
meshing of technology goals and writing goals problematic. To frame this argument, I use
Legitimation Code Theory (LCT) (Howard & Maton, 2011), which is detailed further in Chapter 4.

My contribution to building theory to inform classroom approaches for teachers and students in
writing using multiple modes is a unique, specialised body of content knowledge describing the
types of knowledge needed to engage with multimodal authoring. I also describe and exemplify a
model of writing that responds to the unique and dynamic environment of teaching writing using
multiple modes. The three stage, recursive model emphasises equally, the creation, mediation and
dissemination processes of writing with multiple modes.

The Digital Literacy Landscape

The proliferation and ready access to internet capable multimedia technology has been the
catalyst for a fundamental shift in communication, information searching and language use and
learning (Alexander & Fox, 2004; Fairclough, 2000; Gee, 2000; Leu, Coiro, & Cammack, 2004).
Practices developed by professional communities such as those in the commercial setting of digital
design, for example, include knowledge and expertise with particularly rich understandings around
developing and applying design capabilities when making meaning. In this established field, the
collective knowledge and experience of this group of professionals and others, may offer support in developing design capability for both teachers and students.

Reactions to the shift in communication practices range from those who support the benefits of new technologies and claim positive effects, to those who perceive new technologies as having had a negative influence on, and contributed to, the so-called fall in literacy standards. Irrespective of where personal preferences are positioned, it is increasingly clear that technology is playing a major role in the need to change literacy teaching and learning (Cope & Kalantzis, 2000). There are calls, on one hand, for broader conceptualisations of language and literacy, particularly from the New Literacy Studies proponents (Barton, Hamilton & Ivanic, 2000; Gee, 1999, 2000; Knobel & Lankshear, 2007; Lankshear & Knobel, 2003; Street, 2003) who address different purposes for and responses to being literate (Leu et al., 2004). Alternatively, there is critique of the New Literacy Studies lobby that conceptions of literacy need to be clear to address practicalities when designing learning environments (Merchant, 2007) and for clarity in the formulating of English curricula and interactions with students (Mills, 2009, 2010a). These concerns are of special interest to this study and discussion of them will be developed throughout the thesis.

This study relates, particularly, to the changing nature of writing and the ways we do it (Merchant, 2005), as part of broader conceptualisations of literacy, including the use of technology-mediated multimodal resources and teachers’ responses to those changes. Writing is increasingly interactive, social (Hammerberg, 2001; O’Brien & Scharber, 2008; Takayoshi, 1996) and changing in purpose. Just as the invention of the printing press made printed material widely available to the reading public of the 19th century (Yancey, 2004), multimodal communications technology of the 21st century has made writing widely available and people have learned not only to write but:

- to think together, to organize, and to act within these forums – largely without instruction... They need neither self-assessment nor our assessment: they have a rhetorical situation, a purpose, a potentially worldwide audience, a choice of technology and medium – and they write (Yancey, 2004, p. 301).

This new writing public (Yancey, 2004) includes students of all ages who, largely outside of school time, participate in all that multimodal authoring has to offer. According to Yancey (2004), these writers think differently about the way information is organised to suit their needs (Penrod, 2005) in a seemingly limitless, global communication environment. As Hammerberg (2001) suggested, “if we can imagine it, it just might be possible to represent it through various modes of representation such as print, video, audio, graphic images, and many combinations in between”
The role of this new communication environment assumes even greater significance when considered in terms of its place in teaching and learning writing in the classroom. Not yet clarified in this domain, is the type of response needed from policy makers, education leaders and teachers. This group are, largely, still informed by a writing paradigm that adheres to traditional conventions of written English or as Chandler, O’Brien and Unsworth (2010) claim as evident from their research, “a pedagogic chasm between writing pedagogies of the past still dominating most children’s school experience and the multimodal, dynamic publishing practices that increasingly children routinely engage in” (p. 34). Increasingly, a traditional classroom writing paradigm no longer serves the purposes of a society where literate practice is shaped by digital technology.

Assessment, above other components in education, has the potential to bring together all the elements necessary for improving learning. According to Black and Wiliam (1998), learning gains from innovations featuring formative assessment are “among the largest ever reported for educational interventions” (p. 140). Rich and timely feedback informs learning and refines the tools, processes and objectives of education (Looney, 2010). Clarity, therefore, is needed around the skills to use multimodal tools and associated practices (Bearne, 2009b; Hammett, 2009).

Fundamentally, however, there has been a lack of empirical investigation that has enabled the development of theory (Howard & Maton, 2011) into what constitutes effective and purposeful endeavour in multimodal authoring. The use of technology for teaching and learning needs further investigation, discussion and development to address the many claims made about technology’s impact on teaching and learning in general and writing in particular.

The Research Topic: Its Importance and Significance

The ways in which today’s students communicate, build knowledge and produce texts within a multimedia environment, are the catalyst for a need to learn about what features and structures of technology-mediated multimedia work together and how they do so and, although ultimately, not addressed in this study, what benchmarks might indicate proficiency at different levels. Technology integration is aspirational across the curriculum, but of most interest to this study is the manner in which technology use is being integrated into writing multimodally.

*The New Zealand Curriculum* (Ministry of Education, 2007) promotes the teaching of effective writing skills as a means to both demonstrate and construct knowledge. Expectations are that students will develop explicit knowledge of the steps of the writing process, such as forming intentions, composing, drafting, correcting and publishing; understand the conventions of written language and use them accurately, especially in formal contexts; write confidently, clearly and appropriately, in a range of styles and for a variety of purposes. Notably absent is any specific
reference to multimodality. The lack of a clear mandate in this document for multimodal authoring, arguably, inhibits the cohesive development of relevant teacher skills, knowledge, behaviours and expectations for student progress. The latter is particularly relevant to the development of teacher capability to give effective feedback and feed forward in order to improve student learning. Although there has been the promise of writing using multiple modes being included purposively in school curricula for some time (Braaksma, Rijlaarsdam, Couzijn, & van den Bergh, 2002), and not just in New Zealand, the promise remains just that.

The literature in this study cites insufficient teacher knowledge, lack of subject content knowledge, ineffective teacher practice and the absence of robust theory on technology integration, as continuing to impede multimodal authoring in the classroom. In addition, teacher use of technology that would support the multimodal authoring of their students has not changed sufficiently to achieve changed literacy practices in a changed literacy environment. Reasons for this include both environmental variables and individual characteristics of teachers as factors in the relationship between teaching and technology use. This relationship will be explored in the literature review in terms of intrinsic and extrinsic barriers. Extrinsic barriers include aspects of the systemic framework that surrounds teaching while intrinsic barriers refer to teacher values and beliefs around technology integration. To enable teachers to address these barriers, Unsworth (2008) suggested that teachers of all ages and levels of experience need support to maximise the use of information and communication technologies.

Uncertainties exist around, for example, what constitutes a multimodal authoring task; whether or not multimodal authoring tasks require mastery of totally new skills or whether utilising and building upon skills that can be related to other writing tasks is sufficient; what makes multimodal texts effective, and their place in the writing curriculum. These and related areas of inquiry have been explored to a degree, but remain under-theorised. By their very nature, as conduits to nurturing in students the knowledge and skills to make sense of their world, schools have a key part to play in the process of equipping children with the capability and developing dispositions to participate fully in the informed and critical use of technology, in this case, the use of multiple modes when authoring texts, both inside and outside school (Hague & Williamson, 2009).

**Research Aims of the Study**

The research planned in this thesis was based on the reported understanding that the widespread use of multimodal technology to mediate writing, in formal and informal learning environments, requires a particular response from teachers to this change in the potential literate practice of their students. This includes exploring the relationship between context, form and purpose. The
research therefore, seeks to identify and explore the knowledge needs of teachers to enable them to interpret and define the features of multimodal authoring. Potentially, this would help teachers inquire into the multimodal authoring of their students and contribute to the improvement of student learning and achievement and teacher knowledge in this area.

Mindful of the need to learn more about what issues arise for teachers when supporting students to produce texts within a multimodal environment, the main question posed is: “What are the knowledge needs of teachers to inform the multimodal authoring of their students in years 1–8?”

More specifically, the research seeks answers to the following questions:

- What understandings, beliefs, skills and knowledge do teachers, nominated as having expertise in technology and writing, have about the nature and role of integrating multimodal technology into their teaching and learning programmes to support multimodal authoring?

- What are the knowledge needs of teachers in order to talk about, teach and interpret, the processes, practices, skills and competencies, structure and content evidenced in multimodal authoring?

- What are digital design practitioners’ understandings of skills and knowledge necessary for effective design using multimodal methods?

- How could the knowledge gained from digital designers be used to support the teaching and learning of multimodal authoring in Years 1–8?

Establishing the understandings, beliefs, skills and knowledge teachers have in a certain field, provides a baseline from which to determine what is known, and subsequently what are the knowledge needs and next steps in learning. Without this information, it is difficult to understand and plan for appropriate learning and further enquiry. Insights from digital media producers, as established specialists in design practices, are explored to consider further contributions to the body of knowledge teachers could draw on that may have relevance to teaching and learning multimodal authoring. A model that allows for the dynamic and evolving nature and the complex decision making involved in multimodal authoring is then described, as part of building strategies that may support multimodal authoring across a range of contexts. The model is exemplified using a typical writing task, an expository text.

The results of this study contribute towards the development of an educational resource to give teachers and students help that supports the creation of meaningful texts in a digital environment.
The latter is consistent with the requirements of the New Zealand Curriculum (Ministry of Education, 2007). As stated in this document, as part of the key competencies of using language, symbols and texts, the confident use of information and communications technology (ICT) “to access and provide information and to communicate with others” (p.12) is noted as a priority. It is also consistent with the demands of a world increasingly pervaded by technology and a response to the need for teacher practice to include new and different literate practices.

**The Structure and Organisation of the Thesis**

This thesis is organised into three sections with accompanying chapters addressing specific stages of the study. Each chapter describes a discrete component of the study. Data gathering and interpretation are sequenced to background and build a picture of the research as a whole. An explanation at the end of each chapter details what is to follow in the subsequent chapter.

Section 1 contains the current chapter which serves as an introduction and background to the study including the researcher’s interest in, and stance held about the research topic, as well as explaining its importance and significance, including the main questions that will guide the study.

Section 1 continues in Chapter 2, which presents a literature review of the current state of knowledge on multimodal authoring as a teaching response to changing literacy practices. The review includes a discussion on the changing nature of literacy and literate practices, including curriculum responses in New Zealand, Australia and the United Kingdom. This is followed by details of emerging teacher and student engagement with multimodal resources and methods in writing.

Section 1 concludes with Chapter 3, which contains reporting on the data and analyses of the teacher participants around teacher beliefs and understandings concerning the integration of multimodal technology into the teaching and learning of writing.

Section 2 contains Chapter 4, which describes the interpretive framework, Legitimation Code Theory (LCT), used to further examine the teacher participant data. The framework is described and illustrated through two examples of recent research. A specific rationale is given for its use in this study. The chapter also discusses the knowledge building practices of teachers when integrating technology into the teaching and learning of writing. In Chapter 4, design is identified as a vital constituent of the corpus of knowledge essential to inform teacher practice.

Section 3 begins with Chapter 5, a review of the literature on professional designers’ understandings around media integration and design. This review includes descriptions of the
changing ways of communicating, design modes and their role in the production of meaning, user engagement with different modes of meaning and implications for designing in the classroom.

Section 3 continues in Chapter 6, which considers the practices and narrative from six designers’ perspectives in order to define the domain of design. Designer participant data are presented thematically in terms of their understandings of the practices of design. This chapter concludes with a consideration of how knowledge building practices engaged with by designers could inform teacher design practices and assist in theory building.

Section 3, Chapter 7, describes a body of content knowledge and a model of writing that incorporates the use of multimodal technology. Specific and relevant dimensions of technology use and knowledge practices in the teaching and learning of writing are detailed.

Section 3, Chapter 8 details the conclusions from the research and implications for teaching practice. Future directions for research are suggested and the contribution of the current research to the broader field of enquiry into technology use in the teaching and learning of writing.

**The Next Chapter**

The next chapter presents the literature review. The review defines multimodal authoring as the phenomenon of interest and describes new roles and responsibilities for teachers and learners as part of engagement with multimodal authoring. The review also backgrounds new literacy practices and the current state of knowledge about what teachers know and are doing when integrating technology into the teaching and learning of writing. Although technology use is widely accepted and expected to be integrated into all aspects of the curriculum, literature is presented that details technology integration has not addressed a transformed notion of literacy. Technology is being used to make meaning, but not necessarily to make meaning multimodally. Technology use is still equated with tool use and not a transformative notion (Burnett et al., 2006) of literacy within collaborative contexts supported by technology, innovative curricula and re-designed learning environments. Explanation is sought as to why technology use in teaching and learning of writing has not been sufficient to address new literacy practices.
Chapter Two: Authoring in the Classroom Using Multiple Modes of Meaning. A Review of the Literature.

Chapter Overview

This chapter reviews literature related to the teaching and learning of multimodal authoring. The chapter begins by defining and exemplifying multimodal authoring within a range of current research evidence. Relationships between technology use and writing and the conditions necessary for learning environments that facilitate multimodal authoring are subsequently examined. Detailed is a range of intrinsic and extrinsic factors and teacher knowledge that impact on these learning environments with accompanying implications for teacher practice. Extrinsic factors relate to those influences that individual teachers have little ability to regulate such as resourcing. Intrinsic factors relate to the effects of individual goals, values and beliefs.

This is followed by discussion of the conceptual shift that is occurring in definitions of literacy, particularly in the context of the classroom, moving the focus from the teaching of discrete skills, mainly textually based, to include the multimodal literacies afforded by communications technology. Policy responses to changed literacy teaching and learning environments as reflected in literacy curricula in New Zealand, Australia and England are examined briefly. A review of examples of emerging teacher and student engagement with multimodal resources and methods in writing is then undertaken.

The chapter concludes by bringing together the different strands of research to identify relationships, understandings and current directions of inquiry about the nature and role of multimodality in teaching and learning programmes in writing.

Introduction

Technology driven mass media and communications have changed teaching practices and been catalysts for different understandings around literacy and what it means to be literate. The move from page to screen has meant that the visual has become more important (Kress 1997, 2000, 2003) and afforded new combinations for the creation of texts using multiple modes (Merchant, 2005). Literacy, for the purposes of this study and literature review, is considered in terms of what Kress (2003) describes as symbolic representation through both reading and writing. Digital literacy, based on Kress’s description, includes the use of letters, words, symbols, icons and other visual and navigational features mediated through technology and practised on a screen. Digital literacy is about how and in what context texts are made and how they work to combine modes to
meet the purposes of the author. It involves more than learning traditional skills and then applying them in digital contexts or being another option used to communicate ideas.

As a response to the changes brought about by digital technology, fields of discourse and inquiry continue to be generated describing changed practices, political responses to changed teaching and learning environments, and emerging teacher and student engagement with multimodal resources and methods. Informing this discourse are understandings drawn from the social constructivist paradigm (Bruner, 1990; Vygotsky, 1934/1986), the New Literacy Studies movement (Barton, 2001; Barton & Hamilton, 1998; Gee, 1996; Street, 1997, 2003; The New London Group, 1996, 2000) and literacy as multimodal practice (Jewitt & Kress, 2003; Pahl & Rowsell, 2005). A common thread emerging from this discourse is changed roles and responsibilities for teachers and learners as part of engagement with literate practices that involve technology-mediated sound, image and text manipulation for a diverse range of meaning-making purposes. In responding to changed roles and responsibilities, it has become apparent that teachers cannot implement multimodal technology to enhance teaching and learning through the provision of technological tools alone.

The transformational change that is required to engage with multimodal literate practices, involves shifts in “understanding, values and attitudes” (James & Pedder, 2006. p.27) and acquiring specific forms of knowledge (Howard & Maton, 2011) related to technology integration. Exploring and describing teacher positioning in relation to the use of multimodal resources in the teaching and learning of writing is the focus of the first phase of my research. The supporting literature follows the trajectory, within the broader context of policy and curriculum, of how teachers facilitate technology use related to the teaching of writing, including research around emerging teacher and student engagement with blogs, wikis and webpages. These inquiries assist in framing what is known about working with multiple modes of meaning in the classroom.

This section begins by defining and exemplifying multimodal authoring within a range of current research evidence and examining the relationships between multimodal technology use and writing and the conditions necessary for responsive learning environments.

**Multimodal Authoring**

Defining terms used in the field of technology integration into the teaching and learning of writing is of particular importance because of the rapid development of this domain and the absence of a shared language to describe processed and products. In order to delimit multimodal authoring for the purposes of this thesis the following discourse describes this phenomenon against a background of literature where the terms ‘multimodal’ and “multimedia” are used
interchangeably. Both of these terms have been used to describe the shift from texts using print resources to those that may include visual and aural resources in line with a changing literacy landscape.

Modes and media have a symbiotic relationship where each is influenced by the other’s affordances and limitations. Kress and Van Leeuwin (2001) describe modes as the ways in which information is represented or the semiotic channels used to make meaning. Examples of modes include text, sound, images that are both moving and still; and colour. Media describes the resources that are used to both produce and distribute meaning. Examples of media are computers, mobile phones, tablets and television.

Multimodal is a concept developed by members of the New London Group (1996, 2000), including Cope and Kalantzis (2000), Kress (2003, 2005) and Kress and Van Leeuwien (2001). The basis of their claim is that communication is no longer restricted to the textual mode understood through one medium, for example a book. Rather, due to the widespread availability of technology-mediated resources, multiple modes can be realised “...through a single binary code, and the medium of the screen is becoming the primary site where multiple modes can be composed to make meaning in dynamic ways” (Lauer 2009, p. 227). Therefore, multimodal texts are made by combining modes such as images, texts and sound delivered, largely, through the conduit of a screen. In addition, because of the need to manipulate modes and account for their affordances and limitations, there is specific emphasis on design, process, cognitive and socially situated decisions when making meaning multimodally (Lauer, 2009).

Multimodal authoring requires the author to work with a wide range of resources such as linguistic, audio and visual. It also entails the ability to combine the effects of each mode (Burn & Leach, 2004; Burn & Parker, 2003); account for the social purpose (Cope & Kalantzis, 2009) and situated meaning (Gee, 2000) of the communication and the possession of the skills required to manipulate appropriate software and hardware together with suitable understandings of how meanings are made. Chandler and colleagues (2010) described this approach as one of ‘grammatical design’ which focusses on “…students’ understanding of how the linguistic, visual, spatial, gestural and audio resources can be ordered and structured to make meaning” (p. 36). These authors suggested that these explicit understandings underpin effective multimodal authoring. The use of the word ‘authoring’ is deliberate in an attempt to move away from the limitations of single mode use textual practices associated with the concept of authoring.
Facilitating Multimodal Authoring

Technology-mediated communication affords various ways of producing and distributing information within the notion of multimodal authoring in terms of its potential to change how educational contexts are constructed and engaged with. However, technology has different dimensions. Lankshear and colleagues (2000), in their research on teacher technology use, considered the use of technology in terms of an extension of existing teacher practices, such as the use of hardware and software that supports word processing functions. For example, these tools can facilitate student communication that has often been hampered by poor fine motor skills. In addition to letter and word formation, assistance is available in the editing and revising processes, saving time and making the finished product, arguably, more appealing. At this level, technology provides an amplification or efficiency effect but does not qualitatively change teaching practices.

These researchers also suggested a further dimension of technology; the possibility of collaborative and shared activity that can make learning experiences more authentic although researchers such as Merchant (2007) commented that the context of online collaboration is one that teachers are only beginning to explore. Despite technologies potential, Ward (2013) in her evaluation of the National Education Network (NEN) Trial extension (New Zealand) found that while digital technologies may have in some instances augmented or even replaced pen and paper, the paradigm of teacher-directed learning essentially remains the same.

The relationship between technology use and the teaching and learning of writing in education settings has been complex and continues to evolve as new technologies bring new challenges and as more sophisticated understandings emerge of student experiences with technology (Bennett & Maton, 2010). This is due, variously, to the role of technology itself as part of the overall picture of technology integration (Halverson & Smith, 2009-10; Mueller, Wood, Willoughby, Ross, & Specht, 2008); the nature of the writing process; the lack of clarity around what needs to be taught and subsequently assessed in technology mediated writing, and the broader context of policy, technology and the literacy curriculum. Equipping students to be confident digital authors requires curricula and teaching methods that not only support skills acquisition, but also develop knowledge about applying these tools and understanding the role of technology and media in the world (Hague & Williamson, 2009).

When digital technologies first became available for use in schools, the main precursors to technology use were access, availability and reliability of technology. Difficulties associated with these were perceived as the main barriers to integration. However, more recently, due to widespread fast access to the internet and an increased level of resourcing and support in schools,
these barriers have been somewhat mitigated although access to technology is still problematic for some. Noted here is the issue of access, which is more complex than just the provision of resources (J. Furlong, Furlong, Facer, & Sutherland, 2000), in that availability does not necessarily mean genuine access. Access to technology can be conceptualised in ways other than access to resources; take cultural access, for example, where disadvantage arises because of cultural beliefs or norms or, further, access to teachers with sufficiently developed expertise in this area. Several aspects of access will be noted in this study including the availability of technological resources within a school environment. To develop a clearer understanding of the relationship between technology use and writing, the conditions necessary for learning environments that facilitate pervasive use of technology will now be considered.

Previous research has identified both environmental variables and individual characteristics of teachers as factors in the relationship between teaching and technology use (Becker & Ravitz, 2001; Cuban, Kirkpatrick, & Peck, 2001; Ertmer, Ottenbreit-Leftwich, & York, 2006-2007; Hayes, 2007; Windschitl & Sahl, 2002). More recent research (Vanderlinde & van Braak, 2011) has examined this relationship in terms of layers of variables. For the purposes of the current research, however, and in line with the majority of literature, this relationship will be explored in terms of extrinsic (first-order) and intrinsic (second-order) barriers (Ertmer et al., 2006-2007). The term “barrier” is juxtaposed with “enablers”, consistent with existing literature (Ertmer, 1999; Ertmer, Addison, Lane, Ross, & Woods, 1999; Franklin, Turner, Kariuki, & Duran, 2002).

Extrinsic or first-order barriers entail lack of resources, adequate training, curriculum support, technical support and time; aspects that are often part of the systemic framework that surrounds teaching. Intrinsic or second-order barriers refer to teacher values and beliefs around technology integration and pedagogical understandings; aspects unique to the individual that may be viewed as being more influential in teacher technology use. Commonly, researchers describe a mixture of extrinsic and intrinsic factors impacting on technology integration. Hew and Brush (2007), for example, report factors influencing technology use as 1) resources such as hardware and software; 2) teacher knowledge and skills; and 3) teacher attitudes and beliefs. Intrinsic and extrinsic barriers will now be further clarified.

**Extrinsic Factors**

The following provides a description and synthesis of the extrinsic factors influencing technology integration around resourcing, timetabling, technical support or functionality, curriculum support, training and professional learning, and school leadership.
Resourcing of schools was one of the earliest intervention methods to facilitate technology integration into teaching and learning. This intervention was underpinned by beliefs around addressing the so-called “digital divide” (Tapscott, 1996) that suggested a connection between financial resources and access to technology and the assumption that once financial resourcing was deemed to be adequate, barriers to integration would be removed (Ertmer, 1999). These assumptions were supported in turn by teacher beliefs at that time that technology integration depended upon a perceived sufficiency of hardware and software resourcing (Kerr, 1996; Means & Olsen, 1997). As a result, investment by governments worldwide in equipping schools with hardware, software and infrastructure has been significant, particularly over the past 20 years, resulting in an increase in the computer-student ratio (PISA, 2009). However, the increase in resources has not necessarily translated into equal access of all students to technology; computer use at school “varies significantly across countries and economies” (Valentine, Marsh, & Pattie, 2005. p. 20).

Access to technology is further described in terms of time within a busy curriculum and aspects of school timetabling. Results of a study by Morsink and colleagues (2010/2011) found that time and access to technologies were significant elements that influenced teachers’ experiences and beliefs about the value of technology use. The concept of time included time to teach and implement activities. Access issues were around ensuring sufficient technological hardware and software and ensuring its functionality.

Functionality, that is, ensuring resources are operational, on-going maintenance and technology upgrades are other important considerations in the relationship between technology use and learning in schools and these impact on teacher use (Bauer & Kenton, 2005; Franklin et al., 2002; Law, Pelgrum, & Plomp, 2008; Plomp, Pelgrum, & Carstens, 2009). Technology support, in particular, is seen as having more impact on the practice of experienced teachers. According to Ertmer et al. (2006-2007), this may be due to the fact that teachers who had been teaching for longer needed more support as they were likely to have had less formal training in the use of technology or to believe that the distraction of technical problems interrupts existing successful practices. Access and reliability issues of technological tools have been challenges to integration, as have teacher knowledge and skill around technical issues (Moore-Hayes, 2011). A study by Mueller and colleagues (2008), reported that positive experiences with technology in specific classroom contexts built teacher beliefs and confidence around the use of technology and its potential as a teaching and learning tool. However, as a result of constant innovation, Mueller and colleagues (2008) suggest teachers will be perpetual technical novices and integration is only likely when teachers have a strong personal commitment and feeling of self-efficacy in using technology.
to facilitate learning. Self-efficacy as an important variable in technology use is considered an intrinsic barrier and will be discussed in the next section.

The structure and content of curricula, with embedded political agendas, societal expectations, levels of guidance and associated philosophies that guide instructional practice, are considered as further extrinsic factors and potential barriers to technology integration. Confidence in and familiarity with curricula knowledge was stated by Morsink and colleagues (2010/2011), in their study of professional development to support technology integration, as having potential to strengthen teacher confidence. Many teachers struggle with implementing technology into a curriculum that, for example in writing, still favours traditional content and methods with accompanying specific orientations to knowledge (Burnett, Dickson, Myers, & Merchant, 2006; Kalantzis & Cope, 2010).

Leach and Moon (2000) examined pedagogy, ICT and teacher professional knowledge as described in a UK curriculum document where technology had been added as an afterthought. They wrote, “Far from providing a model of planning for teachers the ICT is inserted quite at random, rather than being systematically integrated into and across the revised curriculum and its accompanying schemes of work” (p. 393). Although this research was published in 2000, little appears to have changed. Further research around the structure and content of curricula (Overbay, Patterson, Vasu, & Grable, 2010; Webb, 2005: Webb & Cox, 2004) suggested that if the content and structure of curricula are designed to promote student self-management and co-operative learning, they are more likely to support technology integration. This is juxtaposed with curricula, common in many schools, which are characterised by traditional requirements, focussed on a narrow set of static skills, and fixed knowledge.

Equally, models of teachers’ professional knowledge and strategic professional learning opportunities, which develop pedagogical capability in integrating technology to improve student learning, are a necessary part of developing and supporting teacher practice. Numerous studies (Becker & Ravitz, 2001; Ertmer et al., 2006-2007; Ertmer, Ottenbreit-Leftwich, Sadik, E. Sendurer, & Sendurur, 2012; Franklin et al., 2002; Moore-Hayes, 2011; Mullen, 2001; Peck, Augustine, & Popp, 2003; Picciano, 2002; Plomp et al., 2009; Webb, 2005) have highlighted the need for ongoing professional learning specifically targeted at how technology use can be integrated into teaching and learning and support new practices.

Ertmer and Ottenbreit-Leftwich (2010) further clarify the type of professional learning that is necessary; namely, that it should incorporate and align with existing pedagogical beliefs and knowledge; provide modelling opportunities; support risk-taking; and develop and expand ideas
around “good teaching” that include the use of technology. These findings are also supported by Mueller and colleagues (2008). According to Ertmer and colleagues (2006-2007), strategic professional learning opportunities are most effective when facilitated via workshops, seminars and conferences, and least effective when delivered via group training with a technology coordinator. The conclusion drawn by these researchers was that in sharing ideas, exemplary practices and effective ways of integrating technology, teachers find the support they need from their peers, which is their most preferred method of professional learning.

Leadership in technology integration is very much about leading and managing culture change effectively. Therefore, school leadership at all levels is a critical factor in facilitating teacher change (Ertmer & Ottenbreit-Leftwich, 2010; Somekh, 2008). One of the main roles of a leader is to articulate a shared vision and expectations of desired outcomes and then to create the environment and supportive culture that will enable the vision to flourish. In the SITES (Second Information Technology in Education Study; Plomp et al., 2009) data, high numbers of participants indicated it was necessary for school leaders to be competent in developing a common pedagogical vision among their teaching staff. This finding is supported by research carried out by Vanderlinde and van Braak (2011) who noted that shared decision-making, borne out of effective leadership, was a positive predictor of pedagogical use of technology.

Some researchers argue that when all the extrinsic factors of integrating technology into teaching and learning are put together, they paint a picture of in-built failure (Burnett et al., 2006) before any considerations of teaching pedagogy and self-efficacy can be considered. Results from the SITES study (Plomp et al., 2009) suggested that both extrinsic and intrinsic obstacles correlated significantly with lower probabilities of teacher use of technology. A description of intrinsic factors will now be presented.

**Intrinsic Factors**

Intrinsic factors, those elements fundamental to teachers and teaching, include teacher knowledge of how technology works and ways of teaching using technology; teacher goals, values and beliefs; and self-efficacy around technology integration.

Much of the literature related to technology integration explores the teacher attributes of knowledge, pedagogical beliefs and practices (educational beliefs and practices about teaching and learning); skills related to how technology works and its specific affordances; and values, beliefs and goals related to teaching and learning outcomes. The following discourse explores teacher attributes contained within the notion of intrinsic factors in order to describe them, their
relationship to extrinsic factors and possible implications for teaching and learning using technology.

To facilitate technology integration that improves student learning, it is necessary to understand how technology works, the capabilities of certain applications and relationships between them (Webb & Cox, 2004; Webb, 2005). Also needed is clarity around ways of teaching and assessing student learning using technology. Further, Mueller and colleagues (2008) suggest that direct, contextualised experience with technology that is either hands-on experience or vicarious modelling by more skilled colleagues assists in building teachers’ confidence to integrate technology. Similarly, Moore-Hayes (2011) suggests that there is a need for providing practical, personal development in technology related skills to prepare new teachers for technology integration.

However, skill in using and integrating technology in teaching and learning is more complex than knowledge of skills and techniques with applications alone (Ertmer, 2005; Leach & Moon, 2000; Loveless, 2007; Mueller et al., 2008; Webb, 2005). Teachers may have certain knowledge about technological affordances and processes, but their core beliefs about teaching and learning that influence their pedagogy, may not support the use of technology and its application in effective teaching and learning. This may be especially so in light of previous unsuccessful attempts at implementing change such as technology integration (Ertmer, 2005; Mueller et al., 2008). Teacher beliefs, frequently consistent and difficult to change (Ertmer, 2005; Hughes, 2005; Kagan, 1992), are built from personal experiences (often very early on in a career) and influenced by many years spent in classrooms as a pupil. For many of today’s teachers, that has meant no, or very little, exposure to the use of technology in teaching and learning because technology use has developed mainly over the past 20 years. Teacher beliefs are, however, significant predictors of classroom technology use.

Teacher adoption of technology is also closely linked to the goals teachers have and how the integration of technology might support or impede these goals. Zhao and Cziko (2001) examined this issue from a perceptual control theory perspective and propose understanding around teacher use of technology in terms of the necessary conditions of a) teacher belief that technology can meet a goal more effectively than traditional methods, b) that the use of technology will not interfere with other important goals, and c) that the teacher will have sufficient ability and resources to be able to utilise technology. Along similar lines is Rogers’ (2003) notion of innovation diffusion. He argued that how an innovation is perceived, aids in determining its rate of adoption. Understanding teacher perceptions and beliefs around the use of technology, therefore, can be an
indicator of its future adoption. Changes to the way teaching and learning take place must be examined in the light of how the suggested change will influence decision making by professionals who are goal oriented and have a significant amount of autonomy in their decision-making.

Further, in addition to beliefs and goals related to teaching and learning facilitated by technology integration, teachers also hold beliefs about themselves, their capabilities and what they are able to achieve, referred to by Pajares (1996) as efficacy beliefs. They also hold value beliefs. Efficacy beliefs focus on what individuals believe they are capable of, irrespective of the skills or knowledge they possess. Without a strong sense of self-efficacy, it is unlikely that any action will be taken, despite a belief that a particular action may be beneficial. Kagan (1992) and others posited that efficacy beliefs have a greater influence on teacher practice than teacher knowledge. Value beliefs, associated with technology integration, refer to the significance placed by teachers on technology integration; that this is an important aim of their teaching (Starkey, 2011). So integrating technology must support core beliefs and value beliefs held about teaching and learning; perceived as having value, and underpinned by strong self-efficacy beliefs.

The structuring of teacher knowledge related to technology integration is not well described in the current body of literature. According to Howard and Maton (2011), although empirical research describes a range of surface features that either inhibit or contribute to technology integration such as the structure of curricula, understanding remains at a surface level of empirical descriptions rather than at a theoretical level. As these researchers comment, “knowledge is overwhelmingly a missing factor” (p.193). A contributing factor to this gap in the literature could be the lack of, or weakness in, a shared language or metalanguage (Czerniewicz, 2010; Reigeluth & Carr-Chelmon, 2009; Sheridan & Rowsell, 2010; Unsworth, 2006) and that “concepts, terms, relations and procedures are not explicitly and properly articulated” (Czerniewicz, 2010, p.530). Further, Young and Muller (2007) suggest that any knowledge base that has weak shared understandings and grammar struggles to progress. The structuring of teacher knowledge and in particular the absence of a shared grammar and more broadly a “conceptual syntax” (Czerniewicz, 2010, p. 531) has implications for teacher practice which will be explored next.

**Implications for Teacher Practice**

The many dimensions of technology integration as they impact on teacher practice are complex, debated and still evolving. Existing studies describe levels of influence that extrinsic and intrinsic factors have on the integration of technology but, as yet, there is little in the way of a conceptual framework on technology integration to inform teaching practice (Howard & Maton, 2011). Research by Ertmer and colleagues (2012) into the beliefs and practices of exemplary teachers
found that extrinsic factors, reported as the negative attitudes of colleagues, provided the greatest barrier to technology integration. Participants reported their own attitudes and beliefs, that is, intrinsic factors as defined in this review, as enablers to technology integration. Similarly, Eteokleous (2008) identified the influential factors for technology integration, that had the most impact on teacher technology use, were extrinsic influences, such as a lack of resources; the “tyranny of the curriculum” (p. 680) - in other words, a curriculum where dominant philosophies did not align with appropriate instructional practice; and inadequate professional learning opportunities.

Some research, however, takes the opposite view that factors intrinsic to teacher practice are most predictive of technology use. Teacher variables such as knowledge, pedagogical beliefs and practices, and values have the greatest influence over adopting technology for learning (Ertmer, 2005: Ertmer & Ottenbreit-Leftwich, 2010), based on whether teachers think that technology can help them to achieve the learning goals they believe to be most important (Watson, as cited in Ertmer & Ottenbreit-Leftwich, 2010). Wozney and colleagues (2006) found that those who have strong efficacy beliefs and value the outcomes associated with technology use were likely to place them at the higher end of the “technology user spectrum” (p.195). Likewise, Moore-Hayes (2011) noted in her research around perceptions of self-efficacy in both pre-service and experienced teachers that, despite an increasing availability of technology in classrooms, hesitant teacher uptake revealed a lack of teacher efficacy for technology integration.

Changes in teacher practice that are required in order to integrate technology into teaching and learning are influenced by an array of barriers and enablers. Those outlined in this review have been categorised as extrinsic factors but intertwined with teacher practice, and intrinsic characteristics of teachers such as beliefs, attitudes, knowledge and skills. Facilitating teacher change and thereby creating a new definition of effective teaching requires changes in teacher knowledge, beliefs, and culture and shared understandings of what this new definition looks like in practice (Ertmer & Ottenbreit-Leftwich, 2010).

Although teachers may be armed with knowledge of new technology and seek to change their pedagogical beliefs, strengthened efficacy beliefs and a positive perception of the benefits of technology integration are still needed in order to effect change. In addition, change should occur within an environment where there are opportunities to talk about what is happening (Le Fevre, 2010), try out new practices and see changed practices modelled effectively with comprehensive technical support. Most importantly, there needs to be ways of witnessing and measuring how innovative teaching methods that include technology integration positively influences student
learning. This is particularly relevant to writing, as teachers have to address changing literacy requirements within a background of rapid technology change.

**Changing Nature of Literacy and Literate Practices**

Traditional notions of literacy and being literate have, for centuries, been based on the encoding and decoding of written text, with mastery measured by acquiring certain discrete skills. Writing has been the most significant social tool for communicating and shaping social attitudes and beliefs (Walsh, 2009). Schools were charged with the task of teaching textual based skills in a society where knowledge was slow to advance and value was placed on individual endeavour.

However, in the latter half of the 20th century, globalisation and developments in multimodal technology and communication tools have effected significant change in the way people live their lives, access and create knowledge, and communicate. Understandings of being literate have evolved to include using multiple media forms and multimodal resources to engage in practices that include mixing images, sound and text for a diverse range of purposes. Skills used in decoding and encoding pen and paper texts have been expanded to embrace those needed for new writing methods and purposes. As Leu and colleagues (2004) suggested, “Change increasingly defines the nature of literacy and the nature of literacy learning” (p.1607).

The young, in particular, have embraced the possibilities of using, mixing and remaking images, sound and text for a diverse range of meaning making purposes. They do this, typically, in their everyday culture outside the classroom (Alvermann, Xu, & Carpenter, 2003). Often children use, at home, a far wider and more complex range of technology than can be accessed at school. Peers, who play an important role in mentoring and establishing literate practices, have provided knowledge and support around technology-based needs. This contrasts with the traditional teacher led, top-down method of instruction typically associated with traditional school-based learning (Mills, 2010a).

Many governments around the world have prioritised the provision of technology in classrooms to enhance teaching and learning opportunities in all areas, and writing is no exception. However, identifying different functions and methods for writing has challenged previously held pedagogical understandings about the teaching and learning of writing and associated curricula and, as Bearne (2009a) noted, accepted theories on literacy and literacy learning have been brought into question. Of the responses that literacy researchers have made to addressing different approaches to literacy learning, the New London Group’s “A pedagogy of multiliteracies: Designing social futures” (1996, 2000) further developed by Cope and Kalantzis (2000, 2005) has, arguably, been one of the most influential. This pedagogy describes how available sources of meaning are
reformed to create new resources to suit the purposes of the user. This process pervades the use of multimodal tools along with the ability to move resources around not only on screen, but also in cyberspace with possibilities for dialogue and collaboration with others virtually anywhere. This has resulted in a changed role of the audience.

Along with responses to addressing different approaches to literacy learning, discussion and critique of literacy policy and practice has emerged including exactly how teachers respond to different approaches to literacy learning that have not been made explicit. The education sector has been slow to respond to changes in teaching and learning brought about by technological changes (Ward & Parr, 2011). Consequently, the impact on teaching, learning and assessment of technology-mediated literacies has been limited (Merchant, 2005). Pedagogy and school literacy curricula are still dominated by the production and assessment of traditional text.

Therefore, a disconnect exists, and continues to deepen, between what is taught and tested and what today’s students know as writing (Yancey, 2004). Significantly for teachers, despite the implementation of multiple government strategies and policies aimed at extending capabilities of teachers and school leaders in the use of technology for teaching and learning, research shows (Parr & Ward, 2010; Scardamalia & Bereiter, 1994) there has been little change in pedagogy, merely a rethink of existing practices. The emphasis in writing still remains on a single writing relationship between writer and reader or, more commonly, between writer and teacher (Yancey, 2004).

An examination of the broader context of policy, technology and the literacy curriculum follows in order to background the way in which some countries have responded to changing technologies and changing practices.

The Macro-Level Areas of Policy, Technology and the Literacy Curriculum.

Information and communications technology has been widely used in both popular media and academic literature as a metaphor describing 21st century learning. Alongside constructivist learning theories that foster learner engagement, changed and multidimensional roles for teachers and students, the use of technology is seen as serving the needs of the learners of tomorrow. Of consequence for teachers, in many countries literacy national curricula and supporting policy documents indicate intent for the integration of ICT into teaching and learning not only as enhancement but to expand opportunities to learn (Bolstad & Gilbert, 2006), yet direct references to guide the use of multimodal authoring in the literacy curriculum are not evident. Consequently, what actually happens in terms of using multimodal resources in literacy curricula is
broadly supported in curricula documents but interpreted and implemented at a school or community level.

This has resulted in an ad hoc growth in technology integration in literacy. Whilst this situation is common in the structure and intent of curricula, researchers such as Bearne and Wolstencroft (2007) suggest that because understandings of the knowledge and skills necessary for multimodal authoring are still relatively new, explicit direction is required at an official curriculum level around the tabling and interpretation of curricula goals, teaching approaches and assessment practices. Alongside these strategies is the imperative to strengthen the pedagogical capabilities of teachers in order to develop the skills and knowledge necessary to integrate multimodal resources into the teaching and learning of writing, particularly in instructional and evaluative competencies.

Policy aspirations of most industrialised nations over the past 20 years have been to realise the potential of information and communications technology in improving education outcomes for its citizens (Leach & Moon, 2000), which has resulted in strategic planning highlighting the role of digital technologies. In New Zealand, for example, successive governments over the past 10 years have supported projects to enhance professional learning by funding Information and Communication Technology Professional Development (ICT PD) clusters; to improve learning through the innovative use of leading edge technologies through the Digital Opportunities (DigiOps) projects; to resource all teachers with a laptop for their professional use through the laptops for teachers scheme (TELA); and through the School Network Upgrade Project (SNUP) to provide Ultra-Fast Broadband (UFB) services. These projects are typical of the considerable financial commitment Governments throughout the western world have made to support the use of technology in teaching and learning.

The implementation of government agendas of technology use in teaching and learning have been by way of national curriculum documents detailing links between information and communications technology and learning goals in all areas. Various iterations of this process are features of curriculum reform over the last 10 years in many different countries. However, as Merchant (2005) pointed out, it is puzzling that literacy curricula in many industrialised nations continue to be characterised by traditional requirements associated with print-based text. This pre-occupation is also reflected in an emphasis on standardised measures of achievement, which ignore diverse paths to literacy. Merchant further comments, “Adopting this unilinear, print-based model, creates distance between classroom instruction and everyday uses of literacy” (p.50).

Three recent literacy curricula iterations from New Zealand, Australia and England will be described briefly as they relate to technology mediated writing. Two curricula, that of England and
New Zealand, illustrate Merchant’s argument about the continued emphasis on print-based text and associated assessment priorities while the other curriculum, that of Australia, demonstrates a response that includes a more detailed literacy framework with the use of multimodal resources.

New Zealand

Before describing the literacy aims of the New Zealand curriculum, it is pertinent to background the unique situation in New Zealand of self-managing schools and the policy environment under which school leaders manage their schools. In 1989, a school self-management policy was introduced into New Zealand that gave individual school leaders significant autonomy in how they responded to the learning needs of their students. This was based on the assumption that schools would be more responsive to localised contextual needs and variables which would in turn lead to better learning outcomes for students. Part of this assumption included the idea that schools would have sufficient expertise and capability amongst staff to respond to the learning needs of their student communities. Cumulative evidence gathered over the ensuing years, and particularly recently, according to research by Robinson, McNaughton and Timperley (2011), suggested “this assumption was faulty” (p. 734). This research suggested that the capacity of individual schools to address learning needs of the students within the context of their schools is highly variable.

Literacy aims and content in the New Zealand Curriculum (Ministry of Education, 2007) are detailed under the learning area of English. Interconnected strands of making meaning (listening, reading, and viewing) and creating meaning (speaking, writing and presenting) make up the oral, written and visual forms of language. A stated aim of the New Zealand Curriculum document as a whole is to provide the principles “on which to base curriculum decision making” (p.4). In addition, the curriculum document identifies five key competencies students need for effective citizenship, including the ability to use language, symbols and texts. This ability is further clarified to include the confident use of ICT “to access and provide information and to communicate with others” (p.12). Achievement objectives are specified for curriculum levels 1–8 which correspond to Years 1–13. Achievement objectives for writing, in the early years in particular, focus largely on acquiring fixed skills associated with language features and structure. Although not stated overtly in this document, the assumption is that capability in this fixed, specialised knowledge also governs and regulates evaluation and assessment in this domain.

The New Zealand Curriculum encourages schools to “explore not only how ICT can supplement traditional ways of teaching, but also how it can open up new and different ways of learning” (Ministry of Education, 2007, p. 36). This and similar aspirational statements in the curriculum document indicate an intent for the integration of ICT into teaching and learning not only as
enhancement but also to expand opportunities to learn (Bolstad & Gilbert, 2006). However, direct
references that support and guide multimodal authoring in the literacy curriculum are not evident.

The New Zealand English Curriculum is supported further by The Literacy Learning Progressions
(Ministry of Education, 2010) guiding literacy teaching and learning, promising to detail “the
specific literacy knowledge, skills and attitudes that students draw on in order to meet the reading
and writing demands of the curriculum” (p.2). However, apart from a reference in the indicators
for achievement by the end of Year 4, which suggests when students create texts they “make
choices, when appropriate, for publishing in a variety of media, including digital and visual media”,
there is no overt reference to the knowledge or skills required for multimodal authoring.

**England**

Proposed primary curriculum reforms, as detailed in what is referred to as “The Rose Report”
(Rose, 2009), prioritised literacy, numeracy and ICT. Particular emphasis was placed on recognising
the increasing use of digital technology in the world young people are growing up in, which
requires high levels of digital literacy to enable full participation. The programme for study in
English in the National Curriculum for England (Primary National Curriculum, 1999) Key Stages 1 &
2 (primary) outlines the key skills, knowledge and understandings to be taught alongside the
contexts, areas and activities of study. For example, on p.52 there is a reference to the use of ICT
across the curriculum to develop capabilities in information searching and synthesising, critical
literacy, developing expertise in tool use, communicating via ICTs and reviewing, evaluating and
modifying their work as it progresses.

A feature of the format of these documents is supporting comments in the margins with suggested
opportunities for pupil use of ICT, aligned with a summary of the main learning goals of each key
stage. The English curriculum document is also supported by schemes of work detailing objectives,
activities and outcomes, including the use of ICT. These may be used by schools when developing
their own work plans. However, as Leach and Moon (2000) suggest, “Many schools, given the
scrutiny of external inspection, will see it as ‘playing safe’ to adopt these wholesale” (p. 389)
without necessarily tailoring resources to suit the needs of individual students. Again, as in the
New Zealand curricula context, in the main body of text detailing knowledge, skills and
understanding relating to writing achievement, no explicit reference is made in support of the
inclusion of multimodal methods of writing.

The attainment targets for writing which set out the indicators of knowledge, skills and
understandings at each of the key stages covering the primary and secondary curriculum contain
no descriptors or indicators of writing using multimodal methods.
**Australia**

In contrast, the Australian English Curriculum (Australian Curriculum, Assessment and Reporting Authority, 2011), being trialled at the time of writing, makes sustained reference throughout all levels to standards, progressions, skills and understandings related to creating multimodal texts. For example, at Year 1, students are expected to “Understand concepts about print and screen, including how different types of texts are organised using page numbering, tables of content, headings and titles, navigation buttons, bars and links” (Australian Curriculum, Assessment and Reporting Authority, 2011, p. 21). Further explicit reference is made to changing pedagogies articulated in goals such as “to collaborate and communicate with others both within and beyond the classroom” (p.11).

Clear purpose, rationale and pedagogical considerations are detailed for the inclusion of multimodal methods in the teaching of English. Guided by ‘Shape of the Australian Curriculum: English’ (Commonwealth of Australia, 2009), the role of digital technologies and accompanying pedagogies are prioritised in statements such as “digital and online materials present the English Curriculum with new teaching opportunities” (p. 15). Importantly, both of these documents contain a framework for a metalanguage through which teachers can talk about teaching and learning around multimedia authoring pedagogies. A context of shared understandings, including a shared language, is required to make processes and content explicit and to engage in inquiry and dialogue amongst stakeholders.

As an example of explicit approaches to framing the use of multimodal methods in teaching and learning, the Queensland Government (n.d.), through their Smart Classrooms initiative, details how curriculum goals will be implemented including a comprehensive support package for teachers using digital technology in teaching and learning. Importantly, this document not only supports knowledge and understandings of multimodal texts and production skills, but also, by establishing and developing digital pedagogies as part of this initiative, acknowledges support for developing effective teaching practices when using technology-mediated learning opportunities. The South Australian Curriculum Standards and Accountability Framework (Department of Education, Training and Employment, 2009) summarises similarly comprehensive goals particularly related to producing and responding to broad definitions of what constitutes texts.

The level of governmental influence in curriculum development, teaching methods and content promotes substantial debate in many countries. The curriculum at a national level provides the basis for teaching, learning and accountability regimes that highly influence the enacted curricula in schools and classrooms (Leach & Moon, 2000). Curricula considered here represent different
perspectives and offer varying levels of support around what is considered benchmark information for the inclusion of multimodality in student authored texts and just how teachers will engage with this process. Their architects have, seemingly, attempted to combine sufficient central guidance with flexibility at a local level, so that teachers can take into account the individual and contextualised needs of their students when making teaching and learning decisions. This implies a capacity for teachers to be able to develop curricula, thus making sense of national strategies in a way that will improve learning for all students. However, some would argue that this capacity is limited (Priestley, 2011; Robinson et al., 2011).

Decisions that affect the structure of national curriculum documents must be rigorous enough to describe core knowledge needs but flexible enough for teachers to craft decisions that facilitate and enhance student learning (Primary National Curriculum, 1999). Curricula in New Zealand and England, with minor exceptions, are characterised by generic content statements (Oates, 2010). So, despite intentions for inclusion of technology into the teaching of literacy, the reality is very little direct mention of communicating using technology. Whilst all documents contain aspirational goals for including ICT, the Australian Curriculum details expectations at a national level related to writing multimodal texts and, further, individual states have further refined and explained desired skills, knowledge and understandings.

Clarity around what needs to be taught and subsequently assessed is a necessary condition for teaching and learning to be equitable for all students. There is also the added requirement that governments demonstrate commitment through curriculum documents to espoused educational policy (Oates, 2010). Curricula that provide a comprehensive, contextualised framework on which to develop teaching and learning strategies, particularly in relatively new areas of learning, have the potential for greater success than curricula that support aspirational goals only (Bearne & Wolstencroft, 2007). Adjusting teacher practice and pedagogical orientations to match new learning purposes and outcomes need not only time and resources to develop, but clear guidelines to foster necessary theory building and conceptual change (Leach & Moon, 2000). As Merchant (2005) suggested “a literacy curriculum that ignores on-screen writing is an impoverished one…but we still have a long way to go in investigating the specific detail” (p. 120).

The effectiveness of any school curriculum depends upon those who teach it. Teaching practices intersect with curriculum requirements to such an extent that both must be considered when seeking clarity about teaching and student engagement with multimodal resources and methods in writing. The ways in which teachers have interpreted curriculum requirements and developed
Emerging Teacher and Student Engagement with Multimodal Resources and Methods in Writing

Writing using multimodal resources and methods differs in two important ways from that using pen and paper resources alone. Firstly, multimodal tools enable the use of visual, aural, textual and haptic modes, to foster meaningful learning (Mayer, 2003) and, second, there is the ability to reach an extended audience via internet capable online technology. As researchers Jenkins and colleagues (2013) suggested, access to diverse, global audiences has resulted in “fundamental shifts in the audience’s position” (p. 159) enabling, as part of online affordances, audience collaboration and interaction. Collaboration and interaction between the writer and the audience implies working together to create something that participants could not create on their own. These processes have changed, not only the way we do writing, but also the way we think about writing (Merchant, 2005) and how we make meaning that is arguably more powerful than any single mode of meaning alone for both the reader and the writer (Labbo, 2004).

A range of studies exists that examine the use of multimodal resources in writing. The majority use qualitative methodologies and are often framed within a context of the New Literacy Studies, and “A Pedagogy of Multiliteracies” (The New London Group, 1996, 2000). Some research addresses the enhancement of existing practices but, of most interest to this study, is research that reports on the development of new literacy practices in teaching and learning, termed by Burnett and colleagues (2006), as transformative practices. Based on their research into the email interactions of a group of 10 year olds, they propose a transformative versus enrichment view of the use of new technology (Burnett et al., 2006). “Transformative” is explained in terms of “contexts and forms of collaboration that extend beyond the classroom” (p. 13) supported by technology, innovative curricula and re-designed learning environments. By contrast, “enrichment” refers to the use of technology as augmenting what is already happening in teaching and learning. The enrichment view of technology use is consistent with Cuban and colleagues’ (2001) premise that computers, in particular, can maintain existing instructional practices that focus on transmitting information rather than helping learners actively construct knowledge.

In order to clarify characteristics and affordances of digital communications, a distinction is made between “synchronous” or “asynchronous” communication in the forms that text takes in technology mediated communication. The distinction is important because of the different forms of texts and similarities to traditional print literacy forms when considering the inclusion of
technology-mediated forms of writing in teaching and learning (Merchant, 2007). Examples of synchronous communications are instant messaging (IMing), texting (can also be asynchronous), chat room communication and online gaming; in all of these forms, the immediacy of the communication is critical. In this type of communication, the text is often, quite literally, written speech and includes the use of hybrid textual forms, such as “text language”, where words and syntax are shaped by the demands of a rapid response to maintain a relationship. Examples of asynchronous communications, on the other hand, include activities such as emails, discussion boards, blogs, webpages and wikis, all of which rely on the presence and interaction of others at some point without the sense of immediacy of synchronous communications. Both synchronous and asynchronous forms of multimodal authoring provide different opportunities for communicating, bound by different contextual properties.

To summarise, because the focus of this study goes beyond using technology to enhance existing literacy practices, research that reflects a transformative view of technology use was reviewed, mainly published within the last five years, relevant to or framed within Years 1–8 of schooling. The most recent literature reviewed, where possible, reflects the constantly changing nature of technology and related literate practices. The research will be discussed in terms of the two main types of multimodal authoring that has been the focus of recent research. Potentially, these are both asynchronous types of technology-mediated communication, namely a) blogs and wikis and b) producing web pages. Research around the use of blogs and wikis constitutes the bulk of the discourse, which in itself is interesting as both these forms of communication rely heavily on the use of textual resources and thus align with traditional foci in the teaching and learning of writing.

**Working with Multimodal Authoring in the Classroom: Blogs and Wikis**

“Wikis” typically consist of a number of connecting webpages that allow creating, sharing and developing knowledge and information with the aid of multimodal resources designed for multiple users. Examples of wikis include intranets and online communities based around a particular topic, interest or subject. A “blog” is a website often taking the form of a journal or diary (originally a “weblog”) that most commonly is interactive, providing information and comment on a particular theme, updated regularly by the users. Blogs can be individualised with pictures and personal information. Both these applications are fast and easy to participate in without the need for sophisticated technical knowledge (Boling, Castek, Zawilinski, Varton, & Nierlich, 2008; Huffaker, 2005) and have rich potential in the collaborative nature of their knowledge building for development and support of transformative pedagogies.
Empirical evidence about the use of blogs and wikis dominates the literature in multimodal authoring. A possible explanation may be that a blog or wiki is one of the least problematic conduits to incorporating technological resources into writing, as blogs and wikis have a high textual component. They also may be forms with which teachers have experienced success and be familiar with and, therefore, value. This is consistent with research carried out by Ertmer and colleagues (2012) who propose that teacher beliefs and attitudes about the relevance of technology have a big impact on successful integration.

Evidence from the research suggests that, typically, participants in blogs and wikis construct knowledge collaboratively including contributions from beyond the immediate classroom enabled by internet capable technology for authentic audiences (Boling et al., 2008; Dohn, 2010; Drexler, Dawson’ & Ferdig, 2006; Huffaker, 2005: Lankshear & Knobel, 2006; Lund, 2008; Marsh, 2008; Merchant, 2005; Storch, 2011; Woo, Chu, Ho, & Li, 2011; Zawilinski, 2009). Collaboration is reported as being useful in terms of peer comments to assist in scaffolding writing; facilitating, sharing and co-constructing knowledge; writing for authentic or real-life purposes and audiences (Andes, 2011; Andes & Claggett, 2011; Boling et al., 2008; Mabrito, 2008); pooling linguistic resources particularly for English learners (Storch, 2011); engaging in collaborative behaviour (Woo et al., 2011); and modelling effective writing thus developing writer self-efficacy (Drexler et al., 2006; Pennay, 2009). Being able to access and collaborate on authoring anytime and anywhere (Huffaker, 2005) is suggested as having significant advantage over more traditional forms of pen and paper authoring. However, individual access to and the reliability of technological tools are referred to by some researchers as problematic and unequally distributed (Marsh, 2007; Woo et al., 2011), negatively impacting on collaborative relationships.

In addition to the opportunity to write for authentic purposes and audiences, research suggests that collaboration in authentic tasks increases learner motivation and engagement. Boling and colleagues (2008) reviewed the use of collaborative internet literacy projects as a way to engage elementary school students in writing. In one such project, it was reported that the use of classroom blogs provided opportunities for the development of collaborative writing skills, which led to increased learner motivation. Similarly, Andes (2011) describes a project in which, amongst other activities, students interviewed an important person in their lives and included their findings on a class wiki. Family, friends and staff were given the opportunity to post comments and “talk” with the bloggers. Authentic activities and audiences were posited by Andes as motivation for students to read and write. Mabrito (2008) also notes motivation as a feature of creating texts shaped by the interactive audience that is built up through blog posts. This argument is not without critique, as suggested below.
In response to calls from researchers such as Storch (2011) for clarification of the use of blogs as an educational strategy, Zawilinski (2009) designed a framework for blogging to promote higher order thinking in which she describes the multiple ways in which participants collaborate to build shared understandings of ideas and evaluate and produce data from multiple sources. A series of four recursive steps was proposed as an approach to using blogs in the literacy classroom, each step integrating both traditional literacy skills and those required when using multimodal resources. Results of the study indicated that the use of this framework supported the development of a collaborative learning community. Benefits of membership of this community included accessing a broad range of information and diverse perspectives. There was also an increase in participants’ critical thinking and information synthesising skills.

Dohn (2010) offers critique of the use of blogs and wikis in teaching and learning in research. Despite the intent of wikis and blogs to be collaborative and learner-centred, there is often uncertainty as to whether goals are established based on accountability requirements or the needs of the learner. A tension exists in the “meaningfulness” (Dohn, 2010, p. 147) of participation in relation to the teacher’s expectations and educational goals, and the learner’s expectations in terms of value to the learner. An example of this is detailed in my research into the social literacy practices of young adolescents (Bedford, 2008) describing the experiences of a participant who attested to the very demotivating experience of being directed to participate in a teacher-initiated class blog. Dohn (2010) suggested that a teacher-initiated blog or wiki may be very similar to any teacher-initiated task in that the tasks are demotivating for students if they are seen as compulsory and teacher driven. Further, that students may be familiar with contributing to blogs and wikis in their out-of-school activities but unsure about expectations around the use of such platforms in an educational context.

Similarly, Storch (2011) reviews the use of blogs and wikis in his research into English as a second language user in which he suggests that, whilst participation may be increased, the quality and extent of language use may not improve. He calls for clarification of wiki collaboration as an intentional educational strategy in terms of purpose, structure and optimal group size. He also reported on Kessler’s (2009) data collected from adult English learners that when collaborating on a wiki, grammatical accuracy was ignored as the participants saw the exercise as social and meaning making with participants suggesting that grammatical accuracy does not largely affect meaning.

When wikis and blogs are used in ways that are consistent with a transformative learning typology, learners have the opportunity to make the most of multimodal technologies in support of a range
of communication and knowledge building opportunities. Inherently, wikis and blogs as communicative functions have the potential to serve several purposes. They offer opportunities for collaboration; enable learning to take place beyond the classroom; facilitate a significant degree of user autonomy; offer the prospect of using multiple modes including the visual, audio and textual; encourage the use of critical literacy skills when using a range of ideas and deciding which information sources would be appropriate; and allow authoring for an authentic audience having real relevance to the learner (Marsh, 2007). There is inevitable variation in the way in which blogs and wikis are used in differing contexts suggesting minimal homogeneity or characteristics shared by the research reported on, rather, engagement and outcomes appear to be highly context dependent.

**Working with Multimodal Authoring in the Classroom: Producing Webpages Using Multimodal Technology**

Children’s experiences with multimodal authoring were explored by Merchant (2005) in a small scale study conducted with a group of 9–10 year olds culminating in the production of web pages which showcased results. Data collected detailed understandings students had when authoring multimodally; namely, language choices influenced by awareness of purpose; literacy strategies used across sites; the unique affordances and properties of multimodal resources including interactive audience participation; and the use of a meta-language about multimodal authoring that bridged the contexts of home and school.

Despite increasing use of technology in classrooms and the possibilities this presents for transformative pedagogies, Merchant observes that technological resources merely “…tend to extend didactic pedagogies rather than transform classroom practices” (p.59). This researcher concluded his findings with a call for models of classroom practice that support multimodal authoring not only to confirm user choices that account for on-screen authoring affordances, but also pedagogical actions that support extended notions of literacy.

Although much of the research referred to details the use of blogs, wikis and creating web pages in formal education settings, it does not explore nor address comprehensively how the skills and knowledge developed while participating in these activities are linked to improved teaching and learning nor preparing students for more complex academic practices. For example, comments from peers on areas of personal interest may be valued within a particular community, but they may be of lesser value in an academic context, viewed using different criteria (Bennett & Maton, 2010).
Working with Multimodal Authoring in the Classroom: Assessing Multimodal Texts

Within the increasingly contextualised domain of technology mediated communication, accurate benchmarks of student progress are not necessarily gained by assessment practices dominated by decontextualised skills such as those used to assess traditional text. However, because of its pervasive use, multimodal authoring deserves a place in the classroom as these texts are experienced everyday by students in their out-of-school literate practice (Bearne, 2009a).

Although little clarity and shared understandings exist around what is valued knowledge and corresponding appropriate assessment practices when producing multimodal texts, some research has begun to explore these and related issues (Bearne, 2009a; Burke, 2009; Kendrik, McKay, & Mutonyi, 2009; Vincent, 2006; Whithaus, 2005). A common theme of research in this area is that definitions of literacy are changing, it is context dependent, distributed and multimodal in nature. This makes it challenging to establish assessment processes and procedures, for writing facilitated by multiple modes, as it does not readily fit within current pen and paper based methods promoted currently at a national level.

In considering the value of multimodal technology-mediated communications, there is a need to understand their composition, what teachers need to know to teach them, what students need to learn in order to produce them and, in turn, what students learn from producing them. Researchers, such as Burke (2009) suggested the importance of, for example, critical literacy skills, remaking and remixing texts that characterise multimodal communication and the creation of hybrid languages to communicate. She further posits that also necessary are “exemplars which illustrate the ‘what’ and ‘how’ of multimodal texts combined with explicit criteria which uphold authentic and realistic assessment, and provide feedback” (p. 42).

Bearne (2009a) details a model of what progress in multimodal authoring looks like. She proposed that progress in creating multimodal texts is marked by growth in four critical components. First, the choice of mode must reflect the content, purpose and audience that will best communicate meaning. As part of mode choice, she included the use of such features as colour, sound and language to sustain reader engagement and the selecting of appropriate content to match the writer’s purpose. Second, the design, layout and organisation of texts are highlighted as a means to maximise information structuring for effect. Next, technical features are considered such as camera angles, presentational perspectives and gesture, in order to gauge the effectiveness of using these features to meet the author’s purpose. Finally, Bearne suggested benchmarks for
students to inform the ability to describe and explain their choices of mode and design, and comment on the overall effectiveness of their message.

These indicators would then be used to describe student authoring from:

- a multimodal text maker in the early stages through to being an increasingly assured multimodal text maker, then becoming a more experienced and often independent multimodal text maker and later an assured, experienced, and independent multimodal text maker (p. 23).

In their research into visual literacy and ways of interpreting and assessing it, Kendrik, McKay and Mutonyi (2009), point to the difficulties of applying narrow assessment criteria to texts that use multiple modes. They commented that language and image are co-dependent in making meaning and cannot be separated and when examining multimodal texts “assessments of these visual texts can only ever point to meaning potentials or possible meanings as opposed to discovering the “one true meaning of the text” (p.70). McClay and Mackey (2009) expand on the need for wider notions of evaluating student multimodal work and argue for distributed assessment. This involves interpreting student work in terms of an audit rather than the dichotomy of right and wrong or good and bad. This method has the advantage of creating “useful baseline information from which to assess gains over the course of a semester or a year” (p. 126). Importantly, these researchers also emphasised the need for the involvement of teachers and others in education in negotiating frameworks for assessment.

Research into assessment in multimodal authoring in primary school, although variable in its scope and recommendations, does not espouse the need for a total overhaul of assessment practices in writing but calls for a more nuanced approach to understanding how technology mediated multimodal texts evolve (Burke & Hammett, 2009). Seeking ways to blend what may appear to be dissimilar practices and traditions could offer a way forward. Whithaus (2005) cautioned against ignoring recognition of student multimodal authoring. He said:

Worst yet is for writing teachers to ignore the call to establish some form of criteria for students’ e-texts. Not having any guidelines in place at all implies that e-textual writing has no value in the writing classroom. We assess what we value in writing. If it’s measured, it’s treasured (p. 158).

The only widely tested instruments available for use to inform progress in writing, at present, do not reveal student learning using multiple modes. As Vincent’s (2006) research into the
multimodal work of a group of 10 year olds showed, some children benefit from the support multimodal opportunities present to communication. Assisting teachers to accept the benefits of this type of communication requires not only the inclusion of multimodal opportunities in teaching and learning, but also support to inform student progress with appropriate assessment and evaluation strategies. Failure to do this prevents students from reaching their full potential.

The next section describes learning mediation frameworks that outline possible models on which to base teacher practice related to technology mediated multimodal writing.

**Working with Multimodal Authoring in the Classroom: Research Describing Multimodal Authoring Pedagogies**

In an attempt to illuminate the pathway to teaching multimodal authoring, researchers have proffered an array of different models in the form of approaches and teaching frameworks. This has been despite a lack of evidence to support their use in teaching to improve student learning. Newman (2009) suggested that creating a development framework for schools could enable digital literacies, including multimodal authoring, to become established into the educational landscape and anchor developing understandings. Some models focus on a process to support teaching practice that, in theory at least, develops competency in multimodal authoring in learners such as Learning by Design (Kalantzis & Cope, 2005, 2010). Research by Chandler, O’Brien and Unsworth (2010), for example, reported on developing a 3D multimodal authoring pedagogy in the middle years of schooling building on teacher experiences of the multimedia construction platform Kahootz. Multimodal authoring pedagogies have a significant presence in the literature and are suggested as ways to assist teachers to adapt understandings of how children develop as writers and locate these understandings within writing curricula to include multimodal methods (Flynn, 2007). One important example of research describing multimodal authoring pedagogy is now described to illustrate strategies researchers and teachers are proposing to provide clarity around enhancing the quality of teaching and learning in writing using multimedia resources and multimodal methods.

Learning by Design (Kalantzis & Cope, 2005, 2010) was chosen as an example of a framework that supports teachers to design online learning experiences for their students that include pedagogical scaffolds to support the introduction of multimodality into teaching and learning. The utilisation of this type of frameworks, however, is not considered as evidence of pedagogical capability for the purposes of this research but rather a technical ability to follow a specified programme. As Flynn further commented “However carefully thought out, no framework for literacy teaching can be teacher proof: knowledge and understanding of underlying principles and key research findings
are still needed in our classrooms” (p. 138). Further comment by Timperley and colleagues (2010) supports Flynn’s position, that teaching that merely follows a certain framework, does not support sustainable improvements in teaching practice in the long term.

**Learning by Design (Kalantzis & Cope, 2005)**

“Learning by Design” is a learning mediation and planning tool developed by Kalantzis and Cope (2005, 2010) with the intention of addressing the changing literacy needs of learners who are increasingly “immersed in digital and global lifestyles” (Kalantzis & Cope, 2010, p. 200). The Learning by Design framework provides a way of planning for an online interactive, multimodal, learning environment. By using the framework in their planning, teachers are able to monitor the effect their pedagogical choices have on student learning by the provision of a pedagogical “stepping through” of the learning process, from the initial focus, to knowledge objectives and processes, to outcomes and next steps.

Researchers Mills (2010b), Neville (2010), Cloonan (2010) and Van Haren (2010) all reported on studies, with teacher and student participants, carried out to explore the utility of the Learning By Design framework. Cloonan and Neville investigated how teachers used the framework to make pedagogical decisions that would facilitate quality teaching and learning using multimodal resources. Both studies reported that the schema had positively impacted on teachers employing appropriate pedagogy to affect student learning.

Cloonan concluded that engagement with the pedagogical schema of knowledge processes encouraged teachers to be explicit about their choice and implementation of appropriate pedagogy and the multimodal schema influenced teachers to consider a broader range of literacy tools. Neville reported a strong correlation between teacher pedagogical choices and quality learner outcomes and detailed the existence of five associated conditions necessary for effective implementation of the Learning by Design framework; namely, broad content specific knowledge, time and a willingness to engage in professional learning and new knowledge, selection from a broad range of knowledge processes, and the capacity and orientation to a collaborative approach to designing within a technology rich environment.

Similarly, Van Haren detailed the positive correlation between pedagogical decisions and quality student outcomes as she tracked four students and two teachers over the period of one year. Further, this researcher highlighted the importance of teacher pedagogical interests aligning with student interests especially in classrooms of cultural and socioeconomic diversity. Mills used the Learning by Design framework as an analytical tool to examine the “what” and “how” of student learning when working with digital media production.
Summary

This review has explored the changing nature of literacy and literate practices underpinned by a steady conceptual shift from teaching discrete, mainly textual based skills, to include literacies afforded by multimodal technology. Literature reviewed emphasises the importance of extended notions of literacy and developing teaching practices that are transformative, which necessitate development of innovative, collaborative curricular and classroom environments as opposed to those understandings and teacher actions that enhance existing practices (Burnett et al., 2006; Merchant, 2005; Webb & Cox, 2004). Emerging from the examination of the literature was the complex relationship between technology and the intrinsic and extrinsic factors influencing its use. Implications for teacher practice and improving student learning mediated by technology include witnessing and measuring how innovative teaching methods that include technology integration positively impact on student learning.

The broader context of policy, technology and the literacy curriculum was examined using the curricula from New Zealand, England and Australia to identify specific indicators for the inclusion of multimodal technology in writing. Evidence suggested that curricula that provide a comprehensive, contextualised framework on which to develop teaching and learning strategies, as well as clear guidelines to foster necessary theory building and conceptual change, particularly in relatively new areas of learning, have the potential for greater success than curricula that support aspirational goals only. In the absence of clear guidelines, teachers’ own assessment practices need to be robust in the area of multimodal authoring and to describe indicators that support feed forward to inform progress. To enable effective integration of technology to improve student authoring, apposite skills and knowledge of how technology works and the capabilities of and relationships between certain applications are necessary (Webb, 2005).

A range of studies was examined around the use of multimodal authoring, mainly focusing on blogs and wikis. Their inherent nature as methods of communication offers opportunities for collaboration, user autonomy, the development of critical literacy skills and authoring for authentic audiences which maximise student learning. In this literature, evidence suggested that, in this largely textual context, teachers have begun to build a body of knowledge to inform such practices. However, there was less evidence to suggest the development of a knowledge base to inform strategies that would support the effective use of multiple modes of meaning across a range of contexts.

Learning by Design (Kalantzis & Cope, 2005) was referred to as it detailed the use of a teaching framework to assist teachers to adapt writing curricula to include multimodal methods. This
framework includes structures for evaluation and assessment in relation to effective multimodal authoring.

Technology integration offers significant opportunities to enhance meaningful student learning in authoring. Further, as Merchant (2007) suggested, the centrality of written communication is likely not only to be sustained, but to become more significant and to continue to develop different registers. Merchant continues that, “building a flexible and intelligent education response to digital literacy then becomes important both from the point of view of valuing children’s everyday digital experience and in terms of preparing them for the future” (p. 127). Available research does suggest, however, that significant barriers to full integration will have to be addressed before the opportunities can be fully realised. Of the barriers mentioned perhaps one of the most significant is teacher understandings of what needs to be taught and assessed and how this can be achieved, cognisant of the fact that curriculum requirements, resourcing, knowledge and skills and teachers’ positive perceptions of the benefits of technology integration are still needed in order to effect change.

The Next Chapter

The next chapter explains the research process including the research methodology and design to foreground the data which is reported from the teacher participant semi-structured interviews. The purpose of collecting teacher data is to examine the experiences of a group of purposively chosen expert teachers using technology to support multimodal authoring. It is proposed that examination of the data will address one of the main questions of the thesis to describe the understandings, beliefs, skills and knowledge teachers, nominated as having expertise in technology and writing, have about the nature and role of integrating multimodal technology into their teaching and learning programmes to support multimodal authoring. In effect, these data will establish a baseline of knowledge on which to further investigate teachers’ knowledge needs.
Chapter Three: Results of the Teacher Participant Data to Investigate the Understandings, Beliefs, Skills and Knowledge Teachers Have About Integrating Technology to Support Multimodal Authoring in Years 1-8

Chapter Overview

This qualitative enquiry aimed to investigate teacher beliefs and understandings about the integration of technology to support multimodal authoring in Years 1–8. In this chapter, data generated from individual, semi-structured interviews with 15 teachers are presented to address one of the main questions of this study:

*What understandings, beliefs, skills and knowledge do teachers, nominated as having expertise in technology and writing, have about the nature and role of integrating multimodal technology into their teaching and learning programmes to support multimodal authoring?*

Data presented in this chapter seek to clarify how this group of teachers facilitated the use of technology to support multimodal authoring and explore some of the complexities of student and teacher experiences. Environmental variables and individual characteristics of teachers are considered as factors in the relationship between teaching writing and technology use that supports multimodal authoring. Data were sought on emerging student and teacher engagement with multimodal resources for teaching and learning writing. The use, by some teachers, of existing learning frameworks is noted as being a pathway to teaching multimodal authoring in certain circumstances.

The methodology and research processes used to collect data from the 15 teacher participants are outlined followed by presentation of the results of the data examination. Results of the data collected are then described as a set of four categories abstracted from a mixture of the data, pre-existing theory and literature. The core category identified in the data is understandings informing teacher practice. The other three categories are: skills and knowledge about using technology; teacher beliefs informing the use of technology; and influence on technology use of systems factors. In describing the four categories, annotated examples from the semi-structured interviews are used to give “voice” to the participant teachers.

The core category of understandings informing teacher practice is addressed first. Teacher-reported actions that related to this category were central to examining the data. The underlying
assumption, key to identifying this category, is that teachers use multimodal resources in their writing programmes to some degree because the integration of technology into teaching and learning to support such, has been a priority for successive governments in New Zealand. This initiative has been the subject of significant professional learning initiatives nationally. The data are further clarified by the use of an adapted Levels of Technology Implementation (LoTI) scale (Moersch, 2002) to define dimensions of technology integration more accurately and describe teacher progressions.

The chapter concludes with a summary of what the teacher participants in this study understand about the nature, place and role of integrating technology to support the multimodal authoring of their students.

**Methodology**

The interpretive paradigm was considered to be the most suitable for examining and interpreting data in this research because, in fulfilling the research aims of describing teacher beliefs and understandings, there would need to be an exploration of participant contextualised experiences and perspectives. Understanding and analysing these was central to the investigation.

Aligned with the interpretive paradigm, qualitative methodology addressed the need to interpret and contextualise participant responses, behaviours, in order to generate theory and comment on existing theory. The choice of qualitative method for this study reflects the call by researchers in the field of learning using multimodal methods, such as Ainsworth (2008), for different methods of design when exploring how people learn with and about multimodality, to move away from quantitative experimental designs towards methods that describe processes created and experienced by human interactions. Further, suggested by Ainsworth, is a flexible rather than fixed research design. Such a design is offered by qualitative methodologies using multiple data sources that can give richer data that details technology use to support multimodal authoring and how it is experienced by participants. A flexible approach could also address the context of rapid change associated with the domain of enquiry around technological tools and methods. Analysis of the data will help to build understandings around current knowledge on technology use that supports multimodal authoring.

**The Design**

The researcher sought approximately 15 teacher participants, self-identified and/or recognised according to criteria provided, who had interest and skills in the use of multimodal resources for teaching writing. The target population for sampling was teachers in the greater Auckland area.
who met identified criteria (see below). The purpose of interviewing teachers was to investigate how teachers experience technology to support multimodal authoring in their classrooms. It was proposed that the examination of experiences and knowledge of teacher professionals would enhance understandings about multimodal authoring in the teaching and learning of writing for students in Years 1–8.

**Criteria for Participation**

- Each teacher participant was working in a mainstream class regularly. This may include a teacher who has a curriculum responsibility related to the focus of the study but this was not a prerequisite
- Self-identify and/or be recognised as representing “good practice” in current writing pedagogy
- Competent and confident users of multimodal technology themselves and able to recognise and discuss their own learning needs in this area
- Working with students that represent the level and focus of the project focus, that is Years 1–8 of schooling
- Self-identify and/or be recognised as representing “good practice” in integrating multimodal technology into children’s learning and teacher planning
- Willing to talk about integrating multimodal technology into children’s learning and teacher planning and commit to an interview of approximately 45 minutes
- Experienced with at least one year’s classroom teaching experience

An extensive search was undertaken for potential participants. Potential participants were sought through an advertisement placed in a magazine of interest to teachers of literacy in Years 1–8 and, with permission from the Head of Faculty, on a literacy course intranet site at the University of Auckland. Contact was also made via the internet with teachers who had presented papers at a conference held in New Zealand which focused on teaching and learning using technology; with schools that had been part of professional e-learning contracts; and with teachers who were Ministry of Education sponsored e-learning fellows. Some teacher participants were approached via the internet through their blogs and wikis and some were approached via principal contact.

Included in the process of approaching teacher participants was contacting the principals of schools where teachers had agreed to take part in the study, in order to offer an explanation of the purpose and nature of the research that their staff member had agreed to take part in. As the
interviews were to take place out of school time, it was not considered necessary to get the principal’s permission for the interview but a courtesy to inform them of my research intentions. Where appropriate, a request was made to access the school site to conduct the interview. Three interviews took place out of school with two participants being interviewed via Skype. The rest of the interviews took place at schools but outside of normal operating hours.

Twenty potential participants were identified initially. Two withdrew for personal reasons, three participants were used to participate in the pilot study to trial the questionnaire and, subsequently, to examine integration levels. Fifteen participants took part in the main part of the study (see Table 1). Of the 15 participants, three were male and 12 were female. Their ages ranged from 24 years to 56 years with a mean age of 39.2 years. This mean is slightly lower than the national mean age of teachers in New Zealand, which is 44.5 years (Engler, 2008). Years of teaching ranged from 2 to 32 with a mean for this group of 14.13 years. Year levels taught included the full range from New Entrants to Year 8, ages 5–13 years. The participants included four ICT expert teachers (for definition see Table 1); one IT specialist (for definition see Table 1); an e-learning fellow (for definition see Table 1); two teachers from “beacon” schools that are known to be committed to, and are acknowledged as leaders in, technology integration; two teachers who had presented papers relevant to technology integration at conferences in New Zealand; three teachers who were heads of departments; one teacher who had just returned to full-time teaching after a 6-month sabbatical in which she undertook professional learning in inquiry learning; an associate principal who had been given ICT responsibilities as part of that position and two principals who taught in classrooms as part of their role.

Participants possessed a wide range of skills and experience in integrating technology into their teaching and learning programmes to support multimodal authoring. In the baseline information sheets that all 15 participants completed prior to the interviews, the majority of participants rated their range of technology use and skills as either 4 or 5 on a 1–5 self-rating scale where 5 indicated technology use as using more than 5 technological tools and possessing skills to perform all technology-mediated tasks to advanced levels of competency. Predominantly, participants used technology constantly throughout the day and expressed confidence using ratings 3–5 in modelling technology use. However, the majority of the participants were not confident that their current assessment practices and those used for evaluating multimodal authoring were in alignment. All participants considered themselves competent as representing “good practice” in teaching writing and current assessment pedagogy. During the interviews, each of the 15 teachers talked about their use of technology with reference to supporting multimodal authoring.
The highest professional qualification held was a postgraduate degree and the lowest was a Trained Teacher’s certificate. Two participants had specialised technology related qualifications and three were involved in school-wide professional learning provided by external providers. All of the full-time classroom teachers (12 participants) were in full control of the literacy planning within the framework laid down by their schools and the New Zealand Curriculum (Ministry of Education, 2007).

Table 1 summarises the demographic information for the teacher participants.
Table 1. Demographic information: Teacher participants

<table>
<thead>
<tr>
<th>ID</th>
<th>Age</th>
<th>Gender</th>
<th>Years teaching</th>
<th>Currently teaching</th>
<th>Highest professional qualification</th>
<th>Other relevant criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>42</td>
<td>M</td>
<td>20</td>
<td>Year 8</td>
<td>Bachelor’s Degree</td>
<td>E learning fellow&lt;sup&gt;1,3&lt;/sup&gt;</td>
</tr>
<tr>
<td>B</td>
<td>24</td>
<td>M</td>
<td>2</td>
<td>Year 6</td>
<td>Bachelor’s Degree</td>
<td>ICT expert teacher&lt;sup&gt;2&lt;/sup&gt;</td>
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<tr>
<td>C</td>
<td>33</td>
<td>M</td>
<td>10</td>
<td>Year 6</td>
<td>Bachelor’s Degree</td>
<td>ICT expert teacher&lt;sup&gt;2&lt;/sup&gt;</td>
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<tr>
<td>D</td>
<td>49</td>
<td>F</td>
<td>27</td>
<td>Year 8</td>
<td>Postgraduate</td>
<td>Relevant tertiary&lt;sup&gt;4&lt;/sup&gt;</td>
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<td>Professional learning</td>
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<tr>
<td>E</td>
<td>39</td>
<td>F</td>
<td>17</td>
<td>Year 5</td>
<td>Dip. Teaching</td>
<td>Conference presenter</td>
</tr>
<tr>
<td>F</td>
<td>53</td>
<td>F</td>
<td>11</td>
<td>Year 5</td>
<td>Dip. Teaching</td>
<td>Literacy HOD</td>
</tr>
<tr>
<td>G</td>
<td>52</td>
<td>F</td>
<td>30</td>
<td>Years 0–6</td>
<td>Postgraduate</td>
<td>School IT specialist</td>
</tr>
<tr>
<td>H</td>
<td>36</td>
<td>F</td>
<td>6</td>
<td>Years 4 &amp; 5</td>
<td>Dip. Teaching</td>
<td>Conference presenter</td>
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<tr>
<td>J</td>
<td>31</td>
<td>F</td>
<td>11</td>
<td>Year 5 &amp; 6</td>
<td>Dip. Teaching</td>
<td>Associate Principal</td>
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<tr>
<td>K</td>
<td>34</td>
<td>F</td>
<td>12</td>
<td>Year 0–6</td>
<td>Dip. Teaching</td>
<td>School IT specialist&lt;sup&gt;4&lt;/sup&gt;</td>
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<tr>
<td>L</td>
<td>56</td>
<td>F</td>
<td>30+</td>
<td>Year 3</td>
<td>Teaching Cert.</td>
<td>IT Beacon school&lt;sup&gt;3&lt;/sup&gt;</td>
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<tr>
<td>M</td>
<td>43</td>
<td>F</td>
<td>9</td>
<td>Year 7</td>
<td>Postgraduate</td>
<td>HOD English</td>
</tr>
<tr>
<td>N</td>
<td>29</td>
<td>F</td>
<td>7</td>
<td>NE</td>
<td>Bachelor’s Degree</td>
<td>ICT expert teacher&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>P</td>
<td>25</td>
<td>F</td>
<td>3</td>
<td>Years 3 &amp; 4</td>
<td>Bachelor’s Degree</td>
<td>ICT expert teacher&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>Q</td>
<td>37</td>
<td>F</td>
<td>15</td>
<td>Years 5–8</td>
<td>Bachelor’s Degree</td>
<td>HOD Literacy</td>
</tr>
</tbody>
</table>

Notes.  
<sup>1</sup> E learning fellow. “The e-Learning Fellowships Initiative was launched in 2003 by the Ministry of Education. Annually, up to ten teachers in early childhood primary and secondary are released from the classroom to conduct e-fellows research for teachers with academic support and mentoring including professional learning workshops for two weeks each term and participation in an online learning community. The fellowship recognises those teachers who are already leaders in utilising e-learning in their schools and enables them to have professional development in this area to further their understanding and share their knowledge” (http://www.core-ed.org/foundation/past-efellows).  

<sup>2</sup> An ICT expert teacher, for the purposes of this research, possesses technological and pedagogical skills sufficient to enable peer tutoring and mentoring and is recognised within the school in that role. The recognition may involve the awarding of management responsibilities with related pay reward. The teacher also has full-time teaching and classroom responsibilities. The term ICT expert teacher is used by the teachers themselves but has no generic description related to it.  

<sup>3</sup> Beacon School. A school that purportedly exhibits exemplary practices in the integration of technology into teaching and learning.  

Tertiary professional learning refers to a recent period of sabbatical leave taken to complete post graduate studies on learning relevant to teaching and learning integrating ICT.  

<sup>4</sup> School IT specialist. This participant had no classroom responsibilities and provided expert technical and pedagogical support to teachers in the school around integration of technology into teaching and learning.
Method

The semi-structured interview was chosen for this study purposively, as a rich method by which the participants could describe how they experience technology use to support multimodal authoring. It was anticipated that participants would share a “narrated reality” (Silverman, 2003, p. 123) which, in this context, would describe personal, contextualised experiences. This approach closely aligned to the methodological orientation of the study. Whilst some specific information was required in this study, using semi-structured interviews was flexible and allowed exploration of whatever aspect of the research questions arose in discussion.

In addition to the use of semi-structured interviews and in order to triangulate the data, field notes were made and relevant documents to support and exemplify teacher responses were collected. These documents included teacher planning exemplars and school policy documents on writing and the use of technology. Table 2 provides an overview of this data gathering phase, its primary purpose, collection methods used and the participants involved.

Table 2. Overview of the teacher participant data-gathering phase

<table>
<thead>
<tr>
<th>Research section</th>
<th>Primary purpose</th>
<th>Data collection methods</th>
<th>Participant name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section Teachers 1</td>
<td>To investigate teacher understandings, beliefs and knowledge about the nature and role of integrating multimedia technology into the teaching and learning programmes in writing</td>
<td>Individual semi-structured interviews. Field notes. Collection of relevant artefacts: teacher planning exemplars, school writing policies, electronic copies of student work</td>
<td>Teacher A</td>
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<td>July 2011–Sept 2011</td>
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<td>Teacher B</td>
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<td>Teacher C</td>
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<td>Teacher D</td>
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<td>Teacher E</td>
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<td>Teacher M</td>
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<td>Teacher N</td>
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<td>Teacher P</td>
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<td></td>
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<td>Teacher Q</td>
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</tbody>
</table>
Teacher Interviews

Teachers were provided with a Participant Information Sheet (Appendix 1) and their written consent to participate in the study was sought (Appendix 2). The teacher participants’ interview schedule (Appendix 3) consisted of a series of open-ended questions and a series of responses indicated on a Likert scale. Initially, the definition of multimodal authoring was clarified and examples of these resources were detailed. Each question was foregrounded by a rationale which assisted in describing the question. Background information was sought from participants around professional demographics such as the number of years and levels of teaching experience and technology use to support multimodal authoring, skill and experience. Teachers were asked to self-rate their levels of expertise in planning, teaching and assessing writing and levels of resourcing of technological tools and infrastructures. This part of the questioning was designed to explore with participants their perceptions of their own skill and use of technology to support multimodal authoring and to elicit their beliefs and understandings around multimodal authoring to enhance the teaching and learning of writing.

Responses were also sought as to the ways in which the national curriculum document informed teacher technology use that supports multimodal authoring and experiences related to professional learning opportunities participants had had. Assessment and evaluation practices related to writing were explored in the final section of the interview. Participants then had the opportunity to add any extra comment or information relevant to the discussion at the end of the interview schedule.

The collection of relevant documents

Documentation related to the teaching and learning of writing was collected from teacher participants. Access to these documents was negotiated with teachers and consisted of individual plans of teacher’s work related to the teaching and learning of writing to support multimodal authoring, including syndicate plans and school curricula (the New Zealand Curriculum is able to be adapted by schools to fit the local context). This information was requested before the interviews took place and, in the majority of cases, participants provided this. In some cases, participants were prompted to recall relevant information during the interview and copies were provided to the researcher at this time.

Field notes

Reflective field notes serve the purpose of capturing impressions, patterns and are often iterative over the course of the study. They should also record “researcher biases, standpoint, dilemmas, possible mistakes, reactions and responses to fieldwork and participants” (Brodsky, 2008, p. 342).
Field notes can also be a conduit to capture errors that the researcher may make in the interview process, identify new and existing themes which may alter subsequent data collection or provide an opportunity to begin consideration of coding themes (Davidson & Tolich, 2003). Best practice suggests that field notes should be recorded as soon as possible after, in this case, each interview and in as much detail as possible. For the purposes of this study, field notes were recorded initially, on an iPhone using the app iTalk Recorder, then transcribed after the interview was completed.

**Coding Strategies: Open, Axial and Selective Coding**

A combination of computer assisted qualitative data analysis software (NVivo9) and manual methods of data management were used to examine the data in this research. Based on the volume of textual data, and to assist in the management of a large amount of textual data contained in the interview transcripts, all interview transcriptions were transcribed verbatim and after having been checked for accuracy, examined using NVivo9 software. In view of the interpretive nature of the transcription process, there was a need to ensure accuracy of the verbatim transcriptions. Strategies to increase accuracy were employed by customising Silverman’s (2001) method to suit the context of the interviews. These strategies included ensuring clarity of the original audio recording, an agreed upon notation system for the transcription, close liaison with the transcriber, a review process for the quality and accuracy of the transcription including member checks (used to interpret a particularly difficult to transcribe audio file), a system for addressing ambiguity and confusion over language use, particularly terminologies, and the use of field notes. The transcriptions were made over a period of two months.

A coding frame emerged inductively from the data and evolved as new categories were uncovered. The coding frame, including explanations for decisions made in the classification of data, was detailed within the NVivo9 software. This was necessary to provide guidelines for classification.

In the initial stages of examining the data, coding was undertaken in terms of identifying information as it related to the questions posed by the study. In this initial or open coding stage, the data was read through several times. Then, tentative labels for chunks of data were created that summarised what was emerging. Many different codes were extant in the data, ideas were evidenced repeatedly and variations on themes recognised. In the next stage, where axial coding was undertaken, the codes from the initial stage were linked together using the memo function in NVivo9, to assist building up of themes across the data. Individual themes were analysed and
possible relationships explored manually (For an example of the coding process see appendices 7 and 8)

Coding then began again using only the thematic codes. In this selective coding stage, the categories and their interrelationships were combined to support the ultimate account of the data. A “best fit” approach to coding the data was used. Some codes appeared to be more significant than others were and connections between codes became more apparent (Benaquisto, 2008). For example, if teacher beliefs on the benefits of multimodal authoring were strong, this tended to lessen the significance of the impact of systems factors. Coding continued until there was nothing new that emerged. In examining the teacher data, there was a need to go back and re-code some of the data, as additional concepts emerged in the preliminary stages of writing up the data. This iterative process was done in consultation with colleagues and participants.

**Examining relevant documents**

As previously indicated, documentation related to the teaching and learning of writing was collected from teacher participants. These documents consisted of individual plans of teacher’s work related to the teaching and learning of writing to support multimodal authoring, including syndicate plans and school curricula. On examination, there was no evidence that teacher’s writing plans, syndicate plans or school curricula made specific mention of including multimodal authoring opportunities, knowledge building or skill development. In three schools, teacher participants indicated that this would be a focus of professional learning going forward and their respective schools were making plans to do this. Some teacher participants sent documentation relating to overall e-learning strategies for their students but no documents related specifically to multimodal authoring knowledge and skill development.

In consideration of the absence of any significant mention of multimodal authoring in the documents received, the examination of these documents did not form part of the overall data examination and interpretation of teacher participant data.

**The Use of the LoTI Scale**

The LoTI scale (Moersch, 2002) was used as a classification system for the examination of teacher participant data, in order to clarify for the researcher and to feed back to participants, the levels at which teachers were integrating technology into their teaching and learning. Using this scale had the added purpose of confirming the findings of the coding stage of the data. The LoTI scale provides descriptors of levels of technology integration in teaching and learning aligned with descriptions of the classroom environment, typical teacher comments and typical classroom
observations. Contextualising the terminology within the descriptors, classroom observations and typical teacher comments, was undertaken by the researcher and a panel of colleagues to account for the New Zealand context but the basic scale intervals and conceptual framework remained the same (see Table 3).
Table 3. LoTI Scale and attributes (Moersch, 2002)

<table>
<thead>
<tr>
<th>Level</th>
<th>Name</th>
<th>Description</th>
<th>Classroom Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Non use</td>
<td>A perceived lack of access to technology-based tools or a lack of time or disinclination to pursue electronic technology implementation.</td>
<td>No visible evidence of use of technology in the classroom. Student learning is based primarily on book centred textual practices. Teaching practice does not include the use of technology.</td>
</tr>
<tr>
<td>1</td>
<td>Awareness</td>
<td>The use of technology-based tools is either (1) one step removed from the classroom teacher for example, using generic software programmes or work processing functions; (2) used almost exclusively by the teacher for classroom and/or curriculum management tasks, for example recording attendance, accessing email; and (3) to embellish or enhance teacher-directed lessons; for example the use of PowerPoint presentations.</td>
<td>Teacher uses technology for productivity requirements for example, email, word processing, collating assessment data. Technology use serves as a reward or as an additional activity when other tasks are completed.</td>
</tr>
<tr>
<td>2</td>
<td>Exploration</td>
<td>Technology based tools supplement the existing instructional programme (for example, searching the internet for information, using multimedia for presentation and educational games). Digital technology is employed either as extension or enrichment and is related to content. Focus is on computer use not the critical content.</td>
<td>Technology is used for student projects, for example research via the internet, creating multimedia presentations, creating graphs and charts; focus on lower levels of student cognition. There is greater emphasis on the technology rather than on the critical content, for example, creating a Web Quest using generic software. Teacher identifies that using technology can involve using different modes of meaning that have unique characteristics.</td>
</tr>
<tr>
<td>3</td>
<td>Infusion (combining)</td>
<td>Technology-based tools including the internet complement selected instructional events or multimedia/web-based projects at the analysis, synthesis and evaluation levels. Although the learning activity may or may not be perceived as authentic by the student, emphasis is placed on higher levels of cognitive processing and in-depth treatment of the content using a variety of thinking skill strategies for example, problem-solving, decision-making, reflective thinking, experimentation, scientific inquiry.</td>
<td>Students use applications such as graphing and concept mapping. Students use the web for research purposes or interact with selected software applications that require them to take a position or role-play an issue. Presenting information or results of an investigation increase in complexity, reflecting higher levels of skill and understanding.</td>
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<tr>
<td>Level</td>
<td>Name</td>
<td>Description</td>
<td>Classroom Practice</td>
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<tr>
<td>4a</td>
<td>Integration (routinised)</td>
<td>Technology-based tools are integrated in a deliberate way that provides rich context for students’ understanding of the pertinent concepts, themes and processes. Heavy reliance is placed on pre-packaged materials and/or outside resources (e.g. assistance from other colleagues) and/or interventions (e.g. professional development workshops) that aid the teacher in the daily management of his/her operational curriculum. Technology (e.g. multimedia, telecommunications, databases, spread-sheets, word processing) is perceived as a tool to identify and solve authentic problems as perceived by the students relating to an overall theme/concept. Emphasis is placed on student action and on issues resolution that require higher levels of student cognitive processing and in-depth examination of the content.</td>
<td>Students use technology to engage in real-life problem solving within their school (for example, addressing the problem of graffiti). Based on their investigations student organise a school-wide response with solutions. Students created a travel brochure for families travel in Auckland that included: (1) a guide for selecting the best modes of travel; (2) recommended accommodation based on information collected from various travel sites; and (3) a listing of the best destination sites based on criteria established by the students. Systematic enquiry and prioritising of relevant teacher practice and content knowledge to include multimodal resources into the teaching and learning of writing. The teacher self-identifies as having considerable expertise in tool use including confidence to model technology use to others and ways to improve skill levels.</td>
</tr>
<tr>
<td>4b</td>
<td>Integration (adaptive)</td>
<td>Technology-based tools are integrated into all areas of teaching and learning in a routine manner that provides rich context for students’ understanding of relevant concepts, themes, and processes. At this level, teachers can readily design and implement learning experiences (for example, units of instruction) that empower students to identify and solve authentic problems relating to an overall theme/concept using the available technology with little or no outside assistance. Emphasis is again placed on student action and on issues resolution that require higher levels of student cognitive processing and in-depth examination of the content.</td>
<td>Students create a website devoted to exploring solutions to, for example, the illegal dumping of rubbish in the local stream. Subsequently, they prepare a multimedia submission to be displayed on the council website regarding the illegal dumping of rubbish including using multimedia to demonstrate environmentally friendly ways to dispose of plastic. Teacher practice and content knowledge identified and engaged with to enable teaching and assessing of writing using multimodal methods.</td>
</tr>
<tr>
<td>Level</td>
<td>Name</td>
<td>Description</td>
<td>Classroom Practice</td>
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</table>
| 5     | Expansion | Technology access is extended beyond the classroom. Classroom teachers actively elicit technology applications and networking from other schools, business enterprises, research institutions and universities to expand student experiences directed at problem-solving, issues resolution and student activism surrounding a major theme/concept. The complexity and sophistication of the technology-based tools used in the learning environment are commensurate with (1) the diversity, inventiveness, and spontaneity of the teacher’s experiential-based approach to teaching and learning and (2) the student’s level of complex thinking (for example analysis, synthesis, evaluation) and in-depth understanding of the content experienced in the classroom. | Students create a virtual online business or social justice venture.  
Students create a website for other students based on data collected from their research and online surveys with other schools.  
Using online accessed weather data and information, students assist in tracking the best course for events, such as, the round the world yacht race. |
| 6     | Refinement | Technology is perceived as a process, product (for example invention, patent, new software design) and/or tool for students to find solutions related to an identified real world problem or issue of significance to them. At this level, there is no longer a division between instruction and technology use in the classroom. Technology provides a seamless medium for information queries, problem-solving and/or a vast array of technology-based tools to accomplish any particular task at school. The instructional curriculum is learner based. The content emerges based on the needs of the learner according to his/her interests and/or aspirations and is supported by unlimited access to the most current computer applications and infrastructure available. | Students design increasingly complex, interactive websites that may, for example, include options for real-time conversations, tutorial sessions and bulletin boards.  
Use of increasingly sophisticated software to solve real-life problems. |
Subsequent to the open, axial and selective coding process, a panel of three teachers, who were part of the pilot study, was convened. Together with the researcher, using the data collected from the semi-structured teacher interviews, this panel collectively assigned levels of integration according to the LoTI scale that reflected individual teacher practice evidenced by the data. Assignment was supported by examining individual data sets against the descriptors of the adapted LoTI levels of integration. All decisions made by the group were supported by measures as detailed in the following section which addresses the issues of credibility, confirmability, transferability and dependability of the data examination process thus ensuring the trustworthiness of the research.

Ensuring the Trustworthiness of the Current Research

Credibility

Credibility increases legitimacy for qualitative methods and relates to consistency between the various components of the research process particularly the methodology, the data sources and the approach to recording and interpreting data. Credibility informs methods of the research process, the quality of the researcher and the orientation and assumptions that underpin a study. As Jensen (2008a) suggests, “The basic notion with credibility is that both the readers and participants must be able to look at the research design and have it make sense to them” (p. 138). The credibility of the inquiry is dependent on the credibility of the researcher (Patton, 1990) because of the pivotal part played by the researcher as the facilitator of data collection and the person with control over data analysis. The experts who assisted in assuring the credibility of the inquiry were part of the pilot study for this research. These participants were chosen for their expert knowledge and experience in teaching writing and technology use.

For the purposes of this research, credibility of the study was underpinned by the four components of triangulation, namely, methods, sources, analysis and perspectives (Denzin as cited in Patton, 1990). During the data analysis, competing themes, disconfirming evidence and alternative explanations were considered and reported in the analysis. All problems and difficulties in both the data collection and interpretation were dealt with openly and honestly. Data were collected using primarily the qualitative paradigm, with quantitative methods—involving simple counting—to support qualitative data.

To triangulate the data sources, the consistency of information obtained was examined recognising that different data capture different aspects. Consistency was identified in the overall patterns of data collected and examined. This involved comparing the interview data with that collected from relevant documents and field notes.
To address possible bias in analysis the researcher was, at both the coding stages and in assigning LoTI levels, assisted by three people who analysed the same data independently then compared their findings. Also, member checks were carried out with the participants who had an opportunity to provide feedback on the analysis of the interviews.

Finally, the credibility of the researcher must be apparent. This is in terms of a researcher’s ability to maintain intellectual rigour and professional integrity (Patton, 1990), which can have significant impact on how findings are perceived and reported. Acknowledged by the researcher, for the purposes of this research, are predispositions that may affect the data analysis and interpretations, namely, years spent as a teacher; a generally positive view on integrating technology with teaching and learning; and a desire to support colleagues in the teaching and learning of writing using technology. These issues were addressed, in part, by the iterative process by which the data were examined ensuring that the interpretations and constructs made sense and genuinely addressed the aims of the research (Patton, 1990).

**Confirmability**

Another feature of the qualitative paradigm that is equated with accuracy in the research process, is the means by which the researcher and, ultimately, the reader, is able to understand phenomena from the perspective of the participants and to recognise the meaning participants give to their experiences. Confirmability is concerned with evidence associated with the degree to which the researcher’s interpretations of participants’ constructions are accurate (Jensen, 2008b). In seeking the evidence, there is an imperative for the researcher to provide a clear audit trail where the research process, data analysis and interpretation are consistent, both methodologically and in relation to the literature.

For the purposes of this research, there were multiple coders to ensure a measure of consistency in the interpretation of themes. Specific training was given to the coders before any coding took place including a detailed description and explanation of the descriptors for each theme and the opportunity to practice matching data to specific themes using excerpts from the pilot study transcripts. A clear research process has been detailed which can be verified and replicated.

**Transferability**

Transferability is about the extent to which the process and findings of a study can be transferred to other settings, situations and groups of people. Lincoln and Guba (1985) suggest that transferability is facilitated by research that is characterised by descriptions that provide sufficient detail of the
processes and findings of a particular piece of research so that it can be replicated and applied in other contexts.

The current research has been carefully detailed and described. The complete set of data analysis documents is available. Access to the project’s processes gives other researchers the ability to transfer the conclusions of this inquiry to other cases, or to repeat, as closely as possible, the procedures of this project.

**Dependability**

Although a researcher could have a well-grounded theoretical understanding of a particular research environment, once in the field of inquiry the reality could be quite different to what was expected. The disparity between what was anticipated and what was found can affect research procedures and the extent to which the research can be carried out as planned, a situation that occurred during this study. According to Lincoln and Guba (1985), dependability in the qualitative paradigm acknowledges that methodologies should be sufficiently clear in terms of approach to replicate the study and achieve similar results. Dependability also requires that results are linked to existing literature and that the findings are an accurate representation of what the participants intended.

**Results**

The following reports on the data obtained from participants during the teacher interviews. The results of the data will be discussed in terms of four themes that emerged from the data, namely; Aspects Informing Teacher Practice; Skills and Knowledge about Using Technology; Influence of Systems Factors on Technology Use and Teacher Beliefs Related to the Use of Technology. Each theme is described and exemplified using participant comments.

**Aspects informing teacher practice**

This category is described in terms of three main aspects, namely, ways of teaching, assessment and evaluation strategies, and specific content knowledge. Reports of ways of teaching consisted of self-reflections of what teachers do and how they shape their teaching practices to meet the learning needs of their students, particularly to facilitate the integration of technology to support multimodal authoring. Assessment and evaluation strategies describe the approaches teachers make to identifying desired learning outcomes, how to best achieve these and, subsequently, deciding on how this information could inform their teaching practice to improve student learning. Specific content knowledge is the set of skills and practices necessary for making meaning when using multiple modes. This includes, for example, knowledge of typography, colour, information hierarchy and the use of interactive features that facilitate meaning making.
Ways of teaching

First, an explanation will be given of the labelling of this attribute. In describing understandings that informed their practice when integrating technology to support multimodal authoring, teachers used the term “pedagogy” in their responses around effective ways of teaching. This term was also used pervasively when describing the perceived disparity between their current knowledge and understanding, and that related to supporting multimodal authoring in their students. Teacher C commented, “The biggest challenge for us is the pedagogy ... to make sure that teachers understand how to best use it (technology, that supports teaching and learning), not just as a publishing tool.”

The term pedagogy is a broad one, with varying contextualised interpretations and connotations. It was not evident in teacher comments or in the clarifications sought by the researcher, that there were shared understandings around the term pedagogy amongst the participants. Therefore, after discussion with participants and for the purposes of interpreting the data, the less contested phrase “ways of teaching” will be used to describe how teachers shape their teaching practices to meet the learning needs of their students.

Responses indicated that, for the majority of participants, there exists an expectation, from within the school and the wider community, that technology will be used in teaching and learning. Essentially, technology use was perceived as positive and necessary in order to equip students to participate in future learning. Put simply, Teacher H stated, “it’s the way of the future.” Participants suggested that learning that used technology was motivating and engaging for students, as Teacher A observed, “You know they are engaged, it’s the nature of online learning, engagement.”

Therefore, participants saw the development of ways of teaching that included technology as an important step in teacher professional growth and data suggested that most participants were at a stage where they were transitioning towards doing that.

Participants mentioned the use of technology-mediated multiple modes to enhance or automate existing practices, such as presenting or publishing, a methodology consistent with traditional approaches and methods of teaching and learning writing. As Teacher L commented, “I see technology as a tool... another way of presenting or publishing children’s work.” Teacher H chose a generic description of a proprietary commercial presentation programme, PowerPoint, to describe multimodal authoring. So “doing a PowerPoint” for this participant, was seen as synonymous and interchangeable terminology for engaging in multimodal authoring. The concept of seeing the use of technology as tools for publishing was in contrast to the opinion expressed by Teacher C, referred to earlier, that teaching using technology must be more than this.
Some teachers described ways of teaching using technology in terms of the range of resources used, “In any one lesson I might use something on the smartboard, the kids could be using the computer, I might have two children using the iPad and then I have a small group using iPods” (Teacher D). This teacher further commented she used technology “for a specific purpose” and then looked at “what tools within the range of tools that is available would be the most appropriate way to represent it”. A diversity of views existed on the actual purpose of technology use and ways of achieving these different purposes.

There was a group of six participant teachers who felt challenged by the expectations and processes of integrating technology that supported multimodal authoring, particularly teachers who were confident with existing practices. As Teacher N commented, “As a teacher who was taught to teach writing with pencil and paper, I don’t know much about teaching using new technology” and similarly Teacher J:

    Well, I don’t really know how to; sometimes the technology doesn’t work and we really don’t have enough of it. I’m not that convinced about it to be honest, does it work? There is also the time thing, it takes so much time and I can get things done so much quicker just using pen and paper.

So, for this group of teachers, changes affecting routines and established practices are not only undesirable but also, for Teacher J, perceived as unnecessary and not beneficial to improving teaching and learning. Further, the frustrations experienced due to technical issues reinforced perceptions that change was not necessary; in fact, it got in the way of good teaching and learning. As Merchant (2009) suggested, the introduction of technology, for many reasons, upset the symmetry of classroom life. The apparent contradiction - namely, that these teachers were either self-nominated or were nominated by their peers as technology users but expressed these seemingly negative views - is discussed in subsequent chapters.

Understandings and actions that supported teaching practices to effect the integration of technology to support multimodal authoring were self-reported by participants as unevenly distributed amongst their colleagues, as Teacher D comments, “there are some of us that use it more than others”. As part of a strategy to ensure a more even acceptance and support for technology integration to support multimodal authoring, some participants had been part of a school and cluster-wide professional learning opportunity. One, in particular, used an existing framework, Solo Taxonomy (Biggs & Collis, 1982, 1989). The descriptions in the taxonomy are developmental, so teachers can use them to set and evaluate progress against goals. Some participants saw the use of this framework as a tangible means by which teachers could improve teaching and learning, in this
particular case, the teaching and learning of multimodal authoring. Within this professional learning opportunity, ways of teaching that included multimodal methods in writing were based on the Solo framework. Teacher G commented on the use of such a framework:

*What I was doing with the children was quite surface, it looked good but there wasn’t any real learning happening... SOLO Taxonomy has allowed me to investigate and to address and to reflect on my own teaching and learning practice using technology.*

Teacher G spoke enthusiastically about the use of Solo Taxonomy but, even when asked for examples of specific understandings related the use of this framework to informing processes related to multimodal authoring, Teacher G responded in a very general way: “The outcome is ...of a much, much higher standard and it has been quite exciting”. Although, as stated in the literature review, the utilisation of this type of framework could be seen more in terms of a technical ability to follow specific progressions and not as supporting sustainable improvements in teaching practice in the long term, for Teacher G it was a useful framework on which to base teaching practice.

Pervasive throughout the data, and relevant to ways of teaching, were responses related to difficulties and concerns when teachers sought clarity from curriculum and policy documents on practices and processes related to multimodal authoring. Teacher J commented: “Well it doesn’t really (make mention of the use of multimodal resources). I don’t think it even mentions it, does it?” There was a sense that teacher practice in the area of integrating technology to support multimodal authoring was unsupported at a national level, through, for example, a lack of documents that should offer rationale and process in a way sufficiently explicit to all teachers.

In summary, participants engaged in a range of strategies to integrate technology to support multimodal authoring including using technology as a tool to automate existing processes or publish student work; choosing technology to augment existing teaching strategies; and basing technology integration on an existing framework. There were those who did not see the need to change existing practices to include technology use or multimodal authoring. Seeking clarity from curriculum and policy documents was a recurrent theme in the data, particularly in discourse related to the property of assessment and evaluation strategies, which will be discussed next.

**Assessment and evaluation strategies**

Identifying desired outcomes, establishing progress indicators and detailing information necessary to make informed judgments about progress in the area of study, prompted comments from participants in three areas. These were in respect of the influence of policy and curriculum directives
on their assessment practices, existing evaluation and assessment strategies, and personal capability.

The absence of any clear guidelines or provision for assessment of multimodal authoring in national curriculum policy documents, school-specific policies and externally benchmarked assessment tools were of concern for many teachers. The following exemplifies the explicit references made around these concerns by participants: “Someone would have to develop some evaluation criteria because we haven’t actually got it. That doesn’t exist yet” (Teacher L); “I still focus very much on the curriculum which does not include technology” (Teacher M); “We don’t do any of our assessment on multimedia at all because we are not there really I guess. I mean it is not available really” (Teacher P); “The challenge we have as a school is that you can create the most amazing blue screen video, animated, multimedia evidence for evaluation purposes. Then you have things like AsTTle which is, linear and paper” (Teacher G). Linking student achievement data to informing teacher practice is the goal of schools in their regular cycle of data gathering and analysis. Within this context, as participants alluded to, it is very challenging to collect data around multimodal authoring to inform teaching and student learning. The curriculum framework does not provide sufficient clarity around benchmarks or standards.

There was acknowledgement by some participants that certain existing assessment and evaluation practices could be applicable to new technology environments. However, insufficient policy and curriculum guidance and support, linked to participants’ inability to clarify and identify the information needed to inform judgments about benchmarks, restricted development in this area. Reference was made, in some instances, to participants collaborating with other colleagues, and talking about the need to engage in assessment of multimodal authoring. Even this discourse was hindered by the lack of clarity and shared terminologies around describing practices associated with this type of writing. Therefore, little had been done in terms of developing a process to facilitate change. Under these conditions, therefore, it was not surprising that evaluation and assessment capabilities in the use of multimodal resources in writing were, in general, placed in the “too hard basket”.

A number of references were made to the need to develop personal capability in terms of the ways that different modes worked together for meaning-making purposes before teachers could consider assessment and evaluation strategies. Participants explained this capability further in terms of knowing about the unique properties of sharing information and communicating online, such as the features and role of interactivity, using colour and typography choices, using visual, aural and oral modes. This area of knowledge and practice associated with writing using multiple modes is
Content knowledge

Most participants described using multimodal methods as combining more than one mode to make meaning. When asked to define what writing using multiple modes might look like, typical comments were, “It is something that incorporates all the modes of communication, listening, speaking. It can have reading and writing, it can have all of them; it can move, it can be static...” (Teacher G); “something that would have more than just text in it... I would need to see pictures, animations, sounds and video...” (Teacher B). So the principle of using more than one method of meaning making was familiar to this group.

In addition, one participant referred to the potential for interaction with others or the use of interaction-capable software when using multimodal resources, “I think that would be something that was a bit interactive” (Teacher H). Of note, another participant talked about the potential for information to be non-linear:

What is new is it is not as linear as it used to be, you know, you go to a multimodal document and it has got this platform to jump from. You can sort of read a bit and jump to somewhere else and come back to it or not come back to it. That is how you actually make meaning by following the links and exploring the links that are provided. So you don’t necessarily start at the top and work all your way down to the bottom (Teacher A).

Accessing information in a “linear” manner as referred to by Teacher H, implies following a fixed hierarchical knowledge structure. Equally, “non-linear” access implies the potential for information to be accessed in the order that makes meaning most effectively for the user as evidenced in the way information is sought through, for example, a web site. It is not surprising that this participant referred to the feature of linearity, as he was a specialist technology teacher who had tertiary qualifications in technology use and an extensive online presence. No other teacher participants spoke of linearity.

It was apparent that there was a low level of shared understanding of terminology and language related to using multiple modes of meaning. For example, some misunderstanding arose for the participants when asked to describe the specifics of creating meaning multimodally. Even though all participants could respond to the idea of multimodal communication, not all could describe certain
features of multimodality for example that ways that different modes work together to make meaning.

In summary, for the most part, participant responses indicated only an emerging awareness of the affordances of multimodal resources and the type of choices and integration approaches that would support meaning making. Using more than one mode of meaning was familiar to participants but apart from one participant who had more advanced content knowledge that included aspects such as linearity, participants knew very little about how choices between and within modes enhanced meaning making.

Although advancements in technology have enabled new ways and purposes for authoring, they have also meant more complex choices available to authors. For these participants, there were gaps identified in, not only knowledge around new ways of authoring, but also the mechanisms, processes and relationships that exist between modes associated with new ways of authoring.

Levels of expertise in content knowledge, assessment and evaluation and ways of teaching were, overall, inadequate for teachers to support student learning in multimodal authoring. In part, the levels of expertise were influenced by the skills and knowledge teachers had in using technology. This will be discussed next.

**Skills and Knowledge about Using Technology**

Examining the category of skills and knowledge about using technology, and associated inquiry into participant practices, were grounded in two assumptions: a) that technology is pervasive in and out of school environments and the focus of on-going and significant education-directed financial and policy initiatives and, therefore, participants would use technology to some degree; and b) in order to use technology, a certain level of skill and knowledge about its operation, functions and capabilities must be present.

Currently, ways of describing and measuring apposite levels of skill and knowledge to integrate technology into teaching and learning, lack consensus and clarity. Therefore, patterns of participation in technology use, including self-reported capability, were examined to understand what participants saw as important. Responses were sought that enabled consideration of participants’ personal and professional levels of technology skills and knowledge to give a baseline of participation in these practices and explore a possible connection between personal and professional use of technology.
Data indicated that technology use for both professional and personal use was widespread amongst these participants. The majority of responses described technology as convenient, fast and automating existing tasks such as communication and information gathering. Thirteen out of 15 participants indicated on a 4-point scale ranging from 1 (once a day) to 4 (constant use), that their most favoured technology tool, the laptop, was used constantly throughout the day. The range of applications participants used was evenly spread from moderate (3–4 tools) to extensive (more than 5 tools) and comments suggested that both the range and frequency of use depended on personal need, confidence and ability with technological tools. Skills were developed through peer mentoring and personal inquiry and related to personal beliefs on the role of technology in teaching and learning. As a result, if participants did not think that using technology would improve teaching and learning, they felt justified in putting little effort into learning associated skills and knowledge related to its use. Teacher beliefs were an important variable in technology use and the role of teacher beliefs will be explored later in the chapter.

Participants represented the range of technology used for both professional and personal tasks (see Figure 1) as *moderate* (3–4 tools) to *extensive* (more than 5 tools). Twelve out of 15 participants indicated their most frequently used application, for example a laptop, was utilised constantly. The range for self-reported expertise in the use of technological tools was broader, from *fairly limited* (skill to perform several basic tasks) to *extensive* (skills to perform all tasks to advanced levels of competency), with the majority of participants indicating they were at the *moderate* (perform all basic tasks competently) and *considerable* (perform most basic and advanced tasks competently) levels. On the upper end of the continuum one participant indicated her skills as extensive which supported her highly confident stance about technology use “I could do anything...” (Teacher G). This teacher talked about her personal motivation to develop her knowledge and skills in hardware and software applications and presence online. She had 52 online sites in the form of blogs, wikis and personal websites. In the case of this participant in particular, data indicated that there was a strong relationship between her personal and professional levels of technology use. She integrated technology into her teacher practices at a significant level.
Extreme confidence from one participant was contrasted with the participant who indicated her level of expertise as “fairly limited” (Teacher F). This limited level of personal use again, related to levels of professional use, which were low. Teacher F described her strategy to compensate for low levels of personal expertise by using student expertise to support her learning and to fulfil a mentoring and tutoring role with the other students in the class.

Participants were also asked to indicate their ability to model the use of technology to their students (see Figure 2). This question was based on the assumption that teachers must have the ability to teach required knowledge and skills in a certain area and also to work out a continuum regarding what students need to learn in order to be effective and improve student learning. The majority of participants, nine in total, indicated their ability to model technology use as moderate (skills to model all basic tasks competently); five indicated they had considerable ability (skills to model most basic and advanced tasks competently); and one participant indicated she had extensive ability (skills to model all tasks to advanced levels of competency). Therefore, for most of the participants, their ability to demonstrate to students certain technology applications and their functions was, likely, insufficient to support teaching and learning in multimodal authoring.
The most significant feature of responses when comparing personal and professional use of technology was reference to aspects concerning availability, reliability and suitability of technology in the school setting and corresponding technical support. The majority of participants commented on these factors at some stage during the interview process and such factors were noted as being problematic and having a negative impact on their ability to integrate technology into teaching and learning. Teacher N commented, “What technology we do have, sometimes doesn’t even work so it’s very frustrating when you want to plan to use it for a lesson and it doesn’t work or works unreliably.”

Under these conditions, the resourcing of schools and classrooms with appropriate technology hardware and software can impact on the use of multiple technology-mediated modes when teaching writing. The impact of technology resourcing in schools is interwoven with variables considered under the notion of systems factors.

For the majority of teacher participants, existing levels of skills and knowledge about using technology would not be sufficient to progress student learning and teachers would need an increased range of strategies to strengthen their capacity to respond to the areas of student need. For those participants who indicated their abilities at the considerable to extensive levels of expertise, there is still no assumption that they possess apposite knowledge as this was enquired into through self-report. The identifying, selecting and applying of effective teaching strategies to improve student writing would involve the need to assess required skills and knowledge.

Figure 2. Self-rated skills on ability to model technology use

The most significant feature of responses when comparing personal and professional use of technology was reference to aspects concerning availability, reliability and suitability of technology in the school setting and corresponding technical support. The majority of participants commented on these factors at some stage during the interview process and such factors were noted as being problematic and having a negative impact on their ability to integrate technology into teaching and learning. Teacher N commented, “What technology we do have, sometimes doesn’t even work so it’s very frustrating when you want to plan to use it for a lesson and it doesn’t work or works unreliably.”

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Influence of Systems Factors on Technology Use

Emerging from the data are a group of variables over which participants perceived they exercised minimal or no control but which impacted significantly on their ability to employ multimodal resources in their teaching and learning. Feelings of not being able to control their environment led to low levels of teacher agency. Kagan (1992) suggests that levels of teacher agency have a greater influence on teacher practice than teacher knowledge does.

Variables making up the properties of systems factors are: the requirements of the national curriculum; technical infrastructure; vision and leadership within the school related to technology use; hardware and software resourcing; teacher professional learning in the integration of technology into teaching and learning, and technical support.

Calculating any correlation between these variables and participant use of multimodal resources was not applied to these data because of the size of the sample but reference was made by participants in such a way that technology use in teaching and learning could be seen to be shaped in some way by each one of the variables.

The requirements of the national curriculum have already been mentioned in the core category as influencing multimodal resource use but, in summary, the majority of participants expressed the view that writing using multimodal resources and associated assessment were not clearly specified in the English curriculum document and therefore teachers did not have any particular direction in this area. Teacher K commented, “No they just don’t mention anything about technology or anything like that.” Teacher N said, “I think of the Literacy Progressions document and even that doesn’t really mention anything much about writing using technology, maybe a bit about reading but certainly not writing.”

By way of contrast, the idea that the English curriculum was sufficiently flexible to allow for individual interpretation that could include the use of multimodal resources was expressed by this participant:

*Personally I find the New Zealand curriculum very broad and it gives you a lot of leeway and I am not just talking technology here. A lot of leeway for teaching and using the curriculum in your own professional judgment and that includes technology (Teacher M).*

In addition, there were two teachers who reported that the curriculum contained a mandate for the use of multimodal resources but perhaps was short on detail. Teacher C said, “Well I do certainly feel that the curriculum encourages it” and Teacher G said:
It helps with the sequencing, the structure of what is expected at each level because literacy is literacy. So, if you are using equipment or other resources or whether you are using paper resources, you still have got all the structure coming through.

Clearly, there was a range of opinions, including those who believe the curriculum documents give no clarity around multimodal authoring. Respondents represented those who believe the curriculum is broad enough to allow for individual interpretation and therefore functional in this regard and those who believe that the curriculum encourages the use of multimodal methods. Returning to a point made earlier, it is suggested that, at the national level, rationale and process for technology integration to support the use of multimodal methods in writing, has not been made sufficiently explicit to all teachers.

Vision and leadership were identified by many participants as playing an important role in supporting multimodal resource use. Teachers equated a lack of strong leadership and a vision for learning that included technology with the degree to which teachers were supported in adopting these practices. The following quote sums up the responses of other participants:

*I'm not entirely sure that it's given the depth of time or interest that is needed. I think maybe the ideal at this school is put emphasis on presentation with a pen and a pencil rather than keeping up with the times and being a bit more innovative. I think it is due to people being comfortable and you know not necessarily seeing other possibilities...no vision or leadership and that's not a criticism it's just how it is* (Teacher H).

Resourcing and technical support have been referred to already by the participants as problematic in relation to the lack of adequate and appropriate hardware and software, and the difficulties with technical issues affecting the usability of certain applications. Concerns around resourcing and technical support were woven throughout the discourse and maintained a high profile in responses. Lack of resourcing and corresponding technical support are mentioned in empirical studies conducted around 20 years ago at the time of initial technology integration as being linked to teachers not utilising technology in classrooms. The legitimacy of this claim is brought into question as improvements in resourcing and technical support have not necessarily resulted in increased usage (Ertmer et al., 2012). The relationship between the two variables of resourcing and technical support and teacher utilisation of technology remains unclear.

Teachers reported that the quality, type and variety of professional learning opportunities they had experienced in developing capacity in teaching and learning using multiple modes varied greatly. There were those participants who were part of a professional learning cluster of schools, those who
had undertaken individual learning, particularly tertiary level qualifications, and other participants who, increasingly, sought professional learning opportunities that involved membership of online communities. These included blogs, where teachers shared ideas, problems and suggestions for multimodal authoring. Connecting with groups of colleagues was mentioned by the participants as being a favoured means of learning new teaching and learning strategies; peer observations were viewed as particularly valuable.

Attending and presenting at conferences was a feature of professional learning opportunities that teachers spoke of enthusiastically, particularly casual gatherings loosely termed as “unconferences”, where teachers informally met and shared knowledge, strategies and skills related to technology integration at little or no cost.

There were also several comments referring to personal interest as driving professional learning: “I think a lot of the stuff you do on your own” (Teacher A). Other comments alluded to the fact that anything that you need to find out or learn, because of your personal interest, you are self-motivated to do so. The following comments reflect the increasingly common trend of teachers seeking opportunities independently online to meet individual learning needs:

Twitter is what I use daily and I get a lot of links from there to new resources or research or to good classroom ideas. I have a professional blog and in that environment I am able to write my own thoughts and get other people’s feedback on things and also a journal of my journey and I write my ideas and it helps me to formulate them better and also knowing that other experts are going to read it. It is like putting my mind through a pencil sharpener and really refines me (Teacher C).

While some teachers sought their own learning opportunities online, others received professional learning as part of a Ministry of Education contract:

Well the opportunity we had was the ICT contract for three years and I was the lead teacher for that. So the involvement in that was huge and the close work with the facilitator... helped me greatly. Learning from what the other schools in the cluster were doing as well as going to other courses, like Learning at Schools conference in Rotorua, an ICT one in Cairns one year and Canberra another year. So I was very fortunate to get a huge amount of PD in this area (Teacher K).
When asked to rate the quality of professional learning opportunities on a 6-point scale from 1 (poor) to 6 (excellent), the majority of teachers rated their experiences as either poor, basic or fair (see Figure 3). Teachers’ ratings of how much they learnt from these opportunities also indicated a range of responses (see Figure 4). Descriptions of professional learning experiences revealed that often content and mode of delivery were unsuitable or inappropriate to teacher needs. The least favoured mode was described as top-down delivery by technical experts where participants were instructed by someone more knowledgeable about best practice. The most favoured was through peer mentoring including online interaction as indicated by Teacher A: “You learn in different ways and you find out about new things in different ways... you find out about it online, from colleagues or from Google.” Literature suggests strong links between the variables of leadership and vision for technology integration, the mode of delivery of professional learning, and the uptake of technology use in teaching and learning (Byrom & Bingham, 2001; Law & Chow, 2008; Picciano, 2002).
Figure 4. How much participants learnt from professional learning opportunities

However, despite frustrations teachers expressed relating to systems factors, there was a small group of teachers who found ways to address challenges in integrating technology into their practice. For example, there was the teacher who took a set of laptops home each night to charge the batteries and make sure they were ready for use the following day to counter the problem of flat batteries in the set of laptops. Also there was a small group who sought to strengthen their own professional knowledge by actively seeking out feedback and information sharing opportunities from colleagues. In effect, they had their own group of learners who collaborated to improve their ways of teaching and student learning.

In summary, situational variables were largely influences outside participants’ control, although a few participants were able to exercise some control over aspects of professional learning and curriculum content and shape these to suit their teaching and the learning needs of their students. This supports the literature in this area that points to a small group of teachers, those working towards best practice in this area, who are able to strategise with existing resources to achieve valued teaching and learning goals such as collaboration and learning related to real-life situations.

Teacher Beliefs Related to the Use of Technology

The role of teacher beliefs associated with good teaching and effective learning impact the nature of instruction and interactions that occur in the classroom. A range of espoused beliefs about the use of multimodal methods in the teaching and learning of writing emerged from the data. These beliefs centred on the notions of multimodal resources as synonymous with 21st century learning, the use of multimodal resources as being motivational, an effective publishing and information gathering tool, readily accessible, as supporting collaborative processes and beliefs that reflected a more traditional
approach to teaching writing and did not express a value for multimodal authoring. Teacher beliefs were an integral part of, and informed, the responses already discussed above.

Typical of comments of participants who did not value multimodal authoring were Teacher L whose preferences were clear: “Well I would still like to teach writing traditionally”; Teacher J who prioritised the teaching of “the basics”, saying, “You need to still get the writing and all those basics that young children need and once they have those basics they can then apply it to those technologies”; Teacher M who espoused a traditional approach to the teaching of writing but with the thought in mind that maybe there will be a place for technology integration at some stage: “My focus is on the actual teaching of writing... and no I haven’t got as far as technology”; and Teacher L who acknowledged student perspectives but referred to the frustration of technological difficulties: “I can see the students I am teaching coming from a different aspect and they actually...like they embrace it. Whereas to me I sometimes think it is a nuisance especially if things go wrong.”

Teacher L taught in a school with a vision that supported a high degree of technology use in the teaching and learning programmes, with each child having access to a laptop. However, her beliefs, as a highly experienced and capable teacher, did not support the use of multimodal authoring although she was expected to fully integrate technology into all areas of teaching and learning as were all teachers at that particular school. This participant, whose compliance in using technology was coerced, had not altered her core beliefs that a traditional approach to teaching writing was fundamental to good teaching and learning.

Some respondents, who had been teaching for a long time, expressed the need for more support to integrate technology into teaching and learning as they, arguably, have had less formal training in the use of technology. They said that the distraction of technical problems interrupted their existing successful practices and they felt challenged by the expectations and processes of technology use.

Some teachers, although supportive of multimodal methods, suggested that they had to know what successful teaching and learning looked like if they were to integrate multimodal resources effectively and provide feedback to their students on how to improve in this area. This point was also made earlier when discussing assessment and evaluation strategies. Teacher J reflected:

*So what are my beliefs? I think that probably it is very important but have I done it [integrated technology into teaching and learning]? No I haven’t...I would say that there is huge scope for integration and for enhancing learning but again I think it goes back to what your resources are and what knowledge you have about what it should even look like.*
The perception of technology use being synonymous with 21st century learning was a feature of teacher beliefs and also discussed in terms of effective ways of teaching.

My understanding is that children need to be in contact with it constantly so that they do understand it, not afraid of it, confident around it and part of their way of thinking is around computers. I mean they are the people that are going to be innovating using computers and using the new technology anyhow (Teacher B).

Of those whose beliefs supported technology, participants described enthusiastically ways in which they used technology to support children’s individual learning needs. They described technology as motivational, and, because it was able to be accessed from home, use of technology allowed parents, for example, to participate in and comment on student activities. A specific example was used by one participant to illustrate collaborative opportunities for English language learners to improve their skills in authentic contexts. The teacher supported her students to become members of online communities and to develop technical skill competence as well as literacy skills. Reservations were expressed, however, around levels of interaction and feedback. Teacher G alluded to the difficulty of receiving quality participation and feedback online when posting, for example, a class blog. She commented there was often no feedback received by students which was very discouraging for them. However, in summing up technology use in general, she described her beliefs in this area as, “I don’t think there is any other way (to communicate) personally” (Teacher G).

In summary, participants espoused largely positive beliefs about the importance of including technology to support multimodal authoring. The main concern emerged as the lack of a model of what successful teaching and learning, and assessment and evaluation would look like if multimodal methods were fully integrated into student authoring. There was, however, a small group of participants who did not see the need to change established teaching practices. Only one participant totally supported the use of technology to effect multimodal authoring and indicated this was a focus of her teaching and learning programme in writing.

The Levels of Technology Implementation (LoTI) Scale (Moersch, 2002)

In order to further examine and rework the data to validate the interpretation of the interview responses, the Levels of Technology Implementation (LoTI) scale (Moersch, 2002) was used. This was a particularly important process considering the teacher participants were supposed to be at the forefront of the teaching and learning of multimodal authoring. It was adapted in consultation with a panel of teachers and used as an interpretive framework.
The Levels of Technology Implementation (LoTI) scale (Moersch, 2002) was developed as a means of measuring authentic classroom technology use (Table 4, and refer back to Table 3, pages 52-54, for descriptions of the scale attributes). The focus is on the use of technology as an interactive learning medium, supporting authentic learning opportunities and corresponding assessment practices, not merely to use technology to enhance existing practices.

**Table 4. LoTI Scale (Moersch, 2002)**

<table>
<thead>
<tr>
<th>Level 0</th>
<th>Non Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>Awareness</td>
</tr>
<tr>
<td>Level 2</td>
<td>Exploration</td>
</tr>
<tr>
<td>Level 3</td>
<td>Infusion (combining)</td>
</tr>
<tr>
<td>Level 4a</td>
<td>Integration (routinised)</td>
</tr>
<tr>
<td>Level 4b</td>
<td>Integration (adaptive)</td>
</tr>
<tr>
<td>Level 5</td>
<td>Expansion</td>
</tr>
<tr>
<td>Level 6</td>
<td>Refinement</td>
</tr>
</tbody>
</table>

The LoTI scale has descriptors of the construct at each level aligned with descriptions of the classroom environment, typical teacher comments and typical classroom observations (Table 3). Adaptations to terminology within the descriptions of classroom observations and typical teacher comments taken from the teacher data were made to align with the New Zealand context but the basic scale intervals and conceptual framework remain the same. As described above, a panel of teachers was used to assign levels of integration that reflected individual teacher practice evidenced by the data. Assignment was supported by examining individual data sets against the descriptors of the adapted LoTI levels of integration. This scale was used as a way of describing teacher practice at various levels along a continuum.

The participants of the panel that was used to assign levels of integration, agreed that for teachers to support the teaching and learning of multimodal authoring, they would need to be skilled in teaching writing and, most importantly, skilled in integrating multimodal technology into learning within innovative and collaborative contexts. The minimum level on the LoTI scale that would reflect this approach to teaching and learning was agreed as being level 4b that is, “technology is routinely integrated” where teachers can readily design and implement learning experiences that empower students to identify and solve authentic problems related to an overall theme or concept using the available technology with little or no outside assistance. It was also decided by the panel of teachers that in terms of teachers self-identifying their expertise in teaching writing with a focus on textual strategies (see Figure 5), indications should be at a level of expertise that was “considerable” to “extensive”.

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Table 5. Levels assigned to participants using the LoTI Scale

<table>
<thead>
<tr>
<th>Participant</th>
<th>Level on LoTI Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher A</td>
<td>4b</td>
</tr>
<tr>
<td>Teacher B</td>
<td>2</td>
</tr>
<tr>
<td>Teacher C</td>
<td>3</td>
</tr>
<tr>
<td>Teacher E</td>
<td>2</td>
</tr>
<tr>
<td>Teacher F</td>
<td>2</td>
</tr>
<tr>
<td>Teacher G</td>
<td>4a</td>
</tr>
<tr>
<td>Teacher H</td>
<td>2</td>
</tr>
<tr>
<td>Teacher J</td>
<td>1</td>
</tr>
<tr>
<td>Teacher K</td>
<td>2</td>
</tr>
<tr>
<td>Teacher L</td>
<td>2</td>
</tr>
<tr>
<td>Teacher M</td>
<td>4a</td>
</tr>
<tr>
<td>Teacher N</td>
<td>2</td>
</tr>
<tr>
<td>Teacher P</td>
<td>2</td>
</tr>
<tr>
<td>Teacher Q</td>
<td>4a</td>
</tr>
</tbody>
</table>

Figure 5. Participant self-rated levels of expertise in teaching writing

The majority of the participants, eight in total, were at the exploration phase of technology integration level 2. Four participants were on level 4a and only one, Teacher A, was engaged in routine integration of technology into teacher and learning in writing which indicated level 4b on the LoTI scale.
Chapter Summary

For these teacher participants, although comfortable using technology to support multimodal authoring practices in their personal lives, teaching and modelling its use in a classroom setting was seen as something outside their usual practice. This appeared to be the result of several factors underpinned by the need to incorporate new kinds of learning that could undermine established teaching and learning relationships and accepted instructional practices that are shaped by existing curriculum imperatives (Merchant, 2012).

Emerging from the data, understandings about the use of technology that supports multimodal authoring were around the ways of teaching multimodal authoring, the type of content knowledge teachers must have to be able to support teaching and learning of multimodal authoring with their students, the need for certain levels of technological skills and knowledge and an acknowledgment of the influence of systems and unique contextual conditions that could support multimodal authoring. These comments were underpinned by their individual beliefs associated with good teaching and effective learning.

Participants saw the development of ways of teaching to support multimodal authoring as an important step in teacher professional growth and data suggested that most participants were at a stage where they were transitioning towards doing that. Most participants described using multimodal methods as combining more than one mode to make meaning. Some participants were exploring ways to develop multimodal authoring practices as involving more than just the use of publishing functions. For these participants, using multimodal methods involved learning about technological affordances and ways of representing and placing information to address teaching and learning needs of their students. Participants indicated that the development of these skills would, in turn, support teachers to adapt their teaching practices.

As participants began to explore ways of integrating technology to support multimodal authoring, apparent was a lack of a shared language to describe experiences and talk about effective ways of teaching because of the “fluidity and instability, multiple meanings, readings and interpretations (that) are a feature of digital environments” (Burnett & Merchant, 2011, p. 47). Sheridan and Rowsell (2010) and Unsworth (2006) propose that teachers could benefit from a language to describe practices in using multiple modes of meaning as such a language could focus attention on effective ways of teaching and learning.
Some participants could describe multimodal resources as being modes of meaning that include visual and aural modes as well as textual modes, for example, but could not explain how using multimodality in authoring could achieve certain teaching and learning goals.

Whilst most teachers had thought about using technology to support multimodal authoring, and indicated a sense of regret at not having operationalised this aim, a few had begun to discuss and clarify practices and processes with colleagues. The sense of regret emanated from a realisation that multimodal authoring is pervasive and used by their students routinely outside of the classroom. However, there were still a number of teachers whose beliefs supported maintaining present textual practices in writing with a concession offered to publishing textual products using technology. Justification for this was offered in terms of maintaining existing practices that focused on text-related surface feature priorities such as appropriate grammar and spelling, of uncertain curriculum and assessment directives, and of a lack of technology provision and support.

Contextual conditions that affect the use of multimodal methods, but are difficult for teachers to influence, were discussed at length by some participants. This helped to explain the context within which teacher understandings of multimodal authoring were grounded. One of these contextual conditions which, arguably, could be both a barrier and an enabler, according to participant comments, is the role of the curriculum. Unique to the New Zealand context is a curriculum document that reflects the self-managing schools policy that has informed education policy making for 25 years. This approach affords possibilities for responsiveness to contextual conditions but by being non-prescriptive, increases variability in enacting curricula uniformity. In framing this model of curriculum implementation in terms of barriers and enablers according to literature reviewed in the previous chapter, the curriculum can be seen as an enabler in terms of its ability to allow individual responses to phenomena such as technology integration, but also a barrier in that it lacks detail and clarity to enable uniform conditions.

Other contextual conditions were identified as the presence or otherwise of technical infrastructure; vision and leadership within the school related to technology use to support multimodal authoring; hardware and software resourcing; and teacher professional learning. Each participant had his/her own specific dimensions as described in the data examination and presented a complex combination of interrelated events to which participants responded in different ways. It was therefore difficult to make assumptions about the relevance and likely causal nature of these contextual conditions but possible to give examples of how participants reacted to the conditions. Some teachers, for example, found ways of overcoming them and either adapted their teaching practices to compensate for a certain variable or manipulated resources and circumstances to achieve learning and teaching goals.
These teachers, however, were in the minority. For the majority, contextual conditions had a negative effect on teacher use of technology to support multimodal authoring.

A considerable range of skills, knowledge, essential understandings and beliefs about multimodal authoring were held by this group of teachers. There were extremes, namely, those teachers who had embraced multimodal practices, were addressing challenges and developing ways to address any systems factors that could have a negative impact on building knowledge of what best practice in multimodal authoring might look like. This was in contrast to those who were (1) at a very early stage in their awareness, (2) were comfortable with existing practices, (3) had a low level of technical skills and engagement, and/or (4) had beliefs about teaching and learning which did not support multimodal authoring.

The Levels of Technology Implementation (LoTI) scale (Moersch, 2002) was adapted in consultation with a panel of teachers and used as an interpretive framework to further examine and rework the data to validate the interpretation of the interview responses. This was a particularly important process considering the teacher participants were supposed to be at the forefront of the teaching and learning of multimodal authoring.

Given that participants were purposively selected as skilled teacher practitioners, knowledge and reported skill about multimodal authoring was low. These were puzzling and challenging results which pointed to important gaps in teacher knowledge. In essence, teachers did not have a sense of what they should be teaching in terms of multimodal authoring.

**The Next Chapter**

In the next section, the data are re-examined in light of teacher participants' low levels of knowledge and reported skills in the teaching and learning of multimodal authoring. Framing the problem necessitated a theoretical lens that could offer clarification around the possible gaps in teacher knowledge and teacher understanding about multimodal authoring and ways of addressing these gaps. Legitimation Code Theory (Howard & Maton, 2011; Maton 2000, 2007, 2010) provided such a lens. LCT, is described and illustrated in two examples of recent research. A specific rationale is given for its use in this study. Then, the findings from the teacher participant data are further refined within the framework of LCT. Further investigation of the data also aimed to explore the structuring of teacher knowledge to enable effective teaching and learning of multimodal authoring.
Section 2: Re-Examining the Data

Chapter Four: Charting the teacher participant data within the framework of Legitimation Code Theory

Chapter Overview

Section 2 explores the themes developed from the data around multimodal authoring that appear to have influenced participant teacher capability to address student learning needs in this area. Included in this examination is teacher-reported use of an existing learning framework as a way to assist in adapting writing curricula and teaching practices to include multimodal methods.

Having established, on the basis of the data examined in the previous chapter, that there was limited understanding from participants on the teaching and learning of multimodal authoring, this chapter now raises the theoretical question of how to conceptualise the phenomenon of limited understandings from participants. The various issues raised by the participants will be considered; in particular, the low levels of knowledge amongst participants compared to what is needed to address the task of teaching multimodal authoring.

To examine the teacher data and frame what they currently know against likely needed knowledge and knowledge practices in the teaching and learning of multimodal authoring, Legitimation Code Theory (LCT), derived from the extensive work of Maton (2000, 2007), Howard and Maton (2011) and Christie and Maton (2011), will be described. LCT will be used to consider knowledge and knowledge practices and the way in which these have been structured for traditional writing practices. The structuring of knowledge in the context of multimodal authoring will then be examined and the notion that traditional knowledge practices are sufficient to inform the teaching and learning of multimodal authoring will be examined. The question of whether new knowledge structures and practices are needed will also be addressed.

Accepting that traditional writing instruction, in the early years at least, is synonymous with the existence of an established body of content knowledge, the need to develop a body of content knowledge to inform multimodal authoring is addressed. The types of knowledge needed are considered, initially, based on Shulman’s (1987) major categories of teacher knowledge. To clarify further what, in this instance, could constitute “content knowledge” to inform multimodal authoring, explanation will be offered using de Jong and Ferguson-Hessler’s (1996) descriptors of knowledge. De Jong and Ferguson-Hessler propose four types of knowledge, namely, situational,
conceptual, procedural and strategic knowledge. Each of these knowledge types is described as a way of characterising the context in which knowledge functions.

The chapter concludes by foregrounding the next stage of the study which aims to further describe the type of knowledge and habits of the knower, needed to support students to develop multimodal communication by examining the experiences and practices of digital designers.

Exploring and Conceptualising the Issues Raised by Participants

Teacher participants brought to this study a range of knowledge, beliefs, values and understandings around teaching and learning of multimodal authoring practices. This included their personal perspectives. Such, inform judgments and evaluations they make about their individual capabilities, a lens through which they view their practice, guiding the decisions they make about the actions they will take, the ways in which they make sense of new information, and what they view as useful knowledge. As discussed in Chapter 2, teachers’ perspectives, beliefs and assumptions have significant impact on the content of what they teach and ways in which teaching and learning interactions occur. Teachers indicated certain knowledge about technological affordances and processes, but their core beliefs about teaching and learning, that influence what they teach and the way they teach it, in some cases did not support the use of technology.

Although participants were purposively selected to take part in this study as skilled teacher practitioners in both teaching writing and using technology in teaching and learning, reported practices ranged widely. There were those teachers who had embraced technology and were addressing challenges and developing ways to address any systems challenges, to those teachers who were at a very early stage in their awareness of technology use and multimodality. The latter finding was anomalous due to the purposive nature of their selection for inclusion in the study and appropriate efforts to obtain a knowledgeable sample of participants.

Further enquiry revealed that there were various explanations for this anomaly. Two teachers from two different schools described a technology focus and vision at their particular school that these participants were required to “buy in to” by virtue of their employment. The school-wide emphasis on technology integration did not necessarily fit with the personal beliefs of what constituted good teaching and learning in writing for these teachers. In spite of this, both teachers outwardly supported the school-wide professional learning initiative and were perceived by their principal as competent users of technology in their teaching and learning programmes. In another instance, a teacher held a senior management position at a school which carried with it, curriculum responsibility for technology integration. This teacher participant admitted her lack of knowledge
Teacher participants in this study accepted technology as pervasive, an imperative of daily life both inside and outside of school settings and influential in how students understood literacy and being literate. Comments by some participants explained the use of technology as positive, the way of the future, indicative of 21st century learning, motivational, an effective publishing and information-gathering tool, readily accessible and supportive of collaborative learning processes. Teachers’ personal technology use was generally high, associated mainly with traditional writing practices, research and planning. This phenomenon is a feature in a range of studies (Burns, 2010; Lim, Zhao, Tondeur, Chai, & Tsai, 2013; Muir-Herzig, 2004; Parr & Ward, 2010; Ward, 2013). Muir-Herzig suggests that the lack of technology use by teachers, even those who use technology widely in their personal lives, may not be due to technology per se, but rather the reluctance to change their teaching practices.

Participants were aware that technological tools and their applications were evolving but there was limited consensus, clarity or understanding of what constituted exemplary practice in multimodal authoring and whether their existing understanding of how to teach writing was sufficient to inform such. Levels of technical capability varied amongst participants with no apparent baseline or minimum standard of skill evident or mutually acknowledged and understood by teachers. In other words, normative indicators did not exist.

Most participants expressed the need for changes to assessment and evaluation strategies, and their comments focused on the need for developing evaluation criteria for multimodal authoring. Participants suggested that the current requirements of assessment and evaluation for writing were not applicable to multimodal authoring. Overall, participants understood that technology-mediated multimodal authoring was relevant and necessary, used by their students outside the classroom, required authentic learning contexts, specific understandings and practices but, they did not understand what knowledge and practices were needed or what would constitute exemplary practice.

There was a range of beliefs about the affordances of technology tools. As part of beginning to transition to teaching multimodal authoring, most participants recognised that this practice involved more than one mode of meaning, such as visual, textual and audio, and that these modes had
unique meaning-making properties. The interactive potential of certain software applications and the affordance offered for collaboration were cited by the participants, as were the possibilities for using resources within modes, such as different font size, colour and type in textual modes, and the way in which writing and reading online have potential to be non-linear as part of the increasing complexity of the choices available to writers. Although there was an awareness of the affordances of technological tools, participants could not articulate how these affordances could transform existing practices and products in writing.

As is the case for most teachers, the curriculum document guided the teaching and learning of writing for these participants. What counts as knowledge in the teaching and learning of writing for teachers and students in New Zealand schools is contained in the New Zealand Curriculum document for English. Concerning direction specific to writing, this document contains general reference to acquiring understandings of potential textual structures and language features; processes by which ideas can be expressed; and using sources of information, processes, and strategies to identify, form, and express ideas (Ministry of Education, 2007). According to participants of this study, the depth of coverage of writing and related assessment for multimodal authoring in the curriculum was insufficient to support teacher practice in this context as practices were still evolving. In particular, participants noted the scope of the curriculum document as allowing for multimodal authoring practices but as lacking clarity and detail to guide teacher practice. There was agreement that curriculum structure and content that would support multimodal authoring has been only partially determined.

Resourcing of technology hardware and software for these participants featured in discourse as being inconsistent, as did the articulation of a vision for technology use by school leaders. Participants acknowledged these factors as sources of frustration and confusion that negatively impacted on their ability and motivation to integrate technology. Conversely, there were those practitioners whose beliefs and values meant a strong commitment to technology use and so they were, therefore, able to overcome factors perceived by other participants as barriers.

These contrasting responses reflect the mixture of circumstances which teachers, with a variety of skills, knowledge and beliefs, attempted to “implement their visions” (Ertmer, Gopalakrishnan, & Ross, 2000, p.2) for teaching and learning “in terms of both curricular expectations and available resources” (p.2). There is no doubt that this group of teachers achieved what, for them, was reasonable and workable given the particular set of conditions they operated in, cognisant of prioritising the needs of their students. These participants were aware that they should be supporting the multimodal authoring of their students but, on the other hand, clearly needed time
and opportunity to build confidence, skills, and learn new approaches and associated content knowledge in a context that is changing all the time. As Gillen and Barton (2010) note, the requirement that teachers have all relevant knowledge in a particular subject area is compounded in the arena of technology use because of the very nature of constant change and innovation that defines this domain.

Despite challenges, there was evidence to suggest that most participant teachers were transitioning their teaching practices, albeit at different stages, to include multimodal authoring. This was despite, for example, a reported lack of tools such as software that is specifically intended to support building teacher capability in designing effective learning programmes using technology. Related teacher knowledge lacked coherence and depth; uneven, and at times inadequate, resourcing; and a national curriculum document that lacked a complete knowledge base to support multimodal authoring were areas identified by participants as being problematic.

In summary, teachers could articulate understandings of multimodal authoring as making meaning with more than one mode; as a way of communicating that was highly relevant and widespread in today’s world and therefore important to their students; multimodal technology was an important and useful publishing tool; multimodal authoring entailed more than just technology use; frameworks can be a tangible means with which teachers could improve teaching and learning; multimodal authoring could be interactive; it would not necessarily follow traditional structures in the way information is both laid out by the writer and accessed by the reader; certain skills and knowledge about technological tools and existing multimodal authoring platforms such as blogs and wikis are necessary. These understandings were underpinned by organisational and curriculum networks where the effects of these systems on teacher practice varied from person to person.

**Framing Knowledge and Knowledge Practices in the Teaching and Learning of Writing using LCT**

Commonly, literature informing the use of multimodal tools privileges contextual factors such as resourcing, professional learning and knowledge, as influencing the degree and kinds of use of multimodal tools in teaching and learning. Contextual factors featured in the data and were described within the theme of systems factors. Systems factors are highly relevant and of great concern to teachers and there is no intention to minimise their impact. However, to examine the data in terms of knowledge practices which would help in moving interpretation of constraints on teachers away from systems factors, examination of the problem faced by the teacher participants will be framed in terms of the type of legitimised knowledge practices that have traditionally
informed teaching, learning and assessment of writing. This will be done using the framework of Legitimation Code Theory (LCT).

**Legitimation Code Theory**

Legitimation Code Theory (LCT) is used to frame knowledge and knowledge practices and the way in which these are structured for both traditional writing practices and multimodal authoring. In the following discussion the question is considered as to whether traditional knowledge practices are sufficient to inform the teaching and learning of writing multimodal authoring or whether new knowledge structures and practices are needed.

LCT integrates insights from a variety of approaches including Bernstein’s theory of the structuring of pedagogic discourse (Bernstein, 1990, 1996). LCT describes a domain where beliefs and practices are often in tension in terms of legitimacy or what is considered valued knowledge. The concept of “legitimacy” is based on accepted measurements of achievement within a particular domain (Christie & Maton, 2011, p.131). Referring to these accepted measures of achievement as “languages of legitimation” (p. 131), Christie and Maton suggest that languages of legitimation can be analysed in terms of measures they refer to as “legitimation codes”. These codes can be analysed using several different dimensions that address a range of issues. This study draws upon one aspect of the dimensions of analysis this theory offers, namely “specialisation”.

Specialisation is conceptualised as the set of beliefs and practices that make something unique, valued by certain groups and therefore perceived as worthwhile. Specialisation is further clarified in terms of epistemic relations (ER) between practices and their focus, and social relations (SR) between practices and their subject. So, in effect, epistemic relations and social relations may vary in emphasis in given practices and beliefs, and the relative strengths give rise to the specialisation code of legitimation.

Howard and Maton (2011) and Maton (2007) describe continua of strengths as x and y axes of a Cartesian plane that identifies four principal modalities (see Figure 6):

- A knowledge code (what you know) where mastery of specialised knowledge, principles or procedures exemplifies achievement whilst the characteristics of the participants are less important
- A knower code (the kind of knower you are) where specialist knowledge is less important, rather the qualities of the knower or participants are valued and cited as the measure of achievement. These attributes may be instinctive or socially based
• An elite code (both knowledge and knower) that combines both specialised knowledge and important knower qualities

• A relativist code (neither) where neither specialist knowledge nor knower qualities are considered important. This is a situation described by Howard and Maton (2011) as “a form of ‘anything goes’” (p. 197).

**Figure 6.** Specialisation codes of legitimation (Maton, 2007, p. 97).

Typically, each code is not mutually exclusive and there may be more than one code present in any given context in varying degrees of intensity. A code clash or code match between learners and contexts may emerge, for example between curriculum goals in a certain subject and learner’s dispositions, or different approaches to learning that may be in conflict with those that typify a certain field of knowledge. In addition, as well as code clashes, the dominant code may change between subjects and levels. For example, learning to write, as described in the New Zealand Curriculum (Ministry of Education, 2007), is dominated by a knowledge code focus, in the early years at least, in that knowledge about grammar and spelling are valued. Similarly in mathematics, legitimisation relies heavily on students being skilful in a particular knowledge code. Once students have developed a certain mastery of the knowledge code, the dispositions of the learners, and the
way in which they can participate and contribute using the knowledge they have, become important learning areas. Participation in tertiary study arguably requires specialist knowledge and knower qualities present in the elite code.

In critique of LCT, Shay (2013) has queried, amongst other issues, the precise nature of the quadrant on Maton’s (2007) Cartesian plane that presents the relativist code favouring neither specialist knowledge nor knower qualities. The implication being that it would be difficult to think of an endeavour or area of learning that is legitimised by low levels of specialist knowledge and low levels of knower qualities. However, Maton and Moore (2010) emphasised that the proposed code classifications reflected the strength of the relationship of these codes and that a relativist code classification would not necessarily mean low levels of specialist knowledge and knower qualities but equal levels of both. Maton (2000) posited that describing the types of knowledge that are valued in this way, is useful to broaden understandings of how knowledge is produced and legitimated within a particular discipline.

LCT is a way of examining and describing knowledge-knower structures, classifying and framing not only knowledge, but also knower attributes. It can be used to describe practices in terms of curricula, pedagogy, beliefs and interactions at different levels (national, school and subject), in conjunction with multiple approaches and methods. These attributes offered a way of analysing integration of the use of multimodal technology in the teaching and learning of writing as proposed in this study.

**Participant Data and the LCT Framework**

Teachers brought their own knowledge of writing and technology use for personal goals, along with current knowledge of writing pedagogy to their responses. Understandings of multimodal authoring were located within those contexts. Participants spoke of the importance of knowledge code practices in terms of assessing capability in their students. So, for these participants, knowledge of specific principles and procedures were the measure of achievement in writing. Although participants spoke of their personal knower code practices in becoming familiar with multimodal authoring, such as collaborating and sharing with others, in terms of student achievement, they placed less importance on this and other types of knower code practices in their students.

Comment and experiences of teaching and learning multimodal authoring were highly contextualised where knowledge gained by participants was not necessarily used beyond a specific teaching and learning context. Decisions were made primarily on a ‘tool use’ basis to enrich engagement with a particular topic. In essence, understandings that teachers reported as having,
had not yet moved to the abstract but had strong epistemic relations (Maton, 2009; Howard & Maton, 2011) in that they were situated learning for a specific purpose.

Participants referred to the importance of traditional writing knowledge which, reportedly, included limited scope for writing using multiple modes or changing understandings of being literate that include multimodality. There was a gap between what teachers have learned to value as important in teaching writing that is their current knowledge code in this area, such as language features of correct grammar and spelling; and valuing practices and attributes of learning dispositions referred to within LCT as the knower code.

The absence of detail regarding specific knowledge and direction in the New Zealand English Curriculum document relating to multimodal authoring was of concern to participants. While the New Zealand English curriculum document has a stated aim of developing learner dispositions such as awareness of purposes and audience needs referred to as knower code practices within the LCT framework, a significant focus remains on specific knowledge and skills with competencies developed within a spectrum of traditional textual practices, knowledge code practices within the LCT framework. Achievement of writing in the New Zealand school environment, particularly in years 1–8, still has a strong bias towards understanding and skill in a series of traditional specialised knowledge principles.

Participants thought of writing as acquiring a knowledge code and they taught accordingly. They expressed concerns that the affordances of technology in highlighting spelling mistakes, for example, may negate the importance of aspects of the knowledge code such as the need for a spelling and regard for conventions of grammar. As Teacher L commented, “Students are using slang language, it is grammatically incorrect and it is full of spelling mistakes...they don’t even bother to use the spellcheck sometimes”. Perceptions were that the increasing use of technology eroded the ability and disposition of students to sustain traditional practices in writing.

Within the LCT framework, knower code practices focus on students as knowers rather than receivers of explicitly imparted specialised knowledge. The understanding of students as knowers is often characterised by constructivist forms of learning, places less emphasis on specific knowledge and instead values the characteristics and disposition of learners. In other words, knower code practices are about nurturing and valuing a certain type of learner and certain ways of learning. Knower code practices characterise technology use. For example, widely accepted as one of the main features and benefits of technology-mediated multimodal authoring, is that this form of communication supports collaborative learning. The ability to collaborate and build knowledge and understandings with others is reliant on the disposition of the learner to work co-operatively with
other learners in an environment mediated by internet capable tools. In theory, learners with
knower code dispositions can overcome barriers of time, distance and certain knowledge traditions,
accessing and exploring new learning environments and co-operating with other learners.

Knowledge code practices associated with traditional writing epistemologies, therefore, are in
tension with knower code practices valued when using multimodal technology. That is not to say
that knower code and knowledge code practices are mutually exclusive. Ideally, there is a
weakening and strengthening of knowledge and knower code dispositions across different contexts
to facilitate knowledge building (Maton 2008; 2009). Both practices do exist together, arguably,
creating ideal learning opportunities. Emphasis may change over time at certain stages of learning
and legitimacy may be placed equally on possessing optimal levels of specialist knowledge and
having optimal learner dispositions, referred to in this theory as the elite code.

Participants recognised that ways and purposes for communication were changing due to
technology being so widely available and its pervasive use outside the formal education
environment. As Teacher D suggested, teaching multimodal authoring at school, is about “speaking
their language ... using the tools and techniques at school that kids use at home...” and that the
writing that is taught and assessed at school is different to that which students engage in out of
school. Teachers spoke of the new online-based forms of communication such as email, blogging,
communicating via social media, that students found highly motivating and self-reported as essential
to the way they lived their lives. Comment was also made that the skills needed to participate in
these literate practices were widely held by their students. Further, teachers acknowledged that
these skills were gained largely outside of the formal education setting.

However, it is not surprising that for the majority of teacher participants, the focus of their teacher
practice in writing emphasised knowledge code practices. At the curriculum and age levels these
participants taught, the building of knowledge is perceived as crucial element to developing and
expanding capabilities in their students. This is an historic role and one that is reinforced today by
literacy curricula, especially. That is not to say that building capacity in socially based settings and
dispositional competencies, as suggested in knower code practices, are not important in writing as
well, or that in the process of using technology for various purposes, knower code practices are
developed. Participant teachers, however, did not appear to be aware of the place of knower code
practices in the overall process of multimodal authoring and therefore did not articulate such. As
Teacher E commented “all I have been worried about is when they are writing their blog if I look at it
is, have they got paragraphs, have they introduced what they are talking about....you know that sort
of grammar and structure stuff”.

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There is evidence to suggest that English, as it is taught and experienced by students at a higher age and grade level than those represented in this study, is characterised by knower code characteristics as opposed to knowledge code characteristics at the lower grades. This point was illustrated in research by Howard and Maton (2011) in their study, carried out in Australia using LCT, which required teachers to assign specialisation codes of legitimation (knowledge code, knower code, elite code, relativist code) to subjects across the curriculum and indicate a corresponding level of technology use. English teachers of Years 9–12 and students of Year 9 reported a greater use of technology in their curriculum area because valued achievement in English tended towards knower code aims of dispositional and socially based attributes. At a senior level (Year 9 students) of English, this subject was characterised as a knower code where dispositions were valued and students were assumed to possess specialist knowledge. “Students were often portrayed as already legitimate knowers, and the specialist knowledge they might need to learn was downplayed” (p. 202). Enhancing student experiences and innovation were valued in terms of achievement in English and both experience and innovation were, in turn, enhanced by using technology. However, as Howard and Maton also note, although overall English was characterised as a knower code, teachers still expressed concern about the value of technology for building knowledge code practices such as spelling and syntax because of overt advantage students could receive from such tools as spell check. These researchers concluded that the degree to which technology is integrated was “related to the code underlying specific knowledge practices rather than to the subject *per se*” (p. 203). Therefore, the learner code that was fundamental to a particular subject appeared to strongly influence the different levels of technology integration and the ways in which various technological tools were used.

In review, the constraints operating on teachers to include multimodal authoring in their teaching and learning of writing did include important systems factors. Notions of both teaching and learning writing using multiple modes was fundamentally governed the English curriculum in Years 1–8 which has a knowledge code bias and were characterised by the type of knowledge that curricula and teachers themselves legitimated. The type of knowledge in writing that has been legitimated over many generations of teachers and those that develop writing curricula, has favoured mastery of discrete knowledge practices. However, viewed through the lens of LCT, a code clash occurs between the knowledge code practices embedded in writing, namely those of gaining specialised knowledge, principles or procedures, and the knower code practices that emphasise the attributes of the knower, for example innovation and collaboration embedded in technology use. Therefore, a code clash between writing’s knowledge code practices and technology’s knower code practices
made the meshing of multimodal authoring goals for the participants of this study, highly complex and challenging.

The code clash, however, is not the only problem. If accepted that writing, in the early years of schooling, is primarily a knowledge code practice, the knowledge that currently dominates this subject area relates to traditional textual practices mainly bounded by language features. So the challenge of multimodal authoring becomes three-fold. Firstly, the knowledge code focus traditionally highlighted in writing in the primary school years is in tension with the knower code practices of technology use; secondly, the practices and purposes for writing in an environment characterised by technology use and ways of communicating are changing; and finally, the existing knowledge code does not ultimately take into consideration knowledge about writing using technology that allows multiple modes of meaning.

For example, assessment practices tend to reflect valued knowledge in all subject content areas. The dominant assessment tool, AsTTle, used in New Zealand schools in Years 1–10 to examine student achievement and progress in writing, assesses predominantly textual features. Although intended to assess writing in the context of “writing as communication” (Ministry of Education, n.d.), there is no facility to include multimodal forms of communication which are pervasive in the lives of most students. Similarly, The Literacy Learning Progressions (Ministry of Education, 2010) aimed at guiding literacy teaching and learning in New Zealand schools, make no overt reference to the knowledge or skills required for multimedia authoring.

The place of existing frameworks

Some participant teachers utilised existing learning frameworks as ways to assist them in adapting writing curricula and teaching practices to include multimodal methods. There was mention in the teacher participant data of professional learning centred on existing teaching and learning frameworks. One in particular referred to, Solo Taxonomy (Biggs & Collis, 1982, 1989), is a model using progressions to examine the quality of learning outcomes in a general sense. So, for example, Solo Taxonomy might be used to develop a school-wide approach to making learning and learning outcomes available to students through a shared language and understanding of learning trajectories. Although this framework is not specifically related to multimodal authoring, it is an example of how attempts are made by teachers and professional learning facilitators, to make sense of changing teaching practices within new learning environments.

Participants were enthusiastic about its benefits with comments related to the advantages of a ready-made model, which could be used across many contexts. Teacher G provides an example from
the data of using Solo Taxonomy in feedback. This participant had superior skills in technology use and participated in professional learning around the use of Solo Taxonomy as a way of integrating technology into the teaching and learning of writing. She commented: “Solo Taxonomy has allowed me to investigate and to address and to reflect on the way I approach my own teaching and learning practice” (Teacher G). This participant referred to the attributes of her behaviour and teaching practice as having improved due to participation in professional learning directed at an existing learning framework. There was no reference to developing specialised knowledge related to multimodal authoring per se, only to increasing mastery in teaching practices in a general way.

Frameworks also feature in the literature as discussed in Chapter 2. As stated previously, in a general sense and for the purposes of this research, the utilisation of this type of framework is not considered as evidence of teacher capability, in this case the integration of technology in the teaching and learning of writing, but rather as a technical ability to follow a specified programme. Research indicates that using these types of frameworks does not support sustainable improvements in teaching practice in the long term (Timperley et al., 2010).

Absent from learning mediation frameworks, referred to in the literature and reported by participants, were understandings and ways of building knowledge related to multimodal authoring. Without a corpus of knowledge, a subject or discipline remains fragmented and strongly tied to its context (Maton & Moore, 2010) and difficult to theorise. Knowledge creation in this instance is not proposed as a finite set of static information to be learned and reproduced. This would be problematic in light of the rapidly evolving field of multimodal authoring. Rather, knowledge creation is proposed as a set of core principles, concepts and relations, which aim to develop and enhance understandings for teachers and learners.

**Strengthening the knowledge code: What type of knowledge do teachers need?**

Participants suggested that integrating technology across the curriculum, including assessment and evaluation practices, was important because of the role technology-mediated communication plays in people’s lives. A number of participants made this argument in different ways. Often, the theme of technology integration was followed by comments that indicated a lack of knowledge and understanding by participants about what knowledge was needed, how technology integration would be shaped and the types of learning that would be supported.

Identifying the attributes of quality teachers and teaching practices includes consideration of “the expertise that underpin[s] the expert teachers” (Hattie, 2003, p. 5). One of the five major dimensions of this expertise identified by Hattie is that excellent teachers can identify essential representations
of their subject. In other words, they have sophisticated levels of content knowledge in a domain
and can identify standards and what counts as exemplary process and product. The gathering of
information on student performance and comparing that to an established standard or expected
level of achievement is fundamental to the process of assessment (Black & William, 1998). The
existence of a body of content knowledge, from which such benchmarks can be established to
ascertain student understanding or respond to identified needs, is, therefore, fundamental to
student learning in the area of multimodal authoring.

Content knowledge is knowledge about the field of study or subject to be taught. Typically, content
knowledge in any given subject is cumulative, exists on a continuum and is influenced by a range of
variables. Other researchers have detailed the importance of content knowledge. The work of
Shulman (1987), for example, is seminal in this field. Shulman (1987, as cited in Mishra & Koehler,
2006) suggests that:

Teachers must know and understand the subjects that they teach, including knowledge of
central facts, concepts, theories and procedures within a given field; knowledge of
explanatory frameworks that organise and connect ideas; and knowledge of the rules of
evidence and proof (p.1026).

Similarly, Figg and Jaipal (2011) suggest meaningful learning that is mediated by technology happens
when teachers focus on specific content learning referred to as “content-centric pedagogy” (p.
1227). Content knowledge evolves into what is counted as valued knowledge (Wyatt-Smith &
Kimber, 2005, 2009) and ultimately forms the basis for assessment and evaluation. Therefore, in
multimodal authoring, excellent teachers would have a high level of expertise to inform the skills
needed to use multimodal tools and associated practices, the features of effective multimodal
authoring and, importantly, corresponding tools and measures of assessment and evaluation.

To clarify further what, in this instance, could constitute content knowledge in the teaching and
learning of multimodal authoring, explanation will be offered around required aspects of knowledge
using de Jong and Ferguson-Hessler’s (1996) descriptors of knowledge. It is not intended that this
explanation of content knowledge be definitive, but rather an attempt to describe what could be
important understandings to inform the teaching and learning of multimodal authoring. De Jong and
Ferguson-Hessler propose four types of knowledge, namely, situational, conceptual, procedural and
strategic knowledge. These four are not mutually exclusive nor do they have absolute qualities in
light of the complexity of trying to characterise knowledge and the context in which knowledge
functions.
Situational knowledge is knowledge about settings and conditions specific to a certain domain. For multimodal authoring, this could include knowledge of relevant features such as how certain mode features influence meaning making to effect communication. Conceptual knowledge is core understandings about the principles and ideas that apply within a certain domain. An example of conceptual knowledge within the domain of multimodal authoring could be understandings around the use of online technology enabled multimodal resources to make meaning and communicate or the need for a range of both traditional and digital knowledge, skills and dispositions when using multimodal resources. Procedural knowledge is knowledge about processes, procedures and rules that apply in a certain domain. Examples of procedural knowledge could be knowledge of how a particular piece of technology works or understanding the process for posting on a blog site or uploading material onto a website. Finally, strategic knowledge informs decision-making and requires knowledge of the organisation and interpretation of knowledge and information with the domain. Strategic knowledge, in particular, requires a combination of all the different aspects of knowledge in order to problem solve including shared language and discourse specific to this domain.

It is suggested that content knowledge containing situational, conceptual, procedural and strategic dimensions is a pre-requisite to building a domain of knowledge to support the teaching and learning of multimodal authoring. Of course, content knowledge cannot be used in isolation and is limited in value if it is not closely linked to pedagogical knowledge (Shulman, 1987) and, once established and clarified, needs explicit teaching. In the case of multimodal authoring and related affordances of multimedia, explicit teaching and learning is needed around elements of design (Adlington & Hansford, 2008). Design practitioner knowledge and understandings will be considered in the next two chapters.

**Chapter Summary**

This chapter has explored the phenomenon found in the data, namely that of the lack of teacher capability to support multimodal authoring in the teaching and learning of writing. Although teacher participants used technology themselves in many different ways for a range of purposes, for the majority of participants, this did not translate into supporting the multimodal authoring of their students. This was despite a general agreement by participants that multimodal authoring was pervasive outside of school and that their students engaged in literate practices in their out-of-school time. It is also noted that these teachers were purposively chosen to take part in the study and were recognised by colleagues and school leaders as skilled in the integration of technology. Teachers’ comments indicated that there was a lack of content knowledge in multimodal authoring.
to inform their teaching practices. To develop a clearer understanding of knowledge practices in writing, LCT was described and subsequently used, to identify the specialisation code underlying writing as traditionally taught, and compare this to the code that underlies technology use.

The argument was proposed that the focus on specialised knowledge and principles aligned the teaching and learning of writing with knowledge code practices. This was juxtaposed with the focus on knower code practices in technology use where learner dispositions such as collaboration are legitimated as opposed to any static knowledge content. The tension between knowledge code practices and knower code practices within multimodal authoring sits within a context of new literacy practices and notions of being literate and content knowledge in a domain that is uncharted.

The use of learning mediation frameworks were discussed as one way in which participants have sought support for teaching practices that include technology integration to support multimodal authoring. These frameworks have concentrated largely on teacher and learner attributes and approaches as knowers. Whilst being of value, learner attributes need to be developed alongside knowledge practices that inform multimodal authoring. Ways of building knowledge to inform technology integration that supports multimodal authoring are essential for a domain to be created and theorised and necessary to underpin the development of expert teachers in the field of multimodal authoring. The knowledge needed is proposed as situational, about settings and conditions specific to the domain; conceptual, including fundamental understandings about the principles and ideas; procedural knowledge about processes, procedures and rules; and strategic knowledge that informs problem solving and decision making (de Jong and Ferguson-Hessler, 1996).

The need to create content knowledge to inform technology integration to support multimodal authoring is, therefore, pressing.

Section 3 of the study will develop a description of the teacher content knowledge needed to support students to develop the authoring of multimodal texts. Relevant content knowledge could support ways of adapting and modifying the curriculum and teaching practice to meet teaching and learning needs in a multimodal authoring context. To explore the processes and fundamentals of producing multimodal texts, the experiences and practices of digital designers will be examined. This step was informed by research that emphasises the importance of design in relation to multimodal texts (Cope & Kalantzis, 2000; Kress, 2003; Lankshear & Knobel, 2004); the social relationships inherent in the act of communicating; and the facility afforded by multimodal technology to transform texts (Bearne, 2009a; The New London Group, 1996, 2000).
The Next Chapter

The next chapter deals with how meaning is made using multimodal resources and how such resources could be translated into classroom practice. It explores the discourse in the area of digital design drawn on to inform data gathering from the group of digital designers. Digital designers are at the forefront of communicating using multimedia technology and have shaped an important body of knowledge in design within digital communication environments over a period of more than 40 years. Analysis of their role impacts significantly on nurturing new values and practices (Sheridan & Rowsell, 2010). The goals of this practitioner evaluation was to elicit the expertise and opinions of practitioners and external teaching professionals; identify contextual factors such as the current state of knowledge in this established field of digital design; and integrate this expertise and opinion with teacher knowledge to meet the needs of technology-mediated, multimodal student authoring. It will also investigate a data source that could contribute to a body of content knowledge and test whether LCT orientations to knowledge are a feature of the behaviour of Digital Designers.
Section 3: Opening Doors to Writing Mediated by Multimodal Technology

Chapter Five: Digital Design Literature Review

Section 3 explores how meaning is made using multimodal modes. It reviews the literature related to designing meaning alongside data collected from six digital designers. A model of writing is then proposed that foregrounds the use of multimodal technologies and, using this model, an argument is made for the development of related content knowledge. This section concludes with a review of the findings of the research and conclusions.

Chapter Overview

Consistent with understandings of design already developed in this study, this literature review reports on the processes and fundamentals of making meaning with and through technology-mediated multimedia using multimodal methods. Literature emanates from a range of empirical research undertaken and the resulting discourse in the past 10 to 15 years. This timeframe was chosen as it incorporates seminal research in the area of design that was published in the late 1990s.

In order to contextualise changed literate practices, the role that digital environments play in shaping contemporary understandings of multimodal authoring is explored. This includes the nature and role of modes as meaning-making resources and related requirements of reader and writer engagement.

An examination of practices that facilitate multimodal authoring in the classroom, including relevant student and teacher knowledge, follows. Insights from digital media producers, as established specialists in design practices, are then explored to consider knowledge and understanding teachers could draw on that may have relevance to teaching and learning multimodal authoring. The literature review ends with a summary of the literature identifying key concepts related to this study.

Introduction

Advances in communication methods enabled by digital technologies have changed the nature and context of communication. Where, at one time, communication involved using predominantly textual methods, new ways to share and create information (Sheridan & Rowsell, 2010) have given rise to new literate practices that involve an amalgam of text, image and sound. Within school
contexts, however, meaning has remained largely tied to traditional textual practices despite increasingly multimodal and integrated options (Cope & Kalantzis, 2000). Complex reader and writer choices are now available that address how meaning is realised in the unique context of internet capability and multimodality (Bull & Anstey, 2010). New choices and processes have meant that, in addition to traditional considerations of audience and purpose, knowledge and skills with technological tools and their affordances are needed; in particular, how combinations of multiple modes and their unique properties work together to make meaning.

Changed ways of communicating using the intentional combination and positioning of different modes of meaning have been conceptualised in several different ways. Although there is little agreement around how multimodal texts are created and read, (Anstey & Bull, 2000; Unsworth, Thomas, & Bush, 2004), ways of conceptualising these processes have been suggested by several authors. Kress and Van Leeuwen (1996), The New London Group (1996, 2000), Dillon and Vaughan (1997) and Sheridan and Rowsell (2010) all have unique ways of describing how multimodal meaning is made and read and detail ways in which the communicative needs of the audience are addressed and audience engagement and interaction is facilitated. These ideas will be discussed later in this chapter.

Aspects of design will be explored in order to describe making meaning with multimodal methods. It is intended that knowledge and understanding of changed literate practices, the principles of design and examining and details of the ways modes work together will, in turn, contextualise and advance the development of a body of content knowledge to inform technology-mediated multimodal authoring.

**Changing Ways of Communicating: Modality, Design and Making Meaning**

One of the elements that sets technology-mediated communications apart from those developed using traditional pen and paper resources, is the ability to choose from a range of modes of meaning. Modes are channels of representation used to achieve an author’s purpose (Low & Sweller, 2005; Sheridan & Rowsell, 2010) that constitute a set of resources for meaning making (Jewitt & Kress, 2003). Examples of modes are reading, viewing, listening or speaking and include the use of written, spoken, and visual resources such as photographs, animations, graphics, pictures, gestural, haptic (the way something feels to the touch) and aural resources.

realised by all modes in many different ways (Jewitt, 2008). Multimodality is an important construct in the area of study that is the focus of this research and is the basis of much discourse and empirical investigation in the field of technology-mediated communication. Machin (2007), in describing the significance of multimodality, used the analogy of the meaning of individual words and how they largely only gain significance when placed together with other words to form a sentence. He posited that this combining of meaning is the essence of multimodality. Multimodality offers the author choices other than the traditional use of words alone.

Although there is an extensive body of literature devoted to multimodality, for the purposes of this study, a concise description of this concept will be offered. Multimodality signifies that meanings are made, distributed and remade through many different modes (Kress & Van Leeuwin, 2001), realising communication in unique and highly contextualised ways. Ideas and concepts are represented with a range of resources such as print, visual and audio. In addition, the purposes and boundaries of making meaning are understood within a given sociocultural domain (O’Brien & Scharber, 2008) where ways of making meaning depend upon the accepted practices and the unique motivations inherent in particular social contexts. This is particularly evident in contexts such as, social media, where accepted procedures and choices of mode and language are part of membership practices.

Using more than one mode to communicate is not new. Communications have often consisted of more than one mode, mainly pictorial and textual. However, it is the increasing sophistication, the evolving nature of modes and modal affordances, the variety of modes and the ways they are distributed through different communication media that have changed (Bearne & Wolstencroft, 2007; Sheridan & Rowsell, 2010). The choice of the most appropriate mode or modes depends on consideration of how a message is best represented and which modes may expedite the processing of content. By understanding modes and their characteristics, a better appreciation can be gained of the skills and knowledge needs to “compose and communicate multimodally” (Sheridan & Rowsell, 2010, p. 86). Mode choice is fundamental to technology-mediated authoring.

When considering what constitutes a multimodal communication, seminal research by Mayer (2003) described a “multimedia message” as a presentation with pictures, words, sound and touch, “designed to foster meaningful learning” (p. 128). The words can be written, spoken or heard. The pictures can be in still form such as photographs, illustrations or graphics or they can be animations or videos. Sound recordings can be musical or “mood” related, and the haptic or textural mode can be used to replicate the “feel” of a particular object. These visual, aural, textual and haptic elements work together to make meaning but also operate in unique and individual ways. A range of technological affordances allows multiple options for further highlighting and enrichment of each
mode. So, with all these choices available, constructing meaning becomes more of a problem solving exercise that reflects the writer’s disposition and engagement with the world and “less a prescribed series of practices” (Sheridan & Rowsell, 2010, p. 27).

Seminal research was reported by The New London Group (1996, 2000) in conceptualising design and its role in meaning making. This group of researchers described how modes are combined, meaning is realised and readied for distribution under the heading of “design”. Design describes using available resources of, for example, text, pictures and sound, to make meaning and combining and reforming them into what they call the “redesigned” to meet the needs of the writer and reader. The New London Group proposed that the redesigned, being tailored to a specific audience, meets the needs of users more effectively. Reforming resources to suit particular needs is a fundamental goal of design (Sheridan & Rowsell, 2010). The concept of design and its processes has been very influential in conceptualising how multimodal resources are combined to make meaning.

Other researchers have described in detail the specific processes of design. For the purposes of this research and to assist in conceptualising and describing communicating using the unique properties of multimodality, three descriptions of design processes will be offered. Researchers Dillon and Vaughan (1997) describe the design of meaning, using the concept of “shape”. Knowledge of the concept of shape can be used as a means by which readers and writers engage with design using multimodality. Shape accounts for the layout and sequencing of information and the process of acquiring knowledge from a multimodal communication, using such things as schema, modelling, visuals and text. These authors propose shape, not so much as the physical layout of a message in the literal sense, but shape as the organisation of material in such a way as to prompt readers and writers to assist with meaning making as they engage with technology-mediated information. For example, shape prioritises considerations of layout and sequencing of information, the sizing and positioning of images and text on a page. The key element in the concept of shape is the way in which information is presented, including using the affordances of multiple modes, to facilitate the meaning-making process.

Kress and Van Leeuwin (1996) described the combination and positioning of elements in technology-mediated communication as a design grammar approach, in that the properties of a certain mode realise its meaning when combined with other elements. Similar to Dillon and Vaughan (1997), Kress and Van Leeuwin emphasised the combination of modes that facilitate meaning making. Further, as part of their approach to understanding visual design, Kress and Van Leeuwin stated the importance of not only interpreting what is physically represented, but also of recognising the interactive relationships that are fostered through user engagement and the way information is distributed.
These processes include accounting for the relative emphasis placed on the components of a particular communication. The design grammar approach has some parallels with traditional text. Traditional text relies also on the use of a grammar, such as punctuation, so that words realise their full meaning. Both design grammar and shape have potential to provide some guidance to both readers and writers of multimodal communications who need to be aware of meaning implied in the relative placement and structure of content.

Authors Sheridan and Rowsell (2010) refer to the practices and, importantly, the language of design. Language is seen as important and these researchers and others (Unsworth, 2006) highlight the need to develop a language to describe practices of design. As with The New London Group (1996, 2000), Sheridan and Rowsell encourage teachers to “promote practices that both remix available resources to better suit students’ goals and examine how needed resources may converge across multimodal and dispersed networks” (p.41). They further suggest that teacher practices based on remixing support students to be part of not only changed meaning-making practices, but also help develop learning dispositions that encourage problem solving. Changed meaning-making practices and problem solving approaches to learning underpin technology-mediated learning.

The four main ideas to emerge are around the order, placement and emphasis of meaning-making resources to assist interpretation; the possibilities of remixing and combining existing resources to tailor meaning making for particular audiences; the recognition of the interactive relationships that are fostered through meaning making using multiple modes; and the importance of a language that can describe these practices. These are ideas that could be useful to teachers when designing teaching and learning opportunities in multimodal authoring and could in turn, form the basis of a body of content knowledge to inform such.

Although writing using multiple modes is a relatively recent trend without a great deal of specific direction from curricula, the decision making process involved in technology-mediated authoring shares some similarities to those of traditional writing processes. The structure of a textual narrative, for example, can be identical in both media, apart from the obvious difference in type. Whether or not producing technology-mediated communication requires a different set of skills to that required for a traditional pen and paper communication is contested (Bolter, 2001; Braaksma et al., 2002; Gregory, 2004; Henning, 2001; Kress & Van Leeuwin, 1996). For the purposes of this research and in consideration of contextualising and advancing a body of content knowledge to inform multimodal authoring, it is reasonable to suggest that the shift from using only one mode of resource to the use of multiple modes requires a different set of skills.
Some commentators suggested that communicative purpose and context, rather than mode based guidelines, should direct the way a communication is structured (Gregory, 2004). In learning the communicative requirements of, for example, a web page, the author draws largely on knowledge of how text works rather than having to learn a new set of skills (Henning, 2001). The fusion (Millard, 2003) or bridging (Alvermann, 2001; Lankshear & Knobel, 2006; O’Brien & Scharber, 2008) of traditional textual practices and emerging digital visual and aural practices likely describes what is necessary for design practices that facilitate meaning within a multimodal technology-mediated context. Millard details in her transformative pedagogy of literacy fusion, that to be a motivating factor in the lives of students today, literacy needs to be an amalgam of aspects of school literacies and children’s interests, particularly in technology, accompanied by appropriate teacher actions. Practices that combine both technology-mediated and pencil and paper facilitated strategies, as Turckes and Kahl (2011) observe, employ the shared power of the “pencil and the pixel”.

In addition to the skills required to produce and use visual, aural and textual resources, are skills associated with critical literacy. Critical literacy practice, within education, foregrounds skills such as the ability to read, analyse, critique, question and, ultimately, to have some sort of agency over the messages inherently present within any form of communication. These skills are particularly relevant to technology-mediated texts accessed online due to the range of sources and varying levels of authenticity that characterise online material and the powerful role technology-mediated texts play in people’s lives.

In combining several modes of meaning, the result is more than just the sum of the parts “because the complexity inherent in multimodal messages carries a dimension – when combined – that neither alone possesses” (Hilligos & Williams, 2007, p.239). The unique organisation of information that is evident when using multiple modes, in turn, requires comparable forms of engagement from the reader for meaning making.

**User engagement with multiple modes of meaning**

User engagement with multiple modes requires a unique reader response that differs significantly from that required for single modes, such as a document using only text. User interaction with multiple modes must account for the differences in how information is organised in multimodal, technology-mediated, online environments (Whithaus, 2005). For example, specific user interaction can be seen in the way meaning is made from an integrated, multimodal presentation such as a website. Likely, meaning making is approached by users viewing segments of a screen and they frequently focus on something familiar to them, such as a logo, font or colour (Gregory, 2004; Whithaus, 2005). From there, users progress, often through a hyperlink, to another area of interest.
Hyperlinks provide opportunities for interaction that may add to and change the content of elements of the communication. This type of engagement contrasts with making meaning in traditional texts such as a book where progress is dictated primarily by the linear nature of the information presented.

Engaging with technology-mediated communication is synonymous with encountering the familiar, the unfamiliar and an amalgam of both. The amalgamation of different communication structures often results in what The New London Group (1996, 2000) described as “hybrid texts”. Hybrid texts have evolved from the mixing of different elements in response to a particular user’s need. Examples are found in the use of instant messaging and text messaging which utilise existing conventions and practices such as letters, combined with the use of symbols such as icons. An icon is a representation, likeness or sign that stands for an object by representing it either concretely or by analogy. Icons may also be used to navigate a path to a desired online destination (Farkas & Farkas, 2000). These hybrid texts have responded to circumstances such as the small screens of mobile phones and the need to communicate quickly within a community of users. Icons and symbols aid navigation and connect the user with different features of information.

Further, navigational tools, such as links and “drop down” menus, enable users’ access to meaning-making opportunities. Links can be made up of hypertext (a word or phrase taking the user away from a page to another source of information) and hypermedia (similar to hypertext but using media such as pictures). Hypertext and hypermedia links can provide guidance and support on how to process certain pieces of information. The guidance and support that navigational aids like hypertext and hyperlinks provide help the reader to minimise the effects of limited working memory and assist both cognitively and perceptually in making meaning (Mayer, 2001; Schnotz & Bannert, 2003; Sweller, 2003; Sweller et al., 1998). Therefore, the quality of the navigational features has become crucial to meaning making. Farkas and Farkas (2000) referred to negotiating access to meaning in online environments as the “navigation paradigm”. This described the layered nature of information, able to be accessed randomly at the reader’s discretion as meaning-making need dictates. The ability to move between the layers is an important tool to support both the reader’s “departure from the current mode and arrival at the destination mode” (p. 342). The navigation paradigm also supported another feature of working with multiple modes in an online environment, that of interactivity. This feature provides opportunities for readers to respond to, interact with other users or with software applications, together with the opportunity to change any given content.

Any communication, whether constructed digitally using multiple modes or using a single mode of expression, contains opportunities for response and interaction. Texts created using the traditional
resources of pen and paper, for example, require a response from the reader to make meaning and are the basis of traditional classroom based tasks familiar to many as “comprehension”. However, information constructed using multiple modes provide far greater opportunities for interaction, not only because of a broader range of modes but also because of networking being synonymous with online connectivity. Interactivity can take place on several different levels. Sheridan and Rowsell (2010) proposed a useful framework in order to assist with conceptualising online interaction. These researchers understand interaction as happening on three levels. Initially, there is the watching and the mental “note-taking”. Interaction at this level is the first step for engagement with any communication or information online. Research suggested (Li, 2007; Van Dijck & Nieborg, 2009) that the majority of actions taken by people online are at this level. The second step, suggested by Sheridan and Rowsell, is “playing the game”. At this level, active interaction with online material is seen. This interaction could happen within a range of scenarios, from replying to an email to endorsing a blog post. The final or ultimate stage of interacting is where the audience or the players develop a sense of community membership (Sheridan & Rowsell, 2010). The desire and facility to connect and collaborate with others is, therefore, further enhanced. This phenomenon is demonstrated in membership of interest groups or online social media. Researchers such as Van Dijck and Nieborg reported that online audiences interact at levels far lower than expected. Further, Li (2007), in her social technographic trends report, suggested participation levels at 52% inactive, 33% passive spectators and only 13% actual creators.

**Image-Language Relations**

The concept of image-language relations is complex and has been the focus of much research into multimodal authoring and the use of multimedia in communication (e.g. Kress & Van Leeuwen, 1996, 2001; Martinec & Salway, 2005; Liu & O’Halloran, 2009) due to the major role that multimodal tools and practices play in today’s world. For the purposes of this research, image-language relations will be discussed within the context of the teaching and learning of multimodal authoring. Of interest to this study in particular and multimodal authoring practices in general, are the ways in which images and text are structured and how they function to support multimodal authoring where the aim is to produce a coherent multimodal message.

In more traditional settings, it was text that conveyed the meaning with image playing a subordinate role in meaning making. This notion is proposed by Barthes (1977) who argued that images could not of themselves convey sufficient meaning and that the meanings of images are always related to text. This meant that, for example, a picture (used in a subordinate capacity) was used to illustrate the principal meaning making resource, that of the text. In multimodal media, images can be
manipulated to effect different size, colour, and contrast and integrated with other modes such as text, all facilitated by a wide range of software. All modes have the possibility of conveying meaning individually or in equal combination. Therefore, the relationship between language and text has changed fundamentally to that of language and image having equal status and being equal partners in meaning making functions. Each mode of course, has its own properties and possibilities and not everything that can be realised through text, can also be realised through image and vice versa (Kress & Van Leeuwen, 1996). Martinec and Salway comment that conceptualisations of the role of image and language as being “…equal status combinations [that] are especially useful to new media, although their potential has so far not been fully exploited” (p.343).

The role of learning using multiple modes and the relationships between modes is further described in the modality theories of Mayer (2001), Sweller (2003), Sweller et al. (1998), Schnotz & Bannert (2003). Mayer’s Theory of Multimedia Learning (2001, 2005), is based on the notion that processing information and active learning includes the use of dual channels for visual/pictorial and auditory/verbal information with each channel having limited capacity for processing. It details the specific advantages that can be gained by combining these modalities to support integration but without overloading cognitive resources. Mayer posits that active learning requires coordinating five identified cognitive processes during learning; 1) selecting relevant words from the text, 2) selecting relevant images from the pictures, 3) selecting and organizing chosen words into a coherent verbal representation, 4) organizing selected ideas into a coherent pictorial representation and 5) integrating the pictorial and verbal representations and prior knowledge. He suggests that multimedia instructional messages should be designed to inform these processes.

Schnotz’s Integrated Model of Text and Picture Comprehension (2003) proposes that learners can use multiple sensory modalities such as text, image and auditory comprehension to build mental representations from pictures and words. It further suggests that the active, coherent assimilation of information received from text and pictures occurs at a perceptual level; the transfer of information from the ‘outside’ to the ‘inside’ and at a cognitive level; the information processing within working memory and the exchange of information between long-term and working memory. Visual, textual and auditory experiences are processed through separate information processing ‘channels’ with each channel being limited in its ability to process information. The use of multiple channels with their unique properties supports more efficient active cognitive processing to construct coherent mental representations.

Following Halliday (1978) several researchers (Kress & Van Leeuwen, 1996, 2001; Liu & O’Halloran, 2009) explore the notion of image-text relations from a semiotic viewpoint. Semiotics is the study of
signs and processes (sign-making) as they relate to meaning making, including non-linguistic systems. Semiotic choices, which are independently organised and structured, combine when authoring using multimodal resources. These semiotic domains, such as language and text, are connected but not dependent when combined to make meaning multimodally. As Kress and Van Leeuwen suggest

language and visual communication both realize the same more fundamental and far-reaching systems of meaning that constitute our cultures, but that each does so by means of its own specific forms, and independently. (p.17)

Kress and Van Leeuwen’s work recognises that images and texts represent not only what they describe as material reality but also, the relationships between viewers and what is viewed and that linguistic and visual resources can combine to form texts. The interactive nature of this relationship is an important aspect of multimodal authoring as technology has redefined the role of the reader of multimodal communication to include the role of writer who is able to remake the information to suit his/her own purposes. This is a feature of data reported from digital designers and will be further developed in the next chapter.

Integrating text and image requires an understanding of how the meaning-making features of images can mesh with the meaning-making resources of language. Visual grammar (Kress & Van Leeuwin, 1990, 1996; O’Toole 1994) has been proposed as a way of systematising examination of multimodal texts with a view to detail the functioning of visual dimensions of multimodal texts just as traditional textual grammar describes the functioning of textual resources. In turn this supports the development of critical literacy practices (Goodman & Graddol, 1996; van Leeuwen & Humphrey, 1996; Callow & Unsworth, 1997; Unsworth 1997; Lemke 1998a, 1998b). Visual Grammar is described around Kress and Van Leeuwin’s representational (constructing the nature of the events), interactive (the relationship between the speakers/listeners, writers/readers and viewers) and compositional (distribution of the information value or relative emphasis between elements of text and image) meanings that occur simultaneously. Visual grammar provides a way of describing visual meaning-making in both the authoring of multimodal texts and the reading of such.

In summary, user engagement with multiple modes of meaning has unique properties and processes. The nature and degree of engagement differs to that required when working with a single mode because of the range of ways meaning is organised and the different synergies between modes. Users of multimodal texts need particular consideration of how information and meaning is structured and mediated. The structuring of meaning is dependent upon the quality of navigational tools, which are, therefore, crucial to reader accessibility and promoting collaborative and
interactive opportunities. Technology-mediated multimodal communicative practices have spawned hybrid texts that have evolved to respond to new elements of communicative practice. These hybrid texts are used to suit particular circumstances or contexts. User engagement with multiple modes of meaning continues to evolve in response to changing resources and corresponding communication environments.

Literate practices that support digital literacies use skills and strategies that enable representing and understanding ideas using a range of modalities, such as visual, aural and textual, enabled by digital tools. Many students have already embraced the potential of multimodal methods to meet their social literacy needs outside of the classroom. Ways in which teachers can support the classroom technology-mediated literacy needs of their students will be discussed next.

**Supporting technology mediated writing in the classroom: What do teachers need to know to support teaching and learning?**

Currently, the multimodal content that students routinely consume and produce is most likely to occur in their out-of-school lives (Yancey, 2004). In order to support the technology-mediated authoring of their students in the classroom, one crucial aspect that teachers need knowledge around is incorporating the elements of design. This means developing design literacy dispositions that will enable to them to understand and utilise the increasing range of choices available for meaning making (Sheridan & Rowsell, 2010). Having a design literacy disposition offers methods and concepts for understanding how meanings are formed and also helps to explore possibilities about new ways of doing, and thinking about, making meaning. Teachers need to be comfortable in bringing together different modes in “online learning design and delivery platforms” (Kalantzis & Cope, 2010, p. 205) and focus on equipping students with a “strategic repertoire of knowledge and skills around text and context” (Bull & Anstey, 2010, p.8) that supports understandings around the meaning potential of such elements as colour, positioning and font.

As discussed, student learning in writing with and through multimodal technology has similarities to traditional writing models. Knowledge draws, largely, on understanding how texts work and on considerations of purpose and audience but with the added dimension of new possibilities for meaning making using different modes in combination. In addition to detailed scaffolding of student learning and strategic teacher intervention, teaching practices in technology-mediated writing need to reflect an amalgam of traditional writing skills with children’s interests, knowledge and skills with technology, and the affordances of and between modes. A body of shared content knowledge including a language for sharing and developing this domain must inform these actions.
A body of content knowledge already exists that informs technology-mediated communication. This exists outside the teaching profession in the realm of digital design. As the aim of this part of the study is to build a corpus of content knowledge to inform the teaching and learning of technology-mediated writing, it is appropriate to explore different knowledge sources and to look to other contexts that have an established domain of practice that includes technology integration. The following section introduces professional practice outside teaching material that offers insight into design.

**Digital designers**

Several disciplines offer insights into design practices developed in specific contexts for unique communities, such as engineering, computer programming and advertising. Design practices in these contexts act as methods and concepts for understandings about how meanings are formed and they foster new practices and dispositions within a particular culture or community (Johnson-Eilola & Selber, 2007; Sheridan & Rowsell, 2010). Another group of practitioners who have developed a body of knowledge and expertise with particularly rich understandings around developing and applying design capabilities are known variously as digital designers, graphic designers and digital media producers, amongst other descriptors. For the purposes of this study, this group will be referred to as digital designers. Digital Designers dominate the technology cultures of the mass media and exert a ‘normalising’ (Kress & Van Leeuwen, 1996) influence on multimodal communication globally.

Much of what is the current state of multimodal design in technology-mediated communications is developed and disseminated by this group of professionals.

Digital designers are involved with, for example, creating websites, designing video games, graphics, animations, music videos, digital marketing activities and product promotion, to name a few. These professionals use multiple modes to configure messages and communications that address, usually, client-based communicative needs. Their work is informed by tertiary study and often years of industry experience that involves not only high levels of skill in manipulating technology but understandings of how a range of multimodal digital resources can be manipulated to make meaning. This group of practitioners has an established presence in the area of media design of more than 30 years and, to some extent at least, they share amongst themselves, understandings and a language that describes processes, products and dispositions in this arena (Sheridan & Rowsell, 2010).

While designers in fields other than teaching may have knowledge that may cross over into educational contexts, these may not necessarily translate into classroom practice. Sheridan and Rowsell argued that although, “many marketplace tenets come out of contexts and histories that
may not reflect the civic, social justice mission central to education... educators can learn from and adapt the lessons digital media producers teach” (p. 113). These researchers suggested that the practices, dispositions and habits of digital designers that promote problem solving in creative and diverse ways, are critical to developing design capability in both teachers and students.

It may be possible that teachers can learn, not only from the technical capabilities of designers, but also in terms of design dispositions such as collaboration and problem solving, having a range of measures of success and, importantly for constructivist pedagogies, valuing the process as well as the product. Turckes and Kahl (2011) place these dispositions within a culture of iterative problem solving, cross discipline collaboration and the use of both technology-mediated methods and traditional methods of meaning making acknowledging that these two processes are not mutually exclusive.

Chapter Summary

This literature review has described, briefly, discourse on the concept of digital design and shaping communication using technology-mediated multimodal authoring. The purpose of the review is to contextualise examination of data gathered from digital designers described in the next chapter, and ultimately that both inform a body of content knowledge to support technology integration in the teaching and learning of writing. This will be reported in a subsequent chapter. Literature was drawn from discourse addressing ideas of design mainly over the past 10 to 15 years.

Changing ways of communicating are the catalyst for new literate practices that incorporate technology-mediated multiple modes of meaning. These changes have necessitated knowledge and skills of technological tools and their affordances and how different modes work together to make meaning. Manipulating multiple modes to make meaning is theorised in the literature using the concept of design and redesign (The New London Group, 1996, 2000), design grammar (Kress & Van Leeuwin, 1996), shape (Dillon & Vaughan, 1997) and practices and language of design (Sheridan & Rowsell, 2010). The way multimodal resources are brought together through design is a fusion (Millard, 2003; Turckes & Kahl, 2011) of traditional and technology-mediated practice requiring specific skills not only related to working with multiple modes of meaning, but also those associated with critical literacy (Bolter, 2001; Braaksma et al., 2002; Kress & Van Leeuwin, 1996).

Creating meaning using multiple modes requires some of the skills needed for traditional print based communications but, in addition, another set of skills is required to enable meaning to be realised by manipulating various modes and their affordances and unique properties. These affordances and properties were discussed briefly, in terms of what constitutes a multimodal message and the ways
in which different modes make meaning in combination with other features such as those described within the navigation paradigm (Farkas & Farkas, 2000).

Just as different skills are needed to author multimodal technology-mediated communications, different user engagement and response is needed to account for the differences in how information is organised (Whithaus, 2005). Readers and users of multimodal texts need to consider how information and meaning is structured and mediated using navigation tools, which play a big part in accessing and understanding information as well as promoting collaborative and interactive participation. In the classroom, student learning in writing with and through multimodal technology draws largely on existing understandings of how texts work but has different demands in terms of how modes and their affordances work together. Therefore, appropriate teacher actions to support teaching and learning multimodal authoring need direct teacher intervention and modelling of appropriate design strategies and use of resources.

The Next Chapter

In the next chapter, to consider practices developed by other professional communities that may have some lessons to share with teachers about design (Sheridan & Rowsell, 2010), the practices of digital designers are suggested as offering some insight and knowledge that could be applied to the classroom context. Designers negotiate meaning collectively, through collaboration, negotiation and mutually accountable relationships, within what Lave and Wenger (1991) and Wenger (1998) define as communities of practice as part of the social theory of learning developed by these researchers. The knowledge, practices and identities that have been constructed within the professional community of digital designers are of interest to this study in that these understandings may offer support in developing design capability for both teachers and students.

Data generated from the six individual, semi-structured interviews of digital designers are reported. In describing and clarifying the data, a range of beliefs are described and themes common across all participants are detailed. Four themes emerging from the data around what constitutes effective design when using multiple modes of meaning will be defined and discussed.
Chapter Six: Practitioner Understandings of Practices of Design

Chapter Overview
Data generated from the six individual semi-structured interviews are presented. Participants were asked to consider, using their professional skills and knowledge, how communication is structured using multiple modes. Data were examined using applied thematic analysis. This process was done in consultation with participants. Emerging from iterative considerations of the data were four themes, which are described, along with the relationships of those themes to each other and to broader understandings of design. The four themes are: practices of design involve multiple modes of meaning enabled by the use of online technology; practices of design require a range of both traditional and digital knowledge skills and related dispositions; practices of design embody specific structures that facilitate meaning making; and practices of design use interactive features to engage and enhance the user experience of meaning making.

Each domain is described and discussed in terms of how it could inform the teaching and learning of technology-mediated multimodal writing.

Introduction
To clarify understandings around the process and fundamentals of technology-mediated communications, this chapter considers these practices as part of data collected from six designers. The domain they describe will be referred to as “practices of design” (Sheridan & Rowsell, 2010). The designers interviewed found these practices to be central to their work. The skills, knowledge and dispositions described support the development of content knowledge to inform writing mediated by multimodal technologies. In this chapter, discussion centres on designer behaviours and ways of knowing garnered from discussions about their perceptions and practices. Participant designers engage in state-of-the-art practice in both media and paper design and share their experiences of how these practices are operationalised in various settings. It is proposed that the practices and dispositions of the designers reflect the knower disposition as described in Legitimation Code Theory as described in Chapter Four.

Data Gathering

Selecting participants
The target population for potential digital design participants was from a list drawn up following an internet search of digital designers in the greater Auckland area. This included the commercial,
academic and education sectors. It was acknowledged that the potential number of participants could be large and for the purposes of the study only six participants were required. It was considered that six designers would provide sufficient data to inform understandings of the processes and fundamentals of technology-mediated design in this domain. Criteria for selection were established as follows. Each digital design practitioner:

- works with and creates digital designs using textual, visual and audio resources that reflect the focus of this study
- has knowledge of and skill in multimedia design that is represented in the focus of this study
- has been involved in design for at least one year and self-identify and/or are recognised as representing “best practice” in this area
- potentially, has some experience with digital design aimed at a younger audience
- is willing to talk about his/her knowledge of multimedia design by taking part in an interview of approximately one hour.

In keeping with the aims of the interpretive paradigm, which is to collect rich data about people’s experiences and perspectives, six participants were chosen in order to enable some degree of generalisation about how digital designers understand creating meaning using multimedia. The plan was to make an initial approach through email, and then follow up with a phone call. Participant information sheet and consent forms (see Appendices 4 & 5) were emailed to willing participants. In the event that participant numbers exceeded the required number, participants would be selected at random.

Ethics approval was gained on 25 February 2011 from the University of Auckland Ethics Committee.

The Auckland area was chosen as the catchment for contacting digital designers for ease of access as the researcher lived in that area. In addition, it would be practical considering the nature of the data collection tool, which was a semi-structured interview.

The search resulted in more than 300 hits. A random selection was made of 50 designers whose email addresses appeared on the website. An email was sent explaining the purpose of the research and an invitation to contact the researcher by email if they were interested in participating. Fifteen positive responses were received and were followed up by phone contact.

Cognisant of the many different foci of designers’ work, potential participants were sought from all areas of the design industry. In a number of cases, potential participants recommended friends and
colleagues whom they thought would be appropriate participants for the study. In this way snowball sampling in the form of peer nomination was employed as a sampling method. All new potential participants were sent an email of invitation and copy of the criteria for participation by the researcher or the original potential participants. They were, in turn, asked to self-nominate according to the criteria. One recently graduated participant recommended a lecturer at his tertiary institute as being particularly suitable to take part in the study, which he subsequently did.

In this way, nine participants were identified, three of whom agreed to take part in the pilot study and the remaining six took part in the main study.

Once the selection was made, each of the six designers in the main part of the study was contacted by telephone to arrange a suitable time for the interview to take place and given a brief outline of what participation would involve.

The participants

The group of six primary participants was an eclectic mix of ages, years of experience and design interests. There were five males and one female in the group ranging in age from 20s to 40s, with jobs ranging from entry-level positions to senior management positions. One participant came from the non-profit sector and one was a senior academic at a tertiary institution. All participants had a tertiary qualification and all but the academic, were actively involved in designing multimedia products for the commercial world. Table 6 summarises the demographic information for each of the digital design participants. All names are pseudonyms.

Table 6. Demographic information: Digital design participants

<table>
<thead>
<tr>
<th>Name</th>
<th>Age Bracket</th>
<th>Position</th>
<th>Experience</th>
<th>Sector</th>
<th>Media Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peter</td>
<td>25</td>
<td>Communications Coordinator</td>
<td>5 yrs</td>
<td>Non-profit</td>
<td>Print/multimedia</td>
</tr>
<tr>
<td>Brigitte</td>
<td>24</td>
<td>Graphic Designer</td>
<td>3 yrs</td>
<td>Commercial</td>
<td>Multimedia</td>
</tr>
<tr>
<td>Matthew</td>
<td>25</td>
<td>Graphic Designer</td>
<td>3 yrs</td>
<td>Education/commercial</td>
<td>Multimedia</td>
</tr>
<tr>
<td>Julian</td>
<td>40s</td>
<td>Creative Director</td>
<td>30 yrs</td>
<td>Commercial</td>
<td>Print/multimedia</td>
</tr>
<tr>
<td>Bart</td>
<td>30s</td>
<td>Senior academic</td>
<td>7 yrs</td>
<td>Tertiary education</td>
<td>Print/multimedia</td>
</tr>
<tr>
<td>Ryan</td>
<td>25</td>
<td>Graphic Designer</td>
<td>5 yrs</td>
<td>Film/commercials</td>
<td>Animation</td>
</tr>
</tbody>
</table>

Data were collected during April 2011. Details of participants and data collection are listed in Table 7.
Table 7. An overview of the primary purpose, data collection methods and of digital design participants

<table>
<thead>
<tr>
<th>Research Phase</th>
<th>Primary Purpose</th>
<th>Data collection methods</th>
<th>Participant Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital designers</td>
<td>To investigate practitioner understandings of skills and knowledge necessary for effective design using multimodal methods.</td>
<td>Individual semi-structured interviews. Field notes.</td>
<td>Peter Julian Brigitte Ryan Bart Matt</td>
</tr>
</tbody>
</table>

The interview schedule

The designer participants’ interview schedule (Appendix 6) contained a series of open-ended questions and one response to be indicated on a Likert scale. Each question was foregrounded by a rationale, which assisted in describing the question. Initially, inquiry sought background information such as the area of design the participant was working in, for what length of time the participant had worked in that area and a layperson’s description of the tasks that they carried out and areas for which they were responsible. Responses were then sought around professional skills and knowledge, which was intended to elicit information about the ways in which designers structure a particular communication using multimedia and comment on the skills, needed when communicating with multimedia as opposed to pen and paper. Inquiry then focused on the role of the audience and how designers matched the use of multimedia to meet the needs of the intended audience. Participants then had an opportunity to add any extra comment or information relevant to the discussion at the end of the interview schedule.

Data analysis

The process of examining and analysing the interview data from the digital designers involved open, axial and selective coding. A combination of computer assisted qualitative data analysis software (NVivo) and manual methods of data management were used. As with the teacher participant data, a coding frame emerged inductively from the data and evolved as new categories were uncovered. The coding frame, including explanations for decisions made in the classification of data, was detailed within the NVivo9 software.

In the initial open coding stages of examining the data, coding was undertaken in terms of identifying information as it related to the questions posed by the study. In this initial or open coding stage, the data was read through several times. In the next stage, where axial coding was undertaken, the codes from the initial stage were linked together using the memo function in NVivo9, to assist building up of themes across the data. Individual themes were identified and
analysed and possible relationships explored manually (For an example of the coding process see appendices 9 and 10). Coding then began again using only the thematic codes. A “best fit” approach to coding the data was used.

**Ensuring the Trustworthiness of the Examination of the Digital Design Data**

**Credibility**

For the purposes of examining the digital designer data to address possible bias in analysis, the researcher was assisted by two other people who analysed the same data independently then compared their findings. Also, member checks were carried out with the participants who had an opportunity to provide feedback on the analysis of the interviews.

Acknowledged by the researcher, for the purposes of this research, are predispositions that may affect the data analysis and interpretations, namely, years spent as a teacher; a generally positive view on integrating technology with teaching and learning; and a desire to support colleagues in the teaching and learning of writing using technology. These issues were addressed, in part, by the iterative process by which the data were examined ensuring that the interpretations and constructs made sense and genuinely addressed the aims of the research (Patton, 1990).

**Confirmability**

For the purposes of examining the designer data, there were multiple coders to ensure a measure of consistency in the interpretation of themes. Specific training was given to the coders before any coding took place including a detailed description and explanation of the descriptors for each theme and the opportunity to practice matching data to specific themes using excerpts from the pilot study transcripts. A clear research process has been detailed which can be verified and replicated.

**Transferability**

The collection and examination of data from the digital designers has been carefully detailed and described. The complete set of data analysis documents is available. Access to the project’s processes gives other researchers the ability to transfer the conclusions of this inquiry to other cases, or to repeat, as closely as possible, the procedures of this project.

**Dependability**

All methodologies have been detailed in order to replicate the study and achieve similar results. Results are linked to existing literature and that the findings are an accurate representation of what the participants intended.
Results

The results will be discussed in terms of the key findings emerging as themes that describe practices of design as:

1. Involving the use of online technology enabled multiple modes of meaning to realise communicative purposes.
2. Requiring a range of both traditional and digital knowledge, skills and associated dispositions.
3. Embodying specific features such as hierarchy of information, text and typography, navigation structures and the use of colour, that facilitate meaning
4. Using interactive features to engage and enhance the user experience of meaning making.

Each theme will be described and discussed in relation to the practices of design that inform the work of the digital designers.

Practices of Design Involve the Use of Online Technology Enabled Multiple Modes of Meaning to Realise Communicative Purposes

All designers talked about the use of multiple modes of meaning when engaging in the practices of design. These modes included using visual resources such as pictures, animation, videos and diagrams; audio resources such as music, speech and environmental sounds; textual resources such as writing with particular reference to typography; haptic resources; and, to a lesser degree, gestural and spatial resources. Present, also, was the notion that the choice of modes was made in order to accomplish a specific communicative purpose.

Multimodality is implicit in designer’s work

Multimodality, as central to the work of digital designers, was implicit within the more complex explanations of the work of a designer as described by the participants. Julian offered a description of the resources he draws on in his everyday work:

More than one form of media is used...you are drawing on images, sound, type, colour, that sort of thing and things are moving...we are using different types of media that perform different functions to contribute to the meaning making.

Peter detailed the origins of some of the multimodal resources that he used in his work:
It could be images that you create yourself using a digital camera, scanned images that you might have drawn or painted; it could be video footage that you have taken on a video or some other sort of camera; it could be text that you have written or has been sent to you from someone; it could be audio that you have collected and then there is content that you can find on the internet... obviously Google and that kind of thing. Then of course you can purchase stock photography and images, audio, and you can purchase stock video as well.

To enhance their communication, participants selected specific modes for specific purposes and across specific contexts. Peter understood the possibilities afforded by multiple modes and communicating across several contexts as he described his role:

I organise the advertising material and communication that we send out. I print newsletters for our customers and I maintain the website for the organisation and I look after the communication we have across Facebook and Twitter and that type of thing.

**Using multiple modes is screen based**

There was acknowledgement among several designers that the context of the screen was the interface when using digital media to create and distribute information. The screen has unique characteristics that needed to be considered in practices of design. As Peter noted:

Designing something for a screen you have to be very intentional about how it is going to look on the screen. People, for example, have lots of different kinds of screens, different sizes and you’ve got to take that into consideration like colours might look different on different types of screens and the way that it is laid out. For example... interfacing with a computer screen – you are looking at all the information at once.

Both Peter and Brigitte noted that a screen had the added dimension of possibly distracting or redirecting the attention of the user away from a particular purpose because the screen was not only the interface for digital media but also the conduit for online access. Brigitte pointed out that “once you have a screen there are so many distractions...” and Peter said:

If you are looking at a multimedia document on that screen there may be other things on that screen at the same time vying for your attention. There may be other websites open, other programmes or things popping up or you might have that in a window that might be minimised and what happens to that content when the windows have been minimised.
Communication processes are more complex using multiple modes of meaning

Several participants alluded to the more complex structure of communicating with multiple modes, as opposed to using a single mode of meaning. Ryan referred to this when describing complexities of using multiple modes:

> It’s getting that message across is a lot harder, particularly getting that structure, that hierarchy right is a lot harder so that people get the message straight away and also to maintain it. There is an easier hierarchy and an easier structure that can be maintained more easily with pen and paper. With multimedia, you have to understand so many processes.

Included in this discourse was articulated the challenge facing designers in keeping up with constantly evolving technologies and the broad spectrum of possibilities contained within the notion of making meaning with multiple modes. Bart commented on the rate at which technology changes, “the technology outpaces us, outpaces our ability to deal with it…”

As Matt suggested, keeping up with innovation is evident in the way participation has changed from the static Web 1.0 applications to the connected, information sharing applications of Web 2.0, to the artificial intelligence technologies of Web 3.0. “I guess the whole notion of using multiple modes to communicate is continually developing especially the way the web is evolving. It could be anything from Web 1.0 to Web 3.0.”

The challenges of keeping up with rapidly changing capabilities of digital hardware and software are constant themes throughout the literature and the data collected for this study. Included in any plan to address technology use will need to be consideration of how to address this issue.

Practices of Design Require a Range of both Traditional and Digital Knowledge, Skills and Associated Dispositions

All designers expressed the view that there were certain skills and knowledge that were needed in order to design communications in an online multimodal environment. Opinion was divided about whether or not different skills were required for the differing contexts of screen and paper. Participants talked of the need for a disposition of interest in, and motivation to use, multimodal technology as important. They reported that the range of skills required a combination of traditional skills associated with creating pen and paper documents and technical and design skills needed to employ multiple modes.
Essential knowledge and experience with appropriate software and hardware applications

Knowledge of relevant hardware and software was signalled as being important although not crucial to practices of design. There was support for the notion that this knowledge could be obtained relatively easily due to the high level of support for technology resources from their creators and other users, plus the facility to hire experts to perform tasks on your behalf. Brigitte commented:

*Technical skills are irrelevant because they are the kind of things these days that you just have to figure out...like you get something and you just play with it and figure it out...or you hire someone to do things for you.*

And similarly Ryan said:

*There are the technological skills but you can always hire people to do that like computer operators. There is no limit really but it is good to be able to know the technology, like you know how you can push it but in other ways it is a limit by thinking there is a boundary. By knowing technology you can box yourself a bit.*

Both Julian and Peter suggested that technical knowledge and skills were important, commenting on the need to know the affordances of particular software and hardware in order to manipulate them appropriately.

Necessary is the ability to combine skills related to using pencil and paper and those related to using technology mediated multiple modes of meaning

The combination of both pen and paper skills and those related to the use of technology is proposed by Turckes and Kahl (2011)’s observation of the “pencil and the pixel” power sharing in creating messages using multiple modes between the traditional and the digital. All designers articulated this notion as mentioned by Matt. “I use pen and paper to draw an idea...there is less detail but the design is the same. The final is usually a more detailed or filled out version of that [the design done with pen and paper] done on the computer”.

Participant explanations of the combination of skills needed to participate in the practices of design also revealed that using pen and paper for the initial stages of design improved the meta-cognitive awareness of the process. Ryan commented:

*The draft of the multimedia would be based on the draft of the pen and paper one. Like if you did the pen and paper one first it would be a lot easier taking it to the next level to do additional research and have additional content because that would help your understanding and help to figure out the key points and how to explain them.*
Similarly, Matt commented on this practice: “I think everything stems from pen and paper like ideas all start there. I think there is a whole chunk of the process missed out by going straight to the computer...”

Ryan completed his response by saying, “It seems to be for some reason a lot simpler to think using pen and paper and also to understand what the outcome is. I don’t know why or how to explain it.”

Despite innovations supported by new technologies, it appeared that production practices continue to be grounded within traditional contexts that designers themselves were brought up in. There is the possibility that, with expanding use of technological tools in schools and at home, this phenomenon may change.

**Knowledge and understanding of the needs of the target audience is necessary**

All designers talked of being cognisant of who their intended audience was, and the needs of that particular audience in terms of, for example, cultural norms and the purpose for designing. Julian suggested that, “You would have to understand how a message is put together, who was your audience, what you wanted to put across to them, on what level you were wanting them to take up your message.” Bart further described this notion as “an understanding of people and an understanding of who your audience is and an understanding of how they read, how they look and how they use.”

Within the professional context that most of these designers worked, the initial audience for their designing was the customer who was paying for their services. The secondary audience was the consumer who, subsequent to the approval of the design, was going to be targeted to purchase a particular product. Brigitte described her role as that of a translator; translating business needs into a design that is recognised, accepted and ultimately engaged with and purchased by the everyday public. Although these goals better suit the make-up of the marketplace, they can be translated into the classroom context, particularly to support dispositions such as inquiry and solving real-life problems.

**Specific dispositions complement apposite knowledge and skills in the practices of design**

As stated, participants referred to a certain disposition or way of thinking that was necessary, along with technical knowledge and skills, to participate in the practices of design. This disposition was referred to as having an interest in technology use and the motivation to enquire into practices and innovations. Several designers saw the presence of dispositions to design and technology use as critical. As Peter said, “I was interested enough to find out myself about how to use the things to do stuff and how to further develop the text and images.”
Other points made by several of the participants were that there needed to be dispositions towards problem solving; towards a culture of critical collaboration with peers; critical engagement with information sources and contexts; and also the tacit knowledge, understandings and assumptions that designers have when a design “looks right”. As Julian suggested:

*I think that a lot of these things you can’t train for. I think you’ve got it in you and a design school can just nurture it. It’s just a feeling that when you look at something you can decide whether or not it works.*

**Practices of Design Embody Specific Features that Facilitate Meaning Making**

All designers made reference to the unique features of artefacts created using multiple modes that set them apart from pen and paper documents. These features included an “information hierarchy” incorporating positioning, timing and presentation of information; the presence of “links” which can direct a user to another webpage; the use of colour and typography; the presence of a navigation framework; and the essentially visual nature of multimedia documents with minimal use of carefully considered textual resources. In essence, all these features related to a strong focus on the audience or “user” and facilitating user response.

When asked to describe how multiple modes were combined to make meaning, participants struggled to talk about their practices and the principles informing their design decisions. Descriptions of multimodal artefacts were spoken of in very general terms only, as the range of possibilities was so broad. Brigitte summed up what she said that many designers felt: “There are no rules for multimedia documents and there are no specific guidelines…multimedia can be anything.” This comment links to earlier discourse related to the presence of tacit knowledge and understandings that enable designers to know what “looks right”.

Bart, however, said that there are certain structures on the World Wide Web now that are accepted as the norm. He gave the example of a website homepage, commenting that in designing one, particularly commercially, a designer would need to be cognisant of the already established norms so that people would be familiar with layout and user interface:

*I guess in terms of what I have seen from the designers in the commercial world, say, is that they are very much stuck to concepts established within the homepage, because if they tried to change things for a client who didn’t want, who didn’t understand, who didn’t think that their clients would understand it, then they would be pushing it uphill and wouldn’t make the sale quite frankly...*
The following are examples from the interview transcripts that refer to the specific structures that facilitate meaning making that are contained within a multimodal interface.

**Navigation**

Whilst there was no consensus on what an overarching structure might look like when designing an interface using multiple modes, there was consensus on the need for an effective navigation framework, “You would want your navigation system to be pretty clear, easy to use, if you expect people to use it without problems” (Peter).

**Hierarchy**

Ryan commented on how he sees the role of hierarchy. For Ryan, hierarchy or the way that information is arranged and accessed was embodied in the practice of design and he talked about how he saw hierarchy and its relationship to the audience:

*Hierarchy plays a big role. The user needs to be able to figure out how to use it [the document], what’s most important. If there’s all these different things happening they need to see how it relates to each other and what the main focus of it is...So hierarchy plays a very important role in helping the viewer understand what is important.*

Within the notion of a unique hierarchy in multimedia design, comments referred to the non-linearity of how information is configured. Ryan suggested that a multimodal interface is:

*...more like a cloud shape than a straight line...the viewer can choose what they want to learn or where they want to go so they won’t lose interest but it might get dangerous because it might not get all the important information by doing so... If you follow a linear path you can systematically build on your prior and presented knowledge it sort of supports the learner in taking them through a process...*

**Colour**

Julian commented on the use of colour, “the focus is how the colours textures, background, type etc. come together and how all those things put together draws you into the layout.”

**Text and typography**

Drawing on textual features, such as puns, metaphors and alliteration, to carry a message was widespread. Comments were also noted around the importance of the use of text in all documents, the consensus being that it was the text that carried the message.
Typographic design is very, very important; the way the words are constructed and laid out, presented and the typefaces that are used and the colours and the sizes of the words compared with one another. It can all communicate meaning in different ways... (Peter)

Design functions associated with navigation structures, hierarchy, colour, text and typography united to create a certain architecture that facilitated meaning making and, importantly from a commercial perspective, fulfilled their purpose and created “buy-in” or prompted a “call to action” (Matt) from the targeted audience to persuade them to purchase a particular product or service.

**Practices of design use interactive features to engage and enhance the user experience of meaning making**

Designers did not talk about practices of design without mentioning interactivity. The following themes were synonymous with interactivity as described by the participants.

*The role of the user*

All participants redefined the role of the reader of a multimodal interface to that of “the user” who is able to remake the information to suit his/her own purposes and so become both the reader and the writer. This was seen as a powerful tool that design practice has in the context of multimodality, albeit one that designers were trying to manage to ensure the user made the “right” choices in relation to purchasing or being persuaded. As Bart suggested:

> A multimedia document depends inherently on the user. It will sit and wait until it is acted upon...the user is in control ...people can pick and choose and it makes the user part of the information. They can choose what happens and when and there is a certain level of self-determination.

*Degrees of interactivity*

Participants explained the different degrees of interactivity that were possible for different purposes. Peter commented:

> [We can] produce something that may be a static finished result or a flexible finished result in the sense that with a static finish you can interact with it but not change the basic structure or content or a flexible finished result in that it may be changed and altered by other people to add meaning to it or whatever.

*Interactivity and transience*

Three designers also mentioned the perceived ephemeral and superficial qualities of a multimodal message because of the flexibility of its content and structure. An example would the ability of a
user to interact and change the arrangement or content of the information for their own purposes. Julian commented, “Multimedia to me is about transience. Information or messages that are only meant for a certain time or context that is ‘for the moment’ as it were, whereas pen and paper messages have more of a permanent feel to them…”

Similarly, Brigitte said: “I think they [multimedia documents] often don’t have as much depth as printed material because on a screen we expect to spend less time absorbing information.”

All designers agreed that the ability to change and interact with a multimodal interface made possible a rearrangement or remix (Sheridan & Rowsell, 2010) of the information and digital resources to suit individual needs, identities and contexts.

**Linking Designer Knowledge with the Existing Literature on Multimodal Communication**

In review, existing literature tells us that multimodal technology-mediated communication affords various ways of producing and distributing information through multiple media and using multiple modes of meaning to reach an extended audience via online capabilities of technology. Setting it apart from communications developed using traditional pen and paper resources, is the ability to choose from a range of modes of meaning such as writing, viewing, listening or speaking and include the use of written, spoken, and visual resources such as photographs, animations, graphics, pictures, gestural, haptic (the way something feels to the touch) and aural resources. The facility to choose from more than one mode, referred to as multimodality (Cope & Kalantzis, 2000; Hull & Nelson, 2005; Kress, 2003; Kress & Van Leeuwen, 1996, 2001; Kress, Jewitt, Ogborn, & Tsatsarelis, 2001; Machin, 2007; The New London Group, 1996, 2000), enables meaning to be realised by all modes in many different ways (Jewitt, 2008).

Data suggested that for this group of professionals, meaning making involved design practices. Central to these design practices was the use of multimodal resources and their use was implicit within the more complex explanations of the work of a designer. They stated that communicating with multiple modes was more complex than using a single mode of meaning and required collaborative engagement with potential audiences.

Collaborating and interacting multimodally with diverse audiences in distance, time and culture is where the reader often in turn, becomes the writer, implies working together to create something that participants could not necessarily envision and create on their own. As Jenkins and colleagues (2013) suggested, access to diverse, global audiences has resulted in “fundamental shifts in the audience’s position” (p.159) enabling audience collaboration, interaction and manipulation of
meaning. Designers also talked of the need for appropriate dispositions towards problem solving; towards a culture of critical collaboration with peers; critical engagement with information sources and contexts where learners actively construct knowledge.

Helping learners actively construct knowledge is part of the transformative (Burnett et al., 2006) function of multimodal technology-mediated communication where technology use involves more than tool use which merely enhances existing communicative practices. Transformative knowledge can lead to a rethinking of understandings as the result of “…the negotiation of conflicting and complementary perspectives (Unsworth, 2001. P. 19). According to Unsworth (2001), it is transformative knowledge that leads to”… new understandings and the potential for social action (p, 19). Skills and knowledge around tool use are none-the-less, important and the need to maintain current knowledge about new software and hardware applications is a priority. Knowledge of relevant hardware and software was signalled as being important by the participants but they also suggested that this knowledge could be obtained relatively easily due to the high level of support for technology resources from their creators and other users.

Variously, researchers have detailed schema, both grammars and pedagogical approaches, describing ways of combining and positioning elements and modal properties in order make meaning. These include not only creating and interpreting what is physically represented but also demonstrating the interactive relationships that are fostered through user engagement and the way information is distributed. These schemas include the Visual Grammar approach (Kress & van Leeuwen 1996), Shape (Dillon & Vaughan, 1997) Design (The New London Group, 1996; 2000) and Learning by Design (Kalantzis & Cope, 2005). Designers suggested that their work involved specific orientations to making meaning and that combining and positioning elements and methods of utilising modal properties defined what they did and were measures of effectiveness, client satisfaction and commercial success. They suggested the presence of accepted designs, such as website structures used as templates for designing, but also spoke of the notion of ‘no rules’ in that multimodal technology provided endless possibilities for making meaning. As Hammerberg (2001) suggested in a seemingly limitless, global environment, almost anything that can be imagined can be represented and communicated to a worldwide audience.

The way teachers think about writing and adjust their practice and orientations to match new learning purposes and outcomes is the pedagogic dimension of supporting multimodal technology-mediated authoring. The pedagogic dimension to include multimodality involves the use of constructivist practices, overt instruction inclusive of systematic knowledge and student-centred tasks as suggested in seminal research presented by The New London Group (1996, 2000).
Designers reflected on the critical role played by having an appropriate disposition to design work. This disposition included having an interest in technology use and the motivation to enquire into practices and innovations that make technology use seamless. Also included in their practice are dispositions of problem solving, collaboration and critical engagement with information sources and contexts.

Designers negotiate meaning collectively within what Lave and Wenger (1991) and Wenger (1998) define as communities of practice as part of their social theory of learning. The practices and knowledge discussed by the designers consulted for this study were strongly connected with theory espoused in existing literature on multimodal communication and a social theory of learning. Although motivation and context for designer multimodal communicative practices differed to those explored in academic discourse, none-the-less practice in both contexts shared core understandings. Designers show, in a practical sense, what can be achieved within a culture of critical collaboration, interdisciplinary problem solving, integrating multimodal technology seamlessly into their practice and valuing knower dispositions as described in Legitimation Code Theory. In effect, these designers reflect what theories of learning using multimodal resources and methods look like put into practice.

Chapter Summary

Examination of the data collected in this phase of the study was aimed at interrogating further, the domain of the practice of design and to generalise how digital design practitioners understand creating an interface using multiple modes of meaning. The practice of design was explored with six practitioners around their understandings of multiple modes of meaning, interactivity, apposite skills and knowledge, and the unique structures that facilitate meaning making. Emerging from the data were four key findings emerging as themes that describe practices of design as:

1. Involving the use of online technology enabled multiple modes of meaning to realise communicative purposes.

2. Requiring a range of both traditional and digital knowledge, skills and associated dispositions.

3. Embodying specific features such as hierarchy of information, text and typography, navigation structures and the use of colour, that facilitate meaning

4. Using interactive features to engage and enhance the user experience of meaning making.
As expected, the majority of participants talked about the use of different modes of meaning as playing a role both individually and in combination with each other. More than one participant indicated that communicating with multiple modes sat within a very broad spectrum of the communication paradigm and that there were really “no rules” that supported the constructing of multimodal communications. Another participant, however, suggested that some designs are now accepted as standard and cited the homepage of a website as an example. There was consensus that describing what constitutes multimodal communications may be embedded in necessary dispositions such as collaboration and problem solving. The focus is then on designing meaningful interactive spaces as opposed to mastery of reproducing generic structures.

Participants were familiar with the notion of interactivity. It was accepted that in all texts, including those generated using pen and paper, interactivity is a process by which readers or users construct meaning. This happened through the combination of prior knowledge and previous experience, information in the text, and the stance the reader takes in relationship to the text. However, the interactivity referred to by the designers around constructing messages multimodally, went further than this largely cognitive and knowledge based interaction, to include the notion of users being able to, physically, change the multimodal communication by responding to and altering the content according to their meaning-making needs.

As mentioned, referring to the intended audience as “the user” of a multimodal communication implied and brought about a different role than that of “the reader” referred to in a traditional textual environment. Being a “user” of something implies specific engagement. The interactive nature of these communications makes the writing process more recursive than fixed for both the writer and the user. The ability and, increasingly, the expectation, of an intended audience to take an active role in the message delivery, including the ability to add to or change the message, means that they assume the role of both reader and writer. As Peter suggested, designers can facilitate a “static finished result or a flexible finished result in the sense that it may be changed and altered by themselves or other people in the future”. The flexible and highly contextualised properties of multimodal environments and the expectation of user input have implications for technology-mediated, multimodal authoring. Authors in this domain need specific knowledge around the processes, contexts and necessary dispositions in order to make decisions on how to structure communications.

All participants agreed that working with multiple modes draws on a range of knowledge and skills but, reflecting prior research, there was disagreement on whether these skills were different to those needed to create more traditional pen and paper documents. Noted are Peter’s comments
that the two disparate contexts of screen and paper required different skill sets, and the presentation of information required a different mind-set. As mentioned in the literature review, research offers support for both the need for “new” skills, most commonly associated with technology-mediated resources, to adapt to new literacies and, conversely, that “old” skills, commonly associated with textual environments, can easily be adapted to function within “new” literacy spaces. The reference by several designers to the importance of certain dispositions such as being interested in and motivated to use and innovate with technology, and dispositions that support problem solving and critical engagement with information sources, were acknowledged as important in practices of design.

Embodiments of engaging in the practice of design included aspects such as interactivity; notions of information hierarchy incorporating positioning, timing and presentation of information; the presence of links which can direct a user to another webpage; the use of colour and typography; the presence of a navigation framework; and the essentially visual nature of multimodal communications with minimal use of carefully considered textual resources. Understanding these features and the ways in which they support meaning-making have the potential to support the teaching and learning of multimodal authoring, including identifying the types and range of knowledge, skills and behaviours that students may demonstrate when creating multimodal communications.

All participants pointed out that the use of computer generated multimedia resources was pervasive in learning environments. These resources, and the ways in which they can be utilised, would continue to increase and develop in complexity. The majority signalled that using traditional textual resources such as pen and paper were an integral part of using multimedia resources and, for them, the initial stage of “mocking up” an idea was generated with those resources.

Essentially, the practices of design require a range of skills, knowledge and dispositions including the manipulation of various modes of meaning related to the writer’s purpose, organising information so that users relate to it in collaborative and interactive ways and responsiveness to the role that the user plays as both reader and writer. As suggested previously, it is likely that the fusion (Millard, 2003) of traditional textual practices and practices of design are necessary for effective engagement in creating online information spaces. Digital Designers valued knower code practices and although referred to the importance of knowing the capabilities and properties of technology, referred to the ready support available to extend expertise in this area. Even suggested by one designer, was the possibility of employing technical expertise to facilitate technology use. Arguably, digital designers
could be considered to have elite code knowledge practices but the bias towards knower code practices was evident in the data.

To support learners, teachers can adapt some of the practices of design and knowledge code practices described in this data, although with caution that not everything taken out of a commercial context can be successfully transplanted into the work of schools (Sheridan & Rowsell, 2010). However, to assist teachers and students to engage with the range of communication choices available when using multiple modes, it could be important to learn practices of design, ways of working and collaborating with others and subsequently, ways of assessing success based on these practices. To inform the design of multimodal communications, new ways of conceptualising and teaching writing are needed, including a body of knowledge that incorporates understandings of design to support and inform products and processes and encouraging the type of learner who prioritises and facilitates collaborative endeavours.

The Next Chapter

The next chapter describes a model of authoring supported by the creation of a body of content knowledge to support the teaching and learning of multimodal authoring. The development of this model and corpus of knowledge utilises data from both the digital designer and teacher participants to inform teaching and learning.
Chapter Seven: A Proposed Model of Authoring Using Multimodal Technology

Chapter Overview

In this chapter a model of authoring is proposed which uses the lens of technology-mediated multimodality and where multiple aspects of authoring are foregrounded. Although acknowledging that traditional texts are still highly valued, a way is suggested to move beyond the narrow construct of authoring as being “text” only, to a broader understanding of “texts” that include a fuller range of expression supported by multimodal resources.

Using the model, an argument is made for the development of content knowledge. This chapter outlines a unique, specialised body of content knowledge that informs the proposed model of technology-mediated multimodal authoring. A model of authoring outlining processes and the types of knowledge that would support multimodality is designed, specified and described in terms of how teachers understand the subjects they teach and in a way that is useful for teachers to support the development of professional knowledge and skills that inform the teaching and learning of writing.

The content knowledge described is consistent with Shulman’s (1987) seminal research on teacher knowledge and is discussed and framed within the specific context of multimodal authoring that requires different types of knowledge to inform teaching practice. The types of knowledge are described using the framework of the four knowledge dimensions (de Jong & Ferguson-Hessler, 1996) of conceptual, strategic, procedural and situational knowledge. Together, these dimensions form an amalgam of essential understandings that support teacher practice and inform theory for the proposed model.

The model of authoring reflects the dynamic and evolving nature and the complex decision making involved using multimodality across a range of contexts. A comparison is made between traditional approaches to teaching writing and those required to author multimodally in order to illustrate different foci. An example to illustrate both the use of the proposed model and the supporting knowledge required in multimodal authoring is concretised using a “persuasive writing” scenario.

Consistent with other research (Howard & Maton, 2011), the participants of the current study who were teachers could describe a range of surface features that either inhibited or contributed to technology integration that supports multimodal authoring, such as the content and structure of curricula, and access to resources and appropriate professional learning opportunities. However, there was reduced capability to actually realise improved teaching and learning multimodal
authoring. The building of both a body of subject content knowledge and a model of authoring that reflects technology use are starting points, contributions towards developing a range of tools that can, over time, address some of the concerns highlighted by the teacher participants in this study regarding how multimodal authoring is produced and consequently assessed. It may also assist in analysis and review of progress in addressing the needs of students and teachers negotiating the domain of teaching and learning multimodal authoring.

The chapter concludes with a review and summary that gives a clearer sense of the categories of content knowledge that may support a model to inform teaching and learning of multimodal authoring.

Developing Content Knowledge: Identifying relevant forms and dimensions of technology use and knowledge practices in the teaching and learning of multimodal authoring.

The importance of the role of the teacher in mediating learning is a fundamental one. Traditionally, in order to be effective, teachers were expected to be proficient in two areas. First, they needed to be proficient in content knowledge where they were expected to know whatever subject content is described in the curriculum in addition to extended study in that subject area at tertiary level. Second, they needed to be able to teach that subject. Turning first to content knowledge, this is understood to be teachers’ practical understandings of a subject in the context of the work they do, integrating their experiential knowledge, formal knowledge and their personal beliefs (Van Driel, Beijaard, & Verloop, 2001). Capability in terms of how teachers understand the subjects they teach is one of Hattie’s (2003) descriptors as part of his proposed dimensions of excellent teachers.

For most subjects, a distinct, well-established body of content knowledge, developed over time, underpins teaching and learning. Largely accepted is that teachers are familiar with the content that informs teaching of any given subject. Often the content remains unchanged from their personal education experiences as students. However, for learning in the area of multimodal authoring, a body of content knowledge has not yet been experienced by teachers as learners, collectively negotiated or even encountered in their own teacher training, to the degree of there being wide acceptance and agreement of the features of products and processes. Accepting Hattie’s (2003) position that it is what teachers know and do across the board in teaching that has significant impact on children’s learning, the role of what teachers know, conceptualised as content knowledge (Ball, Thames, & Phelps, 2008; Shulman, 1987), is of significant interest to this research.

Essential representations in any given subject are a representation of society’s valued knowledge in the area. Valued knowledge is articulated for use through curricula as subject content. As reported
in Chapter 4, teacher participants indicated that existing curriculum orientations in writing still favoured content and methods related to the textual mode. Some participants were happy with this, but others saw a curriculum orientation to traditional methods as problematic and suggested that subject content in writing needed to be addressed to incorporate technology-mediated multiple modes of meaning if multimodal authoring was to become embedded in school curricula (John & Sutherland, 2005). Comments were that, despite improved resourcing of technology to support multimodal authoring and high societal expectation for its use in schools, little guidance exists as to how this expectation can be translated into practice.

Boyle (2002) suggested that establishing a “systematic, unified knowledge base” (p. 13) to enable the construction of multimedia contexts for multimodal authoring is a significant challenge. This is because of the complexity of the resources and processes involved in meaning multimodally and the constant evolution of hardware and software. Content knowledge in this area of teaching and learning is not well understood nor well described in the literature. Notably, for example, amongst teacher participants, was an absence of a rudimentary language that would allow description and discussion of the products and processes of multimodal authoring. Having no clear understanding of content knowledge is highly problematic for teachers and leads to low levels of professional confidence in terms of knowing what learning should be demonstrated and, consequently, what should form a basis for teaching, evaluation and assessment. Fundamentally, teachers need clarity around what they need to know in order to teach multimodal authoring.

Also, teachers were expected to know how to teach the specific subject knowledge that informs a particular field. Hattie (2003) further suggests that excellent teachers can not only identify essential representations of their subject, but also recognise the learning needs of their students and have the pedagogical knowledge to know how best to address those needs. The partnering of content knowledge and pedagogical understanding is a crucial building block in developing teaching capability. Content knowledge must be partnered with pedagogical understanding and skill, such as effective forms of representing an idea, for content knowledge to serve the purpose of conveying knowledge and the structures of a particular discipline (Shulman, 1987). Shulman referred to this partnership as “pedagogical content knowledge”, a concept bridging the practice of teaching and relevant content. According to the data in this study, both relevant pedagogy and content knowledge are insufficiently articulated and shared to be useful to participants in teaching and learning multimodal authoring. A specific focus on pedagogy, although important, is not the aim of this section. Rather the focus is to outline the absence of relevant content knowledge amongst teachers related to multimodal authoring and then seek to address it. In order for technology to be included in learning, it must be incorporated into teacher practice, which includes teacher subject
content knowledge and pedagogical understandings to act as filters to guide planning, practice and review (John & Sutherland, 2005).

Consistent with other research (Howard & Maton, 2011), participants of the current study could describe a range of surface features that either inhibited or contributed to technology integration, such as the content and structure of curricula, resourcing and access to appropriate professional learning opportunities. However, there was limited capability to actually realise improved teaching and learning in the case of multimodal authoring.

Teachers suggested that the type of content knowledge need to inform technology-mediated multimodal authoring was multidimensional and dependent upon the interplay of different related knowledge structures. Therefore, there was a need for different types of content knowledge, describing different dimensions, to inform their practice in this area. For example, teacher participants commented on a lack of technical knowledge of resources and their functioning; of theory that informed technology use; of how information was organised using digital resources and processes; of rules that govern its use; and of ways of assessing and measuring learners’ progress.

Data reported in Chapter 5 indicated teacher professional learning as needing to encompass several different aims. Drawing on de Jong and Ferguson-Hessler’s (1996) framework and applying it to multimodal authoring, these aims are: conceptual understandings of authoring using multiple modes of meaning; situational knowledge of the representational affordances and capabilities of technology relevant to authoring, including knowledge of ways of witnessing and measuring how multimodal authoring impacts on student learning; procedural knowledge of how tools and resources work; and strategic knowledge and approaches to discussing and sharing with colleagues through the conduit of a shared language. The presence of such knowledge would support explicit teaching, learning and evaluation of multimodal authoring in order to inform student learning. In defining and illustrating specialised content knowledge, the four knowledge dimensions of de Jong and Ferguson-Hessler (1996) will be used as a framework (see Figure 7).
Four important knowledge dimensions are proposed, that of conceptual, situational, procedural and strategic knowledge, which form the basis of specialised content knowledge (see Figure 7) having value, potentially, not only in developing content knowledge in this specific area, but also in cross curricular contexts. In turn, these knowledge dimensions applied to multimodal authoring, support and enhance student actions of what I am calling “creation”, “mediation” and “dissemination” of information for the model of authoring examined through the lens of technology mediation that I am proposing. Each of the knowledge dimensions and actions in the model needs to be understood within the context of, and supported by, specific acts of teaching, and the dimensions are described as explicit but linked components. What is proposed is a depiction of the types of specialised content knowledge and how teachers need to know about the specialised content knowledge that may assist them to support teaching and learning of multimodal authoring. The description of knowledge is not a detailed description of facts per se nor suggestive of a hierarchy nor intended to be an inclusive
list, but is intended as a contribution to developing confidence in both teachers and students in multimodal authoring within the broader context of digital communication (Merchant, 2007).

Knowledge dimensions of content knowledge to inform multimodal authoring

*Conceptual knowledge* encompasses fundamental understanding of the principles, ideas and theories that inform a certain domain. In this instance, authoring is informed by theories from the cognitive, linguistic and rhetorical fields, and writing using multiple modes additionally draws on the fields of technology, learning theory and design. Together, these help to conceptualise multimodal technology-mediated authoring.

From a general literacy perspective, the use of technology and socially mediated communications is largely underpinned by research drawn from the New Literacy Studies (The New London Group, 1996, 2000) movement. This supports an approach to literacy and literacy learning determined by social, cultural, historical and political contexts of the community in which it is used, as opposed to a set of discrete technical skills (often referred to as “skill and drill”), associated with reading and writing. This theoretical positioning is considered fundamental to literate practices that are mediated by multimodal, internet-capable technology.

In terms of multimodal technology use and formal learning, the main theoretical rationale drawn on is Mayer’s Theory of Multimedia Learning (2001, 2005). This theory suggested that processing information and active learning includes the use of dual channels for 1) visual/pictorial and 2) auditory/verbal information, with each channel having limited capacity for processing. Combining modalities supports integration without overloading cognitive resources. Mayer posits that active learning requires coordinating five identified cognitive processes during learning: 1) selecting relevant words, 2) selecting relevant images, 3) organising words coherently, 4) organising selected images into a coherent representation, and 5) integrating the pictorial and verbal representations and prior knowledge. Mayer suggested that creating and designing using multiple modes should be informed by these processes. For the purposes of this research, Mayer’s Theory of Multimedia Learning illuminates the core difference between traditional writing, using a single mode of representation, and the possibilities of writing using multiple modes.

For the purposes of this research, valued learning in this area is informed by Howard and Maton’s (2011) theorising of knowledge practices in writing, where the types of knowledge valued using textual resources (as opposed to technology-mediated multimodal resources) are foregrounded. In the early years of schooling at least, writing has a knowledge code orientation where mastery of specialised knowledge, principles and procedures supports progress and exemplifies achievement.
Situational knowledge about settings, conditions, situations and circumstances is specific to, and operates within, a certain domain. Within the domain of multimodal authoring, situational knowledge incorporates features such as modal affordances that work together to influence meaning making. Modal affordances are the features of a mode that can be manipulated to enhance meaning making. For example, when using the textual mode, features of typography, colour and font size can be utilised for different purposes and effects. Another example is the use of interactive and collaborative tools and features to enhance meaning making. Situational knowledge related to multimodal authoring is significantly more complex than that associated with traditional textual practices.

Procedural knowledge is knowledge about processes, procedures and rules that apply in a certain domain. This includes knowledge of relevant hardware and software and how to gain and develop that knowledge in order to manipulate them to meet user needs. Teacher participants in this study prioritised procedural knowledge as essential understandings (like managing, understanding structuring, and making meaning using a website) that would support the teaching and learning of technology-mediated writing. Procedural knowledge is updated constantly as both the range and function of technologies expand.

Strategic knowledge, including aspects of rhetorical knowledge, informs decision-making and requires understanding of the organisation and interpretation of knowledge and information within the domains that society values. Strategic knowledge, in particular, needs a combination of all the different aspects of knowledge in order to be able to collaborate with others and problem solve. It includes having a shared language and discourse specific to this domain that facilitates such things as planning and problem solving with others. Within such a language corpus, terms that describe the nature and quality of multimodal texts and related processes of development have already been stated as an essential requirement. In addition, strategic knowledge includes learning about technologies and how they change the way, knowledge is structured and represented, in addition to learning with technologies where technology is used primarily as a tool.

As well as supporting decision-making, strategic knowledge helps to interpret learning and progress. Strategic knowledge also includes certain dispositions or ways of thinking necessary, together with technical knowledge and skills, to participate, for example, in the practices of design. Dispositions were described by digital design participants as including having an interest in technology use and having the motivation to enquire into practices and innovations. Several designers saw the presence of appropriate dispositions, related to design and technology use, as critical to successful participation.
Further, included in the notion of dispositions and mooted by several of the participants, was the importance of a disposition towards problem solving, a readiness to engage in a culture of critical collaboration with peers, and a critical engagement with information sources and contexts. All designers talked of being cognisant of who their intended audience was, and the needs of that particular audience in terms of, for example, cultural norms and communication purpose.

As suggested, each of the four types of knowledge described is not intended to form any particular hierarchy or order of importance but, rather, each exists in a manner that interrelates and is flexible enough to respond to different learning contexts. The description of each suggested dimension of knowledge is intended to situate it within the general category of content knowledge for teaching technology-mediated authoring. However, this does not address fully, the specific dimensions of undertaking and completing a technology-mediated multimodal authoring task, including assessment criteria that can be applied to the processes, content and final product. A body of knowledge is an important part of developing teacher capability and situates content knowledge alongside other aspects of teacher professional knowledge, including pedagogical knowledge. An example of the process of completing a technology-mediated multimodal authoring task is presented later in this chapter in an attempt to exemplify a usable body of professional knowledge in this subject area.

Towards a Model of Multimodal Authoring

Content knowledge, framed around conceptual, situational, procedural and strategic understandings, will now be used to inform a model of writing. This model proposes information about the filtering process students could engage with in order to complete a multimodal authoring task. Although in formal learning it is the teacher who sets the task, the model includes potential for students to develop confidence and competence in the skills, knowledge and understanding of multimodal authorship, offering a structure to develop independent enquiry.

This model attempts to capture the relationship between each of three aspects of writing, namely, creation, mediation and dissemination. Each stage is recursive, demonstrating a shift in emphasis from the fixed to the fluid, where actions of communicating are not necessarily limited to any particular stage. Texts can be revised, updated or added to. Although it is likely that writing would be a common element at each stage of the process, information can be multimodal, non-linear and constructed collaboratively with multiple participants whose roles as readers and writers overlap. As Merchant (2007) suggested such a model allows for widespread publication and the sense of synchronous engagement beyond the classroom.
This model supports students being involved in defining tasks or questions and accessing information, knowledge and expertise to support multimodal writing. Information is sought, analysed and re-contextualised in order to effect communication. Students make choices about content and format that is appropriate for their chosen audience and how to create opportunities for contextualised interaction and collaboration. They will also think about how their use of technology shapes the sort of message they are able to communicate.

This theoretical model (see Figure 8) reflects a knowledge code where content knowledge relates to multimodal authoring and a bias towards the more open-ended knower code practices of technological environments that, for example, typify those in which digital designers operate. It is also recognition that writing using digital tools can be quite different to using traditional tools despite the tendency for some teachers to use technology as an add-on to support traditional practices (Merchant, 2007). The setting within which students write using this model requires the author and, importantly, the teacher, to have knowledge of modal affordances, capability with the technical procedures of using multiple modes, and ways of keeping pace with technological advancements.

**Figure 8. Towards a model that supports multimodal authoring**

At the *creation* stage, the author considers the purpose, audience and type of communication and related strategies to achieve these. All designers talked of being cognisant of who their intended audience was, and the needs of that particular audience in terms of, for example, cultural norms and the purpose for designing. At this stage, the author/reader relationship is considered as more than just the student and teacher, it is viewed in terms of audiences that extend beyond the classroom.
The level of audience interaction sought and the degrees of interactivity identified as fitting the purpose of the communication are considered. In creating the communication, the author considers such things as the effects of transferring the communication from one medium or site to the next. Designer participant Bart described this stage as one where “an understanding of people and an understanding of who your audience is and an understanding of how they read, how they look and how they use” is central.

During the mediation process, consideration is given to the best mode (visual, textual, sound) or combination of medium (iPads, mobile devices) and forum (website, wiki, blog) that will suit the purposes of the communication. As the data from the designers suggested, the choice of modes is made in order to accomplish a specific communicative purpose. In this phase, a skill set that combines knowledge of both traditional and digital skills that facilitate technology-mediated authoring is necessary. As discussed by the design participants, the skill set includes an understanding of how text works in the context of screen-based communication and includes design considerations such as information hierarchy, navigational structures, use of colour and typography, and decisions about and allowances for the level of interactivity and audience participation at various points. Also, necessary at this stage, is relevant knowledge of technology such as Web 3.0 products and processes supported by dispositions such as collaboration and problem solving. For example, when deciding on specific resources to mediate a certain communication, a decision to seek feedback or user contribution and collaboration would dictate the mediation platform and structure of the communication. So, if an author wanted feedback and the opportunity to collaborate with others he/she may use Google Docs or screen sharing tools like Join.me.

In the dissemination process, there are considerations of disseminating the communication, that is how a communication reaches the audience, and further authoring and transferring of the communication from one medium to another. In the data, design participants referred to the pivotal stage of disseminating a communication to the intended audience or “user” who is able to remake the information to suit his/her own purposes. If the information is re-formed, it may be used for further authoring purposes or feedback and response may be given to the author. This re-formatting and feedback may lead the author back to the creation and mediation stages to reframe the communication as it evolves and additional contextual criteria and properties become apparent. Therefore, the dissemination process and its proposed relationship with the creation process is the unique feature of this authoring model.

The recursive nature of the model allows for decision making to be extended to include, for example, content-related decisions at the creation stage, design decisions at the mediation stage...
and delivery decisions at the dissemination stage, as well as a consideration of how each of these decisions impacts on meaning making. The acquisition of multimodal composing skills at each of the three stages of creation, mediation and dissemination is seen as recursive and informative (Whithaus, 2005). As a result of feedback the author may have received, either in person or from an online contact, the author may return to a prior stage or move on to the next. For example, an author may receive a “post” from an online participant that the communication could be enhanced with a music clip. This causes the author to go back and edit the communication. Each phase of the process can occur concurrently and with equal emphasis. Creation and mediation could, and often do, take place simultaneously where a response is made and designed at the same time. The model represented in Figure 8 allows for the relationship between the author and the reader or, more accurately, the creator and the user, to include both as knowledge producers.

A model of authoring, as described, is in contrast to the more traditional emphasis in the authoring process, which is, arguably, a linear process. A traditional authoring task is often seen as finite and occurring within the narrow student/teacher relationship, often without the possibility of situating the task within an authentic context. The majority of time is spent in the creation stage, with less consideration of purpose, audience and relating the subject matter to the real world. In technology-mediated communications, however, due to the nature of technology, the possibility of an audience beyond the classroom is an ever present consideration. There are, arguably, some similarities in the proposed model of writing to the Cognitive Process Model proposed by Flower and Hayes (1981), where the intention was to portray a similarly recursive process. However, this is where the similarity ends as, clearly, with interactivity, authoring becomes a socially constructed process rather than a predominantly cognitive one. Although the intention is for a process to be recursive, often its manifestation is a linear one due to the focus of the teacher as the audience and the purpose of fulfilling, through the writing, narrow assessment goals. The proposed model has inherent potential to be recursive because of the flexible properties of multimedia with a “real-life” audience and purpose.

As with any theoretical model, the capacity of my model of multimodal authoring to generalise across contexts is dependent on identifying and utilising its inherent generic properties. Within the framework of Legitimation Code Theory, a body of content knowledge, as for example outlined earlier in this chapter using de Jong and Fergusson-Hessler’s (1996) dimensions of knowledge, provides a basis for knowledge code practices that, in the early years of schooling, typify authoring practices. According to Howard and Maton (2011), content knowledge that characterises knowledge code practices can then be supported by knower code practices consistent with the use of multimodal technology. The proposed model of authoring potentially brings knowledge code
practices, informed by appropriate content knowledge, into relationship with the knower code practices synonymous with technology use.

**Teaching of Multimodal Authoring: An example using a piece of expository writing**

An example is offered of using the knowledge dimensions of de Jong and Ferguson-Hessler (1996) to frame content knowledge that would support a model of writing that includes the use of multimodal resources. Conceptually, any communication that is mediated using multiple modes, is informed by theory that supports using more than one mode to make meaning, the socially situated nature of literacy, and the importance of the process and outcomes as equal partners.

The following illustration is based on a typical authoring task a student in a primary school may be asked to complete, that of a piece of expository text arguing a position, also known as persuasive writing. Relevant to this choice also, is that data gathered from participant designers suggested expository structures as being their main communicative tool for creating an advertisement to market or sell a product. In the following illustration, some processes could be the same using both textual resources and multimodal resources and it is important to note that the two platforms are not mutually exclusive but, arguably, complementary. The topic, for the purposes of this illustration, is “Cell phones should be allowed at school.” This example (see Tables 8, 9 & 10) is adapted from a decision-making matrix developed by Bull and Anstey (2005).

Arguing a position is based on the assumption that the author must convince the reader of the writer’s opinion by presenting relevant and compelling evidence to support a claim and to refute likely counter-claims. For the purposes of this illustration, there is an assumption that the process of arguing a position, of persuading a reader to the author’s point of view, is a familiar task to teachers and students. Capability in arguing a position is required in most English curricula in the western world. Generic elements of expository writing include creating a position statement, making and elaborating the main points of the argument and presenting information to support the writer’s position logically. Also, expository writing contains persuasive and emotive features in order to strengthen the argument. Table 8 proposes examples of the types of knowledge, resources and processes needed at the initial stage – creation - of an expository text.
Table 8. Examples of knowledge, resources and processes needed at the initial stage of creating an expository text

<table>
<thead>
<tr>
<th>Stage</th>
<th>Creation: Gathering information and deciding on how to present a structured and logical sequence of information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purpose</td>
<td>To argue a position or persuade a reader to the writer’s point of view that cell phones should be allowed at school</td>
</tr>
<tr>
<td>Audience</td>
<td>Students 8–16 years old, their parents, teachers, caregivers, school management</td>
</tr>
<tr>
<td>Resources</td>
<td>Information about cell phone ownership and cell phone use Video clips, still shots, animations, text related to cell phone use Information on constructing a blog, wiki, webpage, petition, YouTube clip Existing blogs, wikis, webpages, petitions to learn about their development</td>
</tr>
<tr>
<td>Design</td>
<td>Identify layout and ways in which modal resources may be used including ways feedback and collaboration will be sought. Visual: for example, still shots, video clips, animations Audio: for example, sound effects, oral commentary Textual: for example, written information, headings, sub headings, font size and colour, placement of text on the page</td>
</tr>
<tr>
<td>Types of knowledge</td>
<td>Procedural: managing and working with resources Situational: working with modal affordances and aspects of design Strategic: understand how information is organised and interpreted using multiple modes Conceptual: learning using multimodality</td>
</tr>
</tbody>
</table>

Within the context of a multimodal, online platform, specific decisions will be made at the creation stage of planning, informed by situational knowledge about design. Design choices include selecting those modes and their affordances that best work together to support the nature of the argument. For example, a video clip could support a “live” demonstration of a point or a position; a blog site could exemplify popular opinion that reinforces the writer’s position. Design choices also include strategic knowledge of how the relationships between different media and the audience will affect meaning making. Therefore, the argument needs to be named, described and generalised with these considerations in mind. These decisions are often revised and redesigned as the purpose and content evolve and become clearer. Re-contextualising and redesigning processes are supported by the cyclical nature of the proposed model of authoring.

The next stage - mediation - involves choosing the type of media, medium and forum to communicate the author’s purpose effectively. Table 9 proposes examples of the types of knowledge, resources and processes needed at the mediation stage of creating an expository text.
Table 9. Examples of knowledge, resources and processes needed at the mediation stage of creating an expository text.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Mediation: Choosing types of media to present information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purpose</td>
<td>To select types of media, medium and settings that will work together effectively to have maximum impact to persuade the reader that cell phones should be allowed at school</td>
</tr>
<tr>
<td>Audience</td>
<td>Students 8–16 years old, their parents, teachers and caregivers</td>
</tr>
<tr>
<td>Resources</td>
<td>Selecting appropriate software and templates for organising information Instructions on, for example, designing animations, using audio, moving and still images Mobile and fixed hardware to effect information organisation</td>
</tr>
<tr>
<td>Design</td>
<td>Foregrounding the most important pieces of information using typography, colour, information hierarchy, and placement and navigation features ensuring balance and coherence. Layout of information must link all modes together. All features of information presentation must be meaningful. Consideration of the unique context of meaning making using a screen.</td>
</tr>
<tr>
<td>Types of Knowledge</td>
<td>Procedural: Knowledge of creating and making meaning with constructions such as websites, blogs, wikis Situational: Identifying which mode, forum and medium will be used for what purposes. For example, the visual mode may present most of the information with textual resources playing a lesser role in meaning making. Audio resources may convey the main points of the argument through “mood music” or sound effects. Website may be chosen over blog and cell phone chosen over laptop for reasons specifically related to audience and purpose Strategic: Using appropriate terminology, technology and choosing target audiences Conceptual: Understand the types of responses sought and tailoring resources appropriately</td>
</tr>
</tbody>
</table>

At the mediation stage, decisions are further examined as to media choices and ways in which media will be utilised in terms of communicating the main points of an argument. For example, situational knowledge of how modal affordances work together, video clips supported by music or still images supported by text, along with strategic knowledge about modes that support objectivity and the dissemination of facts, are employed to have optimal impact on the reader. The mediation stage also includes procedural knowledge about managing meaning-making structures such as websites, blogs or wikis and resources needed to build them.

The next stage is dissemination - disseminating the communication in the most effective way possible. Table 10 proposes examples of the types of knowledge, resources and processes needed to distribute the information to the target audience using appropriate technologies.
Table 10. Examples of knowledge, resources and processes needed at the dissemination stage of creating an expository text

<table>
<thead>
<tr>
<th>Stage</th>
<th>Dissemination: Distributing the information to the target audience using appropriate technologies (paper, live, electronic)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purpose</td>
<td>To distribute information via multimodal technology and communicate with the target audience effectively with allowances for monitoring and feedback</td>
</tr>
<tr>
<td>Audience</td>
<td>Students 8–16 years old, their parents, teachers and caregivers</td>
</tr>
<tr>
<td>Resources</td>
<td>Mobile and fixed hardware connected to the internet. Software resourcing as detailed in the first two stages</td>
</tr>
<tr>
<td>Design</td>
<td>Strategies to enable readers of the text to also become designers of the text through feedback and interaction</td>
</tr>
<tr>
<td></td>
<td>Review design decisions in response to feedback</td>
</tr>
<tr>
<td>Types of Knowledge</td>
<td>Procedural: knowledge of hardware, both mobile and fixed, and Web 3.0 applications to enhance and update communication structures</td>
</tr>
<tr>
<td></td>
<td>Situational: adapting design features in response to feedback and collaboration</td>
</tr>
<tr>
<td></td>
<td>Strategic: to enable development of appropriate dispositions and language for participation in technology mediated authoring. Collective knowledge creation, knowledge building and response strategies</td>
</tr>
<tr>
<td></td>
<td>Conceptual: on-going development and extension of information and feedback</td>
</tr>
</tbody>
</table>

The purpose at the dissemination stage of this model of authoring is to make the communication available to the target audience as effectively as possible. It is also an important stage in terms of learning about technologies rather than just learning with technology. Learning about technologies includes developing the ability to think critically in terms of the information and knowledge authors are both receiving and creating, for and from their audience. The availability of networked, multiple modes will move this expository task beyond a traditional, text-dominated structure with a limited teacher or class audience, to one potentially reaching multiple, widely dispersed and diverse readers. Strategic knowledge is therefore needed at this stage to share, build knowledge and collaborate with others to support distribution and interaction. This process includes choosing modes of dissemination that suit a particular argument. For example, a short video clip to be disseminated via social media sites or a tweet could be a more effective and appropriate way to communicate and reach more people than producing a leaflet for a community notice board. Social media sites are places where people go for entertainment and to interact with others and therefore are more likely to promote engagement around a topical issue than a leaflet pinned to a noticeboard. The dissemination stage of the proposed model of authoring highlights two of the biggest changes that the use of internet capable multimodal resources bring to authoring purpose. The first change is the shift from writing for a single audience, such as the teacher, to authoring for an almost unlimited audience via the World Wide Web. The second change is the ability of that audience to collaborate actively with the author.
For teachers, in a traditional piece of persuasive writing, observing and recognising the everyday assignments of their students usually focuses on structural and language features against which student progress is measured. In digital environments, additionally, there is a change of emphasis to, for example, a focus on design, choice of platform and interactive possibilities. Different strategic knowledge underpinning multimodal communications requires the ability to recognise the characteristics of student writing including errors or areas of weakness, provide generative feedback, and feed forward. It requires critical engagement from teachers related to ways of recognising the level at which their students operate when arguing a position using multimodal resources, including recognising and analysing student errors and how to improve learning. It also requires different criteria for observation and evaluation in order to undertake analysis.

A multimodal authored expository piece, therefore, would look and function in a fundamentally different way to a model of traditional text-based communication. The process has different components, including specific terms, language, and milestones, and it has ultimately different outcomes than the traditional teacher/pupil communication based on priorities that are mainly textual.

**Theoretical and Empirical Perspectives on the Proposed Model of Multimodal Authoring**

Using multiple modes of meaning is not a new phenomenon. What is new however, are the affordances of the internet capable multimodal technologies that permeate today’s communication practices. The proposed model of authoring and knowledge dimensions to inform multimodal authoring draws upon a range of theoretical and empirical perspectives.

Situational Knowledge, defined as a knowledge dimension where developing ability to manage and work with context-specific properties is foregrounded, addresses an important feature of multimodal authoring namely, the importance of the context, particularly the social context, of in which communication takes place. Bearne (2009a) for example, details a model of what progress in multimodal authoring looks like. One component she describes as critical is that of context. The context of the communication has a significant impact on the choice of mode which in turn must reflect the content, purpose and audience that will best communicate meaning. This is in contrast to more traditional forms of authoring where the context has been largely a print based one and success has been measured on knowledge of decontextualized practices.

Situational knowledge includes ways of combining and positioning elements and modal properties in order make meaning. As mentioned previously the Visual Grammar approach (Kress & van Leeuwen
1996), Shape (Dillon & Vaughan, 1997) Design (The New London Group, 1996; 2000) and Learning by Design (Kalantzis & Cope, 2005) have been developed to describe ways of combining and positioning elements and modal properties in order make meaning. “Learning by Design” is a learning mediation and planning tool developed by Kalantzis and Cope (2005, 2010) with the intention of addressing the changing literacy needs of learners. Teachers as designers of learning and students as designers of meaning, both, are encouraged to think explicitly about the most appropriate range and sequence of learning activities and meaning making for their particular audiences.

The purposes and boundaries of making meaning are understood within a given sociocultural domain (O’Brien & Scharber, 2008) where ways of making meaning depend upon the accepted practices and the unique motivations inherent in particular social contexts. This is particularly evident in contexts such as, social media, where accepted procedures and choices of mode and language are part of membership practices. Multimodal authoring is highly contextualised and requires situational knowledge of specific contexts in order to communicate effectively.

Procedural knowledge is specific knowledge about processes, procedures and rules that apply in a certain domain. The New London Group (1996; 2000) discuss the importance in “A Pedagogy of Multiliteracies” of what they term as Overt Instruction. Overt Instruction provides learners with explicit and timely information about process and content in a way that enhances and extends their learning. Teacher participants in this study prioritised procedural knowledge as essential understandings that would support the teaching and learning of multimodal authoring. The New London Group stresses that Overt Instruction does not reinforce the memorisation of drills and procedures that have traditionally populated evaluation and assessment practices, rather instruction that helps the learner develop an awareness and agency over their learning.

Strategic knowledge, including aspects of rhetorical knowledge, informs decision-making and requires understanding of the organisation and interpretation of knowledge and information within the domains that society values. The schema of Visual Grammar, Shape and Learning By Design include not only creating and interpreting what is physically represented but also representing the interactive relationships that are fostered through user engagement and the way information is distributed.

Conceptual knowledge encompasses fundamental understanding of the principles, ideas and theories that inform a certain domain. Similarly, Unsworth (2001) suggests the notion of systematic knowledge in his framework of pedagogic practices. Systematic knowledge includes learning within a particular content area about that content area’s fundamental theories and models which help
explain why things exist how they do as well as the potential to change or challenge existing phenomena.

The proposed three stage model of multimodal authoring presents a recursive model where authoring becomes a socially constructed process recursive with a “real-life” audience and purpose rather than a cognitive one. It reflects a particular attention to identity and making meaning within and across social contexts using multiple modes of meaning. This is in contrast to, for example, the study skills model (Lea & Street, 2006) and Cognitive process Model (Flower & Hayes, 1981), which sees writing and literacy as primarily an individual and cognitive skill. Both of these models concerned with the use of written language at the surface level, and concentrates upon teaching students formal features of language; for example, sentence structure, grammar, and punctuation.

Unsworth (2001) also proposes a cyclical writing framework within a Literacy Development Cycle (LDC). He proposes strategies and implementation steps including modelled, guided and independent practice culminating in being available to the intended audience through publishing either digitally or in hard copy. However this model does not explicitly make allowance for audience engagement that would accommodate change or redesign as a result of that engagement.

The model I propose views the multimodal authoring of students as requiring a changed relationship with the audience. In shaping the intentions of the author through images and words and constructing links, “the writer defines the reader’s possibilities for interaction and navigation” (Whithaus, 2005, pp. 151–152). Noting the changed reader and author relationship, data from digital designers included references to the audience as being the “user”, particularly in terms of interacting with the author and other users. The term “user” implies a heightened role in meaning making than that of the traditional consumer of information, the “reader”. Therefore, in conceptualising the multimodal authoring of students, the nature and unique communicative needs of a particular audience requires significantly more consideration. Multiple choices and opportunities are available in a multimodal, online environment for audience engagement. This is in contrast to more traditional writing foci, where the range and nature of choices and opportunities are considerably less.

**Chapter Summary**

This chapter has explored the role of content knowledge in the work that writing teachers do and described a specialised body of content knowledge that describes the types of knowledge necessary to inform the domain of teaching and learning multimodal authoring. The suggested body of content knowledge was then used to construct a model of authoring that purposively scaffolds and responds
to the unique and dynamic environment of multimodal, internet capable digital technology. As Unsworth (2008) suggested most teachers benefit from specific guidance on literacy teaching and learning opportunities afforded by technology. Both the body of content knowledge and proposed model of authoring are offered as an example of specific guidance, a contribution towards enabling a better understanding of the evolving domain of multimodal authoring. Although aware of other complementary frameworks such as those offered by Learning by Design (Kalantzis & Cope, 2005) and work by Bull and Anstey (2010), the aim was to refine understandings of teaching technology-mediated authoring in line with the ideas expressed by the participants of this study.

A description of what constitutes content knowledge was informed by Shulman’s (1987) description of knowledge of the subject and its organising structures. Further, types of content knowledge necessary to inform teaching and learning were articulated using the knowledge dimensions of de Jong and Ferguson-Hessler’s model (1996) of conceptual, situational, procedural and strategic knowledge. Each of these dimensions was defined and described in relation to the development of a body of content knowledge to inform technology-mediated, multimodal student authoring. De Jong and Ferguson-Hessler’s model emphasised the types of content knowledge needed and how teachers need to understand it to assist teaching and learning of technology mediated authoring, as opposed to describing specific knowledge per se.

An account of how types of content knowledge could support student technology-mediated authoring was described using the example of expository writing. The understanding of literacy presented was social and situated, mediated by multimodal technology with particular emphasis on audiences that extend beyond the classroom. Decisions related to the design and to audience were articulated and linked to the potential teacher knowledge and understanding, particularly related to providing feedback and feed forward to their students and improving student learning. Also, the need for skills related to many purely procedural and technical tasks, such as networking systems, and structuring meaning within frameworks, such as websites and wikis, was discussed.

A model of authoring was described that was characterised by three equally important, cyclical aspects compared with the, arguably, more unevenly distributed emphasis of authoring in a more traditional model. The proposed model, with similarities to the Cognitive Process Model proposed by Flower and Hayes (1981), accounts for the transposable role of author and reader when using multiple modes in an online environment where audience feedback is pervasive.

Existing practices in the teaching and learning of writing still lean heavily towards creating print-based texts. This remains prevalent, even in technology-mediated authoring. While there has been a call for different approaches that allow multimodality, these texts are still “expected to function
within the paradigm of school influenced print based modes of literacy” (Whithaus, 2005, p. 139). Implementing a new model of authoring, with its accompanying theoretical underpinnings fostering a conceptual change, has significant implications for the model of teaching and learning of writing that currently operates within a predominantly finite set of traditional textual practices.

**The Next Chapter**

The final chapter summarises the findings from the research and discusses the associated implications of the results. Future research directions are suggested and the contribution of the current research to the field of inquiry is articulated.
Chapter Eight: Conclusion

Chapter Outline

This chapter highlights the main findings of the study. These are summarised then further discussed in terms of their impact on the teaching and learning of multimodal authoring. Multimodal authoring, as conceptualised in this study, is described in order to clarify the features and structures that work together to build knowledge and produce texts within a multimedia environment. A changed relationship between the author and potential audience is highlighted. This includes, not only cognisance of the nature and unique communicative needs of a particular audience, but the potential for the roles of reader and author to be transposable.

Teacher beliefs, understandings, skills and knowledge about the teaching and learning of multimodal authoring are reviewed from the teacher participant data. The knowledge needs of teachers in order to talk about and teach multimodal writing tasks are then detailed. These knowledge needs comprise specific, contextualised, subject content knowledge that includes design knowledge and a common shared language to facilitate the sharing of ideas, processes and products. Knowledge and skills, in this instance, are supported by optimal dispositions to teaching and learning multimodal authoring. The role of a model of authoring that informs and supports multimodal use is discussed in terms of supporting student learning.

Research and theoretical contributions of the study are reviewed and the limitations of the study are discussed. Implications for both teachers and researchers are presented, including directions for future research. Final thoughts are offered to inform continuing development of teacher knowledge and skills that will enhance student learning in multimodal authoring.

Introduction

Seminal research and theorising in the field of literacy and literate practice has placed significant emphasis on the proliferation and ready access to internet-capable, multimedia technology as the catalyst for a fundamental shift in communication, information searching, language use and learning (Alexander & Fox, 2004; Fairclough, 2000; Gee, 2000; Leu, Coiro, & Cammack, 2004). Technology plays a major role in prompting calls for broader conceptualisations of language and literacy that address different purposes for, and responses to, being literate (Leu et al., 2004) and, therefore, the need for changing literacy teaching and learning. The ways in which schools and teachers have responded to this call have been varied. The response is shaped by a complex array of factors
including differing ideas of literacy, varying technological skills levels, beliefs about what should be taught and school factors.

This study aimed to detail the understandings, beliefs, skills and knowledge teachers, nominated as having expertise in technology and writing, have about the nature and role of integrating multimodal technology into their teaching and learning programmes to support multimodal authoring. It also sought to describe the knowledge needs of teachers in order to talk about, teach and interpret the processes, practices, structure and content evidenced in multimodal authoring. To consider practices developed by other professional communities that may have some lessons to share with teachers about design (Sheridan & Rowsell, 2010), the practices of digital designers were investigated and are suggested as offering some insight and knowledge that could be applied to the classroom context.

The research involved examining the changing nature of teaching and learning writing, due to widespread everyday use of multimodal technology, and teachers’ responses to that change. Ways in which today’s students communicate, build knowledge and produce texts within a multimodal environment were considered. Examination of these processes was used as the catalyst to learn more about what the knowledge needs of teachers to support students to produce such texts in a classroom environment might be.

Descriptive analysis of conceptions of multimodal authoring was undertaken using two sets of data. First, using data gathered from 15 teacher participants, the existing ideas and practices teachers have about teaching multimodal authoring in Years 1–8 were outlined. Also, in order to consider practices and processes developed by another professional community, descriptive analysis was presented that defined and analysed technology-mediated multimodal communication as conceptualised and used by digital designers. These designers engaged in state-of-the-art practices of design using both multimodal and traditional materials and operated in an established domain of practice developed over more than 30 years.

The teachers were purposively selected as skilled practitioners in both teaching writing and using technology in teaching and learning, yet, in both the data and extended consultation with participants, it was clear that there were low levels of capability to support teaching and learning of multimodal authoring. The following discourse summarises and discusses the findings of the study.

**Summary of Findings**

Although teacher participants used technology themselves in many different ways for a range of purposes, for the majority, this did not translate into similar levels of technology use in their
teaching of writing, a finding reported widely in the literature (Burns, 2010; Lim et al., 2013; Muir-Herzig, 2004; Parr & Ward, 2010; Ward, 2013). In the teacher data, there was a lack of clarity about integrating technology into the teaching and learning to facilitate multimodal authoring. The rationale for this offered by participants reflected a plethora of contextual variables. These included a range of technical skills, as part of personal knowledge and experience, and assumptions about what counts as the knowledge that teachers bring to the classroom context of multimodal authoring.

The impact of these variables on teacher practice differed from person to person. Conceptualising this type of writing was further shaped, for these participants, by the effects of resourcing levels, the state of technological infrastructure, organisational networks, professional learning opportunities and curriculum requirements. It was also apparent that the absence of a shared body of content knowledge related to the processes and products of multimodal authoring impacted negatively on teacher confidence to support student learning in this area. Content knowledge, for the purposes of this research, is understood as teachers’ practical, experiential and formal knowledge (Van Driel et al., 2001), as well as subject knowledge articulated through curricula.

By synthesising the data and existing literature, the knowledge needs of teachers in order to teach multimodal authoring were described. The absence of shared content knowledge prompted, in the course of the study, the framing of such a body to inform processes related to multimodal authoring. It was proposed that this body of knowledge could form an amalgam of essential understandings that support teacher practice, including describing skills, knowledge and design dispositions, as described by digital designer participants, with which to support multimodal authoring. Cognisant of the complex, integrated set of knowledge and beliefs that inform teacher practice in any subject area, the construction of a body of content knowledge to inform processes of multimodal authoring was not intended as a simple fix to the problem of low levels of capability in teaching multimodal authoring. It was proposed as a place to begin to deepen and extend teachers’ applied knowledge in this area. Such a framework, on which to strengthen teacher capability in teaching multimodal authoring, was presented in Chapter 8.

A model of authoring was described that allowed for multimodality and responded to the unique and dynamic environment of multimedia use. The three-stage, cyclical model highlighted an authoring process that allowed for extended decision making and the mediation and dissemination of information using multiple modes in an online environment. Highlighted equally in this model are creation, mediation and dissemination processes where writers and, importantly, teachers, have knowledge of modal affordances, design processes, target audiences and capability with the
technical procedures of using multiple modes, including keeping pace with technological advancements. This model of authoring also gave credence to the role of both knower code and knowledge code orientations to learning, by acknowledging both processes and products as outcomes of multimodal authoring.

Informing the ideas about content knowledge and the model, are key understandings for teachers that emerged from how digital design practitioners create meaning using multimedia enhanced design features and knower code knowledge practices. Digital Designers valued knower code practices and although raised the importance of knowledge of the capabilities and properties of technology, also noted the ready support available to extend expertise in this area. Arguably, digital designers could be considered to have elite code knowledge practices but the bias towards knower code practices was paramount. Key understandings from this section of digital design data are around the knower code dispositions and the use of design features to plan meaningful, contextualised, interactive information that facilitates audience engagement and meaning making. Digital designers described design practices as utilising online, technology–enabled, multiple modes of meaning to realise communicative purposes, where related skills and understandings sat within a range of both traditional and digital knowledge, skills and related dispositions. Specific features, such as selecting appropriate navigation tools and colour options, facilitated meaning making. The experiences of creators and users of multimedia were enhanced through these and similar features.

Limitations

This study aimed to clarify and describe knowledge needs of teachers to inform the multimodal authoring of their students. The group of participant teachers was small, at 15, and this may be seen as problematic in terms of relating the findings to a wider population. However, the design was chosen in order to understand and account for the meaning of the experiences and actions of a group of purposively chosen participants who were reported to be effective users of technology to support multimodal authoring.

Methodologically, trying to give some shape to the emerging field of inquiry around the teaching and learning of multimodal authoring was challenging. No single, overarching theory, capable of analysing the principles and underlying practices of technology integration to support multimodal authoring, was available for use in this study. Consequently, a variety of theoretical positionings informing the research were drawn from cognitive, learning and multimedia theories. Teaching and learning in this area lacks clarity and the absence of tools such as a shared language around practices and products was, at times, a barrier to the interpretation of the data. Clarification on an on-going
basis and interpretation of the data was sought from several groups of colleagues from outside and within the context of teaching writing, including design professionals.

Examining the teacher participant data, which required using a number of interpretive lenses for different purposes, was a process involving iterative considerations of the data that accounted for its complexity and contextualised nature.

**Implications**

This study has implications for both researchers and teachers. A key implication for both groups is the importance, when exploring the knowledge domain of technology-mediated multimodal writing, of establishing shared understandings of content, including language use, processes and products. To this end, establishing and developing valued knowledge and practices through shared, subject content knowledge is essential. The process of knowledge building is likely to be highly complex as the scope of technology resources available, their properties and the constantly changing nature of technology mean there are few constants in this area. Thus, the need to consider how to address change and assess the significance of continuous technological innovations will be an important part of the process of knowledge building in this area.

Teachers already understand a set of knowledge and beliefs, which informs their practice in teaching writing. This knowledge is unique to each individual and may differ from the aims of teaching writing mediated by multimodal technology. In order to develop capability to teach multimodal authoring, simply adding new information to existing knowledge of teaching writing will not be sufficient. Instead, a multi-disciplinary, collaborative partnership between schools, universities, and professional and industry organisations would be a more effective way of addressing teacher learning needs. The Digital Futures in Education (DeFT) project in the United Kingdom (http://www.digitalfutures.org) is an example of such a partnership. This project developed teaching and learning resources to assist both teachers and learners. These are resources that are freely available online and developed in collaboration with teachers, the project team members and other advisers. Professional learning opportunities such as this are responsive to teacher knowledge and beliefs and contextualised within their teaching practice.

Participant teachers in the current study spoke of their least and most favoured professional learning contexts. Traditional “top-down” professional learning opportunities (experts talking to non-experts) seemed to be the least favoured and least effective by participants. More collaborative informal opportunities referred to by participants, such as “un-conferences” where teachers had an opportunity, informally, to meet and talk with other teachers, were the most popular and seen as an
effective means of improving practice. This conduit appears to be a practical and effective way to address and support teachers to restructure their knowledge and beliefs based on teaching and learning experiences and, in so doing, integrate new material to their practical subject knowledge. However, the process of restructuring knowledge and beliefs in any context is very complex and takes time.

Further, although not addressed fully in this study, it is clear that after establishing the “what” in terms of content knowledge, the “how” of teacher pedagogical approaches needs to be addressed and clarified. Participants suggested that traditional teaching and learning practices and processes favouring text were inadequate for teaching technology-mediated multimodal authoring. Data from digital design participants suggested that teachers of writing, in addition to developing traditional skills, needed to embrace design practices that foster the use of modal affordances to engage the user in meaning making and the disposition of knower code modalities. Largely, teachers are unfamiliar with and therefore lack confidence in teaching and learning with the processes of design and encouraging collaborative problem-solving dispositions as foregrounded in knower code modalities, so this is an area for developing teacher capability (Matthewman, Blight, Davies, & Cabot, 2004).

Implementation of what has been suggested relies on the articulation of these expectations, processes and products at a national level. There is a need for curriculum documents to be explicit in their descriptions of what knowledge, skills and practices are valued, including a shared understanding of what assessing technology-mediated multimodal processes and products might mean for teacher practice. This includes facilitating and supporting diverse teacher learning trajectories and the likelihood of gradual growth in knowledge and expertise in teacher capabilities, together with accompanying sustained teacher support. Direction at a national level comes with the proviso that classrooms are highly contextualised spaces and curricula must be responsive to different approaches to teaching, learning and assessment (McClay & Mackey, 2009). A shared language to describe indicators of success, ways of progressing student learning and ways of incorporating technological advances into assessment and learning in authoring practices is necessary to begin talking about assessment and evaluation.

Authoring that is mediated by networked, multimodal technology has the potential to be uniquely iterative. This feature gives equal emphasis to each stage of the communication process, suggested in Chapter 8 as including the steps of creation, mediation and dissemination. Often in teacher-initiated, classroom writing tasks, a greater percentage of time is spent engaged in the creation stage than is spent on choosing a mode or modes to represent meaning (the mediation stage) or
distributing meaning to chosen audiences (the dissemination stage). At the creating stage, teachers spend a lot of time motivating students to generate content with a single, static audience in mind (often implicitly the teacher). At the heart of the iterative possibilities of multimodal authoring, is the potentially changed role of the audience. The relationship between the creator (author) and user (potentially both the reader and author), both of whom can be knowledge producers and consumers, is quite different to the relationship between reader and author in traditional writing practices. The invitation to participate and access resources enabling active contribution potentially strengthens the iterative nature of writing. The opportunity for multiple inputs opens a pathway for classroom-based student writers to engage in more than just authoring for the teacher.

Finally, for researchers, the importance of developing informative theory that will underpin this rapidly developing area of teaching and learning should be noted. Such theory should be not only specifically related to multimodal authoring, but to the broader area of technology integration and how learning opportunities for students may be improved.

**Future Research**

This study has highlighted many aspects of the teaching and learning of writing worthy of further research that would ultimately develop understanding and changes to practice through a shift in teacher capability.

Suggested by the trajectory of the current findings of this research are two aspects that I would like to consider related to developing a resource for teachers to describe a body of subject knowledge that informs the teaching and learning of multimodal authoring. Initially, groups of teachers, teacher educators, designers and researchers, as equal partners, might work together, as in the DeFT Project (http://www.digitalfutures.org) to explore the possibilities of multimodal authoring and, ultimately, to design, realise and evaluate a body of subject knowledge. This shared knowledge of subject content would then be used as a framework to inform, describe and assess progress and establish the types and range of knowledge, skills and behaviours that students should demonstrate at various levels of the curriculum when engaged in multimodal authoring tasks including the development of exemplars and progress indicators at various stages for various purposes.

As shown by the data, developing content knowledge and progress indicators would necessarily involve targeted professional learning, for both existing teachers and those in teacher education, around teacher understanding and ideas about technology integration in general, and its use in multimodal authoring more specifically. In the context of professional learning, pedagogical considerations, that is, what teachers need to know about teaching technology-mediated authoring,
Research, Theoretical and Conceptual Contributions

This research has offered an alternative approach to understanding why technology mediation in teaching and learning to inform multimodal writing is not as embedded in teacher practice as initially expected. Theorising moved away from a simple dichotomy of enablers versus barriers to technology integration to consider a tension in the types of learning and the nature of knowledge valued in writing and technology use. Building on the work of other researchers (Chen et al., 2011; Christie & Maton, 2011; Howard & Maton, 2011; Maton, 2000, 2007, 2010), data from this study have suggested that the focus on a knowledge code orientation to learning writing by many teachers, curricula and writing systems is mismatched with the knower code focus of technology use. Working from this hypothesis, the research moved in the direction of proposing knowledge and processes that could inform subject content knowledge and a writing model that encompasses both knowledge code and knower code orientations to learning.

Aligned with teaching writing mediated by multimodal technology, are calls for broader understandings of what constitutes literacy. Whilst there is support for a broader conception of literacy amongst researchers (e.g. Gee, 1999, 2000; Knobel & Lankshear, 2007; Lankshear & Knobel, 2003; Street, 2003), there is also concern that conceptions of literacy need to be clear to address practicalities when designing learning environments (Merchant, 2007). To support teaching and learning, there needs to be clear direction from curricula. In terms of the self-managing climate of New Zealand schools, as research has suggested (Robinson et al., 2011), individual school leaders have significant autonomy in how they respond to the learning needs of their students. This assumes that schools will have sufficient expertise and capability amongst staff to respond to the learning needs of their student communities. Consistent with Robinson and colleagues’ research, in the case of technology mediation to inform multimodal authoring, the capacity of individual schools to address learning needs of the students within the context of their schools is likely to be variable. As mentioned, curricula direction that is too limiting can stifle learning in the unique environments that classrooms are. However, clear articulation of teaching and learning expectations in any subject area at a national level, provides a platform for universal, equal access to knowledge and skills that are valued. The absence of such creates potential for disparity.

This study has contributed to theorising existing teaching practices related to multimodal authoring and, subsequently, presented a theoretical model of teaching writing that incorporates digital technology based on a proposed corpus of content knowledge. This model acknowledges and adapts
for communication with audience engagement accommodates change or redesign as a result of that engagement. As stated, the recursive nature of the model allows for decision making to be extended to include, for example, content-related decisions at the creation stage, design decisions at the mediation stage and delivery decisions at the dissemination stage, as well as a consideration of how each of these decisions impacts on meaning making. As a result of feedback the author may have received, either in person or from an online contact, the author may return to a prior stage or move on to the next. For example, an author may receive a “post” from an online participant that the communication could be enhanced with a music clip. This causes the author to go back and edit the communication. Each phase of the process can occur concurrently and with equal emphasis. Creation and mediation could, and often do, take place simultaneously where a response is made and designed at the same time. The proposed model allows for the relationship between the author and the reader or, more accurately, the creator and the user, to include both as knowledge producers.

Together with changed practices, fostering conceptual changes needed to shift teacher thinking and practice in the teaching and learning of writing to such a model that includes multimodality, has significant implications for teacher practice in writing that currently operate, largely, within curriculum guidelines that prioritise print. In the context of my research, teachers have made it clear that they need access to literacy curricula that include making meaning with multiple modes.

**Conceptualising teacher understandings, beliefs, skills and knowledge about the nature and role of integrating multimedia technology into the teaching of writing**

Data collection from teachers representing multiple teaching sites revealed a range of teacher levels of understanding, beliefs, learning, resourcing, leadership and collegiality related to the teaching and learning of multimodal authoring. Included were ideas expressed around the strengths, weaknesses and requirements associated with technology integration that would support multimodal authoring. Teachers encountered barriers such as resourcing of hardware and software and personal knowledge of how technologies worked often requiring skills beyond those, which teachers have. One of the most influential factors enabling technology use, as Ertmer and colleagues (2012) also found, were teachers’ personal attitudes and beliefs. This finding resonated with the body of research that suggests that teacher beliefs associated with good teaching and effective learning have an impact on the nature of instruction and interactions that occur in the classroom.

The majority of teacher participants espoused technology integration to effect the teaching of a transformed notion of literacy as necessary and inevitable because of its pervasive presence in the lives of students, particularly outside school. Teachers referred to their own motivation and personal
beliefs as a facilitative factor in their practice. For many though, technology-mediated multimodal authoring as part of transformed literacy practices was beset with difficulties of resourcing, technical knowledge and teaching knowledge and, consequently, authoring remained very much text based. The result of this was a feeling on the part of some teacher participants that they were not doing the very best for their students if both their teaching and student learning did not include the use of technology.

However, even if access to technology was not optimal, strong beliefs about the positive effects of technology integration were highly influential in teacher practices overall. This was expected, given that all teacher participants were purposively selected. Some teachers expressed negativity related to technology use. For this group, technology use appeared to be a focus for the school as a whole but personal beliefs did not necessarily match the intensity that appeared to accompany a school-wide focus on technology use.

Teachers’ attitudes and beliefs have been an important part of the findings of this study and the discussion that followed, influencing the choices participants made regarding facilitating learning for their students. Teaching and assessment must be coherent with personal beliefs as well as externally imposed features such as curriculum and policy. The political, personal and contextual dimensions that teachers encounter in their everyday practice have featured in this study. This has been done to highlight that a teacher’s ability to teach multimodal authoring is governed by the realities of the classroom, school and the educational and political climate in which they operate (McClay & Mackey, 2009).

In any profession there is variability in the expertise of its members. Some teachers, for example, responded to the challenges surrounding technology integration to effect multimodal authoring and overcame problems by various means to increase capability and enable participation because of their personal beliefs while others did not do so. Illustrated in Chapter 5, both Teachers A and C explained how they informally contacted colleagues, often through their online presence, to share experiences, learning opportunities, problem solve with others and develop expertise. There was also the teacher who took a set of laptops home each night and charged the batteries to make sure that they were ready for use the next day. Other teachers focused primarily on their role as teachers of writing in the traditional sense. They did not prioritise increasing their capability to use technology to support multimodal authoring and sought limited engagement opportunities with both formal and informal professional learning. Required expertise was perceived as falling outside their domain of competency. Ultimately, as suggested in Chapter 2, changes to the way teaching and learning takes place must be examined in the light of how the suggested change will impact on
decision making by professionals who are already skilled in the field of, for example, teaching writing, have clear goals and a significant amount of autonomy in their decision making.

It was significant that, also reported in Chapter 5, when asked to rate the quality of professional learning opportunities on a 6-point scale, from poor to excellent, the majority of teacher participants rated their experiences as either poor, basic or fair. Teachers’ ratings of how much they learnt from these opportunities indicated a range of responses. Descriptions of professional learning experiences revealed that often content and mode of delivery were unsuitable or inappropriate for teacher needs. Literature suggests (Byrom & Bingham, 2001; Law & Chow, 2008; Picciano, 2002) a strong link between the mode of delivery of professional learning and the up-take of using technology in teaching and learning. This has implications for the quality of professional learning opportunities, in particular, their mode of delivery. According to these data, the quality of professional learning opportunities has been inadequate to increase teacher capability in responding to using technology to support a transformed notion of literacy which includes multimodal authoring.

Teacher understandings of authoring were contained largely within knowledge code practices. There was little reference by teacher participants to the place of knower code dispositions although these were highlighted and given value by the Digital Designers. Teacher beliefs and practices valued traditional knowledge code practices such as understanding textual features of grammar, spelling conventions and generic writing structures. This is not surprising considering that knowledge code practices have been at the core of teaching and teacher training for a long time and these practices dominate the types of knowledge practices teachers value and therefore promote. Curriculum documents that direct teaching and learning exemplified in the literature review, although containing some aspirational statements about the traits of the optimal ‘knower’, focussed mainly on knowledge code practices.

In summary, teacher participants understood that integrating technology into the teaching and learning of writing to effect new literacy practices such as multimodal authoring was important, necessary and an expectation from students, parents and school leaders. Participants expressed a lack of knowledge, confidence, pedagogical understanding and technical skills to do this under present circumstances. Most participants worked to address barriers to integration but some saw the barriers as too significant to overcome. Some teachers had established peer networks through which they talked about how to integrate technology into their teaching and learning. Curriculum documents gave little specific direction for teaching and learning writing using technology and professional learning opportunities had been variable in increasing professional capabilities amongst
participants. Some participants felt they were not doing their best for their students by not including multimodal authoring in their teaching.

**Conceptualising the knowledge needs of teachers in order to talk about and teach student multimodal authoring.**

In order to be able to debate, engage with, challenge and improve practice, teachers need knowledge and understanding of three interrelated aspects of multimodal authoring. Primarily, teachers need access to specific, contextualised, subject content knowledge and associated ways of teaching, informed by substantive theory. Teachers need to be able to make teaching and learning connections both within this domain of content knowledge and between this domain and that of more traditional authoring subject knowledge. Both content knowledge of digital authoring and theory must include understandings of design and related dispositions of designers that, in effect, teachers need to adopt.

Teachers need understandings of the knowledge code associated with multimodal authoring. These understandings in part, are in terms of design practices. Evident is a need for technical skills to understand how resources function and malfunction, their affordances, but also understanding of how communication functions when using multiple resources. Teachers also need, for example, knowledge of the interactive properties of digitally authored communication including information hierarchies, incorporating positioning, timing and presentation of information, how to integrate links which can direct a user to another webpage, use colour and typography effectively, incorporate navigation frameworks and account for a strong presence of visual resources in multimodal documents while including carefully considered textual resources. In order to create a multimodal communication, a range of both traditional and digital knowledge, skills and associated dispositions are necessary. However, as reported by one digital designer, production practices of initially “mocking up” and planning a design were often grounded within traditional contexts. This practice was reported in Chapter 8 where the comments from one design participant reflected that much of the initial development of a design was done using pencil and paper. To date, content subject knowledge has not been developed to an extent where there is wide acceptance and agreement of the features of products and processes.

Teachers need to understand the importance of knower code dispositions that allow students access to a collaborative ethos, of open-ended, collective forms of learning. As reported in the digital designer data, this group noted the importance certain dispositions or ways of thinking such as having an interest in technology use and the motivation to enquire into practices and innovations. Several designers saw the presence of dispositions, of enquiring into design and technology use and
the collective construction of knowledge and understandings, as critical. Also valued by this group were dispositions of problem solving, a culture of critical collaboration with peers and critical engagement with information sources and contexts. This contrasts with, for example, emphasising individual, contextual skills associated with print based literacy. There is also a need to understand that knower code and knowledge code orientations to learning strengthen and weaken according to the learning context. These orientations are not fixed but context dependent. Therefore, valuing a range and combination of skills and appropriate dispositions and practices facilitates communicating multimodally.

Emerging, as part of subject content knowledge, is the need for a shared language to construct and negotiate the subject content knowledge. A shared language is fundamental to being able to describe, discuss and debate any domain and has featured in discussions throughout this study. For any domain to progress, ways of describing and labelling processes, products, actions and strategies, are essential. A shared language would, in turn, underpin effective pedagogical measures and understandings including problem solving, inquiry and reflection.

During the data gathering phase involving participant teachers, it was necessary to explain, describe and share terms and identifiers related to multimedia authoring. It was obvious that for most participants, significant negotiation was needed between both researcher and participant so that common ground in terminologies could be mapped. Teacher participant data indicated that those who had higher levels of understanding in describing processes and products of multimodal authoring tended to participate in these practices to a greater extent than those who did not. For the most part, understandings and terminologies were still very much textually based.

The second aspect of multimodal authoring necessary to support teaching and learning is a model of authoring that informs the types of processes needed to complete a technology-mediated, multimodal task in authoring. The model includes potential for students to develop confidence and competence in the skills, knowledge, processes and understanding of digital authorship and offers a structure to develop independent enquiry. The model also supports students being involved in defining tasks or questions and accessing information, knowledge and expertise; these are the knower code dispositions of LCT. The proposed model builds on and extends existing theoretical models and teacher knowledge by highlighting the iterative and recursive nature of multimodal authoring.

The third and final aspect relates to professional learning. As Miller, Looney and Wynn (2010) suggested, supporting the teaching and learning of multimodal authoring will depend on contextualised understandings of effectiveness and competence, facilitated by appropriate
implementation of methods and techniques. This translates into targeted professional learning, including gathering and analysing student data, collegial collaboration within a variety of learning communities, technological skill development and making the conceptual shift from largely textual practices to multimodal ones prioritising elements of design. Another necessary dimension in professional learning suggested by participants is the consideration that pedagogy needs to change to address technology use in teaching and learning. Research (Flynn, 2007; Kalantzis & Cope, 2010; Marsh, 2007; Webb, 2005) suggests there are commonalities in pedagogical approaches that support literacy learning mediated by multimodal technologies. So, further investigation into the pedagogical needs of teachers when integrating technology into teaching and learning is necessary to explore commonalities and develop responsive strategies.

For the teacher participants of this study, the lack of clarity around relevant knowledge and pedagogical practices resulted in teachers having qualitatively different experiences in teaching and learning writing which led to the construction of quite different models of understanding. For some there was a sense of regret that, for whatever reason, the teaching of technology-mediated multimodal authoring in their classroom was not optimal. In light of this and other data reported on in this study, consideration needs to be given to what knowledge and skills are valued in writing that includes the use of multiple modes. This will inform the focus of teaching, learning and assessment in the future and how this knowledge will be shared with teachers effectively.

Ultimately, however, approaches that will facilitate multimodal authoring, sit within the context of teacher practice and organisational structures such as curricula, policies, government directives and schools. Much has been written about leading and managing change but a key principle that underpins the findings of the research presented in this thesis is suggested by Elmore (2004); namely, the need to change the instructional core of “how teachers understand the nature of knowledge and the student’s role in learning, and how these ideas about knowledge and learning are manifested in teaching and classwork” (p. 8). Changing the instructional core necessarily sits in tandem with organisational changes that are notoriously slow, fragmented and resistant to change (Merchant, 2012).

**Final Thoughts**

In the course of this study, apparent were the uncharted theoretical waters of technology integration, in general, and technology integration in the teaching and learning of writing using multiple methods to effect transformed notions of literacy, in particular. As research suggested (Bennett & Maton, 2010; Howard & Maton, 2011; John & Sutherland, 2005), investigation into technology integration is under-theorised and the paucity of powerful theory and cumulative
knowledge building impedes progress in this domain. Teachers need theoretical tools to support the use of technology in the classroom. These theoretical tools include ways of examining the various forms of knowledge and practices in this area in order to understand the role technology plays in learning. Theory is also needed to understand and operationalise various forms of relevant knowledge and practices.

The lack of theoretical tools is in tension with technology’s pervasive use in people’s lives and the perceived imperative for teachers to integrate technology in all aspects of teaching and learning. Further, understandings related to technology-mediated authoring needed by teachers for the specific task of teaching are not described or negotiated within any recognisable body of content, pedagogical or curricula knowledge.

This study has also shown that despite high expectations placed upon teachers and learners to cue themselves into the demands of developing literacy skills that facilitate technology integration, insufficient knowledge building has taken place, therefore progress towards technology integration in multimodal authoring has been slow. Teachers have been encouraged to develop personal expertise with technology hardware, software and related affordances, integrating this knowledge into teaching and learning across the curriculum. These expectations have been based around the accepted mantra that technology is pervasive, enhances learning outcomes and that formal education is somehow “missing out” if technology is not used in the classroom.

What has been proposed in this study is an introduction to and suggested means by which understandings that are more sophisticated can be developed of existing elements of teaching and learning technology-mediated multimodal authoring. They may provide insight into what technology-mediated authoring currently involves and why this practice is not as pervasive in the classroom as it is outside of the classroom. Still to be determined are complex issues such as benchmark indicators of success when using a screen based medium to write. Researchers, in partnership with teachers of writing, now need to focus on conceptualising knowledge practices that will inform technology-mediated authoring and how existing knowledge and teaching practices can be built on in order to improve literacy learning for their students. Authoring that is centred on the use of textual skills is important and will remain so for some time. However, authoring viewed in the context of technology-mediated, multimodal communication means that teachers and learners of writing will need skills, knowledge and attitudes that will address their literacy needs now and in the future which is, and will continue to be, characterised by constant change.
Appendices
Appendix 1: Participant Information Sheet Teachers

 PARTICIPANT INFORMATION SHEET

**Research Project Topic:** Conceptualising multi-media writing of primary school students. What is involved and how can it be assessed?

**Participant:** Teacher Practitioner Participant for Interview

**Principal Investigator:** Sue Bedford

**Supervisor:** Professor Judy Parr

This research is being carried out by Sue Bedford, PhD candidate from the Faculty of Education, University of Auckland, under the guidance of Professor Judy Parr. You are invited to participate in this study. You are under no obligation to do so but I would very much appreciate your input.

I am particularly interested in how learners experience and use multimedia to support writing. I plan to investigate the knowledge needs of teachers to enable formative feedback and the development of a framework of ‘what to look for’ at various levels of competence when students are composing in multimedia contexts.

I seek a detailed understanding of expert teacher participant knowledge in the area of integration of multimodal technology into teaching and learning programmes, particularly those used in the writing programme. I plan to utilise this to work to develop a framework, along with teacher participants, to examine different levels and combinations of engagement and complexity in the use of multimedia to support the writing process. You have been selected to participate in this research because of your experience working with a mainstream class on a regular basis, your confidence in using multimodal technology and familiarity with current writing and assessment practices in Years 1–8.
I want to gather information from you through an interview (approximately 40 minutes) regarding your understandings and experiences of integrating multimodal digital technology into your learning and teaching programmes. With your explicit permission, this interview will be audio recorded. The source of the information provided is confidential to the researcher. The timing and location of the interview will be mutually negotiated.

You can ask that the digital audio recorder be turned off at any time. You are able to review interview transcripts and add to them or clarify what you meant. The audio files can be returned to you if you so indicate. All electronic data will be erased after six years and paper data will be shredded at the conclusion of the study and production of any publications that may result from it.

You may withdraw from participation without giving a reason or withdraw your data at any time prior to the completion of data collection by 1 October 2011. The data you provide will be processed and stored in both paper form and electronically. These records will be stored in a secure database at the University of Auckland for the duration of the research (until 2016). Neither you nor your employer will be identified in any reporting other than by the identifier known only to the researcher. I have sought assurance from the Principal of your school, that there will be no adverse consequences should you decided not to participate in this study.

A detailed report summarizing the results of the teacher interviews will be posted to you by 1 December 2011. These data will be used to inform a group of teacher participants as they work on the development of a framework for examining different levels and combinations of engagement in using multimedia form in writing. The utility of the framework that is developed will be subsequently trialled in a selected school. It is anticipated that teachers may then choose to use these results to shape their on-going work in the integration of multimodal digital technology in teaching and learning programmes that involve writing.

I would be pleased to give more information about this phase of the research on request. If you have any questions to ask or concerns you wish to discuss please contact the appropriate person from the list below

Thank you

Sue Bedford  
PhD Candidate  
Faculty of Education  
University of Auckland  
Private Bag 92019, Auckland Mail Centre 1142.  
Email: sbed005@aucklanduni.ac.nz
Professor Judy Parr
Associate Dean Research
Faculty of Education
University of Auckland
Phone: 64 9 623 8899 ext 88998
Email: jm.parr@auckland.ac.nz

Dr Libby Limbrick
Head, School of Department of Arts, Languages, and Literacies
Faculty of Education
University of Auckland
Phone: 623 8899 ext 48445
Email: l.limbrick@auckland.ac.nz

For any queries regarding ethical concerns you may contact the Chair, The University of Auckland Human Participants Ethics Committee, The University of Auckland, Office of the Vice Chancellor, Private Bag 92019, Auckland 1142. Telephone 09 373 7599 ext 83711

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIPANTS ETHICS COMMITTEE

Appendix 2: Consent Form Teachers

THE UNIVERSITY OF AUCKLAND
NEW ZEALAND
Department of Arts, Languages, and Literacies
Faculty of Education
74 Epsom Avenue, Epsom
Phone: 623 8899
The University of Auckland
Private Bag 92019
Auckland, New Zealand

THIS CONSENT FORM WILL BE HELD FOR A PERIOD OF SIX YEARS

Participant: Teacher Interview Participant

Research Project Topic: Conceptualising multi-media writing of primary school students. What is involved and how can it be assessed?

Principal Investigator: Sue Bedford

Supervisor: Professor Judy Parr

This project has been explained to me and I have read the participant information sheet. I have had the opportunity to ask questions and have them answered to my satisfaction. I understand that I am invited to participate as a teacher participant and I give my consent to be interviewed. I am aware that my participation is voluntary.

- I agree to take part in this research
- I understand that I am free to withdraw participation at any time, and to withdraw any data traceable to me up to 1 October 2011
- I understand that a third party who has signed a confidentiality agreement will transcribe the audio files
- I understand that the source of the data obtained is confidential to the research and that my name will not be used in any report
- I understand that the information that I provide will be analysed and stored electronically in a secure data base at the University of Auckland until the project is completed in 2016
- I understand that the data from this phase of the project will form a baseline in relation to later and more detailed phases of the project.
- I understand that assurance has been sought from my Principal there will be no adverse consequences for me if I choose not to participate in this study
If you agree to take part in this research please complete the consent form and hand it back to the researcher or enclose and post it in the self-addressed envelope provided.

Name:________________________________________

Signature:_____________________________________

Date:__________________________________________

I agree/do not agree to the audio recording of the interview (delete which is not applicable)

I do/do not want to receive the audio file when transcription is completed (delete which is not applicable)

I do/do not want to receive a copy of the transcript of the audio file

Signature_______________________________________

Email___________________________________________

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIPANTS ETHICS COMMITTEE

On 25/02/2011 for a period of 3 years until 25/02/2014. Reference number 2011/009
Appendix 3: Teacher Participants’ Interview Schedule

Interview questions for teachers Phase 2 of Data Collection

For the purposes of this interview, multimodal digital technology (MDT) refers to computers, laptops, IPods, 3G capable hardware/software, handhelds, interaction whiteboards, software programmes, video cameras, digital recorders, digital cameras, mobile phones, Iphones, Black Berries, Ipads.

1. Background Information

   i) How many years have you been teaching?

   ii) What level do you teach at?

   iii) What is the age range of the students you teach?

   iv) Gender

   v) How would you describe the range of MDT you use?

<table>
<thead>
<tr>
<th>Minimal (1-2 tools)</th>
<th>Fairly Limited (2-3 tools)</th>
<th>Moderate (3-4 tools)</th>
<th>Considerable (4-5 tools)</th>
<th>Extensive (more than 5 tools)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

   vi) Thinking about the application that you use most, how would you describe the extent to which you use this in terms of how often

<table>
<thead>
<tr>
<th>Once a day</th>
<th>Twice a day</th>
<th>More than twice a day</th>
<th>Constantly</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

   and for how long?

<table>
<thead>
<tr>
<th>Less than 10 minutes</th>
<th>More than 10 minutes but less than 1 hour</th>
<th>1-2 hours</th>
<th>More than 2 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

   vii) Thinking about the MDT application that you use the most, how would you rate your own skills of using this application?
Minimal (Skill to perform one basic task) | Fairly Limited (Skill to perform several basic tasks) | Moderate (Skills to perform all basic tasks competently) | Considerable (Skills to perform most basic and advanced tasks competently) | Extensive (Skills to perform all tasks to advanced levels of competency)
---|---|---|---|---
1 | 2 | 3 | 4 | 5

modelling their use?

| Minimal (Skill to model one basic task) | Fairly Limited (Skill to model several basic tasks) | Moderate (Skills to model all basic tasks competently) | Considerable (Skills to model most basic and advanced tasks competently) | Extensive (Skills to model all tasks to advanced levels of competency)
---|---|---|---|---
1 | 2 | 3 | 4 | 5

viii) Have you any comments you would like to add?

ix) What do you understand as a very basic and focused definition of a multimedia document. Could you tell me what this definition would look like?

2. Planning and Teaching (PCK)

Thinking about teaching writing, how would you rate your knowledge and expertise in teaching writing

| Minimal (Beginning teacher, new to teaching level) | Fairly Limited (Some knowledge and experience) | Moderate (Able to teach a range of skills) | Considerable Experience and ability to teacher a range of skills | Extensive Ability and experience to teach a wide range of skills & knowledge
---|---|---|---|---
1 | 2 | 3 | 4 | 5

Why do you give this rating?
i) Rationale: The uneven distribution of digital resources and apposite user skill, both student and teacher, impacts on teaching and learning opportunities

a) How would you describe the availability and range of MDT for use in teaching and learning in your school? Does this level of resourcing meet the learning and teaching needs of teachers and students? Why/why not?

b) Do you use any means e.g. test, self-report to establish the level of skill of your students in using MDT? Why/why not?

c) How would you rate the range of MDT resources available in your classroom?

<table>
<thead>
<tr>
<th>Minimal</th>
<th>Fairly Limited</th>
<th>Moderate</th>
<th>Considerable</th>
<th>Extensive</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

c) How would you rate the level of use of the MDT resources available for use in your classroom?

<table>
<thead>
<tr>
<th>Minimal (use by a small number of students for short periods of time)</th>
<th>Fairly Limited (use by groups of students for short periods of time)</th>
<th>Moderate (Use by groups of students for extended periods)</th>
<th>Considerable (Use by most students for extended periods)</th>
<th>Extensive (fully integrated use by all students)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

ii) Rationale: The use of technology can help enhance teaching and learning. Emerging digital technologies provide new ways of being ‘literate’ producing specific texts for specific audiences. Research indicates that teachers plan primarily according to curriculum based learning needs. National curriculum documents offer little in the way of guidance for the integration and evaluation of technology into planning, teaching, learning and assessment.

a) What are your understandings and beliefs around using technology to enhance teaching and learning?

b) Does your school’s writing curriculum detail learning goals for writing using multimodal technology?

c) How does the English curriculum document assist you to make pedagogical decisions about the integration of MDT into your writing programme?
d) How would you rate the quality of the opportunities you have had as a teacher to learn key skills and knowledge about/to inform your decisions around the integration of MDT into teaching and learning programmes in your school?

<table>
<thead>
<tr>
<th>Poor</th>
<th>Basic</th>
<th>Fair</th>
<th>Good</th>
<th>Very Good</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

e) Why do you give this rating?

f) How much have you learnt from these professional learning opportunities?

<table>
<thead>
<tr>
<th>Nothing</th>
<th>Very Little</th>
<th>Some</th>
<th>Quite a bit</th>
<th>A Lot</th>
<th>A large amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

g) Why do you give this rating?

iii) Rationale: Data from a UK writing survey taken in 2009 indicates that it is paramount that the school curriculum reflects and utilises writing forms that young people enjoy and engage with, in order to demonstrate that writing is more than a compulsory task: it is an essential life skill.

a) What your understandings and beliefs around utilising multimodal resources to teach writing.

3. Assessment and Evaluation

i) MDT has altered writing habits and practices and arguably there is a need to establish some form of criteria for students’ e-texts. Not having any guidelines in place at all implies that e-textual writing has no value in the writing classroom. We tend to assess what we value.

a) How do you monitor student learning in an on-going basis in writing? Give specific examples eg AsTTle, SEAs etc.

b) How do you see your current assessment practices aligning with those that you think are necessary for evaluating writing using MDT?

<table>
<thead>
<tr>
<th>Not at all</th>
<th>Very Little</th>
<th>Some</th>
<th>Mostly</th>
<th>Totally</th>
</tr>
</thead>
</table>

c) Why do you give this rating?

Comments:________________________________________________________________________

___________________________________________________________________________

_____________________________________________________________________

d) How do the practices allow you to evaluate writing using MDT?

e) To what extent do curriculum criteria enable you to assess MDT?
ii). Writing, particularly writing that is accomplished using MDT, is contextual and the teaching and evaluation of writing needs to become so as well.

a) To what extent do you agree/disagree with this comment in terms of what you consider is consistent with what works when teaching children to write?

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Mostly Agree</th>
<th>Moderately Agree</th>
<th>Moderately Disagree</th>
<th>Mostly Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

b) Comment on your rating:

___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________

_______________________________________________________________

b) Comment on your rating:

___________________________________________________________________________
___________________________________________________________________________

_______________________________________________________________

c) Are there any other comments you would like to make?
PARTICIPANT INFORMATION SHEET

Research Project Topic: Conceptualising multi-media writing of primary school students. What is involved and how can it be assessed?

Participant: Digital Design Practitioner

Principal Investigator: Sue Bedford

Supervisor: Professor Judy Parr

This research is being carried out by Sue Bedford, PhD candidate from the Faculty of Education, University of Auckland, under the guidance of Professor Judy Parr. You are one of approximately six participants invited to participate in this stage of the study. You are under no obligation to do so but I would very much appreciate your input.

I am particularly interested in how learners experience and use multimedia to support writing. I plan to investigate the knowledge needs of teachers to enable formative feedback and the development of a framework of ‘what to look for’ at various levels of competence when students are composing in multimedia contexts.

You are invited to take part in this research because of your knowledge of and skill in multimedia design that is represented in the focus of this study. I seek a detailed understanding of practitioner digital designer participant knowledge in the area of conceptualising the principles of multimodal form and ultimately integrate these with the knowledge and expertise of teachers. I plan to utilise this to work to develop descriptors of what constitutes multimodal form and, in consultation with teacher participants, to examine different levels and combinations of engagement and complexity in the use of multimedia to support the writing process.
I want to gather information from you through an interview (approximately 45 minutes) held at a place that is mutually convenient regarding your understanding of what constitutes multimedia form. With your explicit permission, this interview will be audio recorded. The source of the information provided is confidential to the researcher.

You can ask that the digital audio recorder be turned off at any time. You are able to review interview transcripts and add to them or clarify what you meant. The audio files can be returned to you if you so indicate. All electronic data will be erased after six years and paper data will be shredded at the conclusion of the study.

You may withdraw from participation without giving a reason or withdraw your data at any time prior to the completion of data collection by 1 October 2011. The data you provide will be processed and stored in both paper form and electronically. These records will be stored in a secure data base at the University of Auckland for the duration of the research (until 2016). Neither you nor your employer will be identified in any reporting other than by the identifier known only to the researcher.

A detailed report summarizing data collected from the Digital Design expert participants will be mailed to you and available for discussion in July 2011. These data will be used to inform a group of teacher participants as they work on the development of a framework for examining different levels and combinations of engagement in using multimedia form in writing. The utility of the framework that is developed will be subsequently trialled with a selected group of teacher participants. It is anticipated that teachers may then choose to use these results to shape their on-going work in the integration of multimodal digital technology in teaching and learning programmes that involve writing.

If you wish to take part in the study, please sign the attached consent form and email it to the researcher. I would be pleased to give more information about this phase of the research on request. If you have any questions to ask or concerns you wish to discuss please contact the appropriate person from the list below.

Thank you

Sue Bedford
PhD Candidate
Faculty of Education
University of Auckland
Private Bag 92019, Auckland Mail Centre 1142.
Email: sbed005@aucklanduni.ac.nz

Professor Judy Parr
Associate Dean Research
Faculty of Education
University of Auckland
Phone: 64 9 623 8899 ext 88998
Email: jm.parr@auckland.ac.nz
Dr Libby Limbrick  
Head, School of Department of Arts, Languages, and Literacies  
Faculty of Education  
University of Auckland  
Phone: 623 8899 ext 48445  
Email; l.limbrick@auckland.ac.nz

For any queries regarding ethical concerns you may contact the Chair, The University of Auckland Human Participants Ethics Committee, The University of Auckland, Office of the Vice Chancellor, Private Bag 92019, Auckland 1142. Telephone 09 373 7599 ext 83711

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIPANTS ETHICS COMMITTEE

On 25/02/2011 for a period of 3 years until 25/02/2014. Reference number 2011/009
Appendix 5: Consent Form Digital Designers

**THE UNIVERSITY OF AUCKLAND**
Department of Arts, Languages, and Literacies
Faculty of Education
74 Epsom Avenue, Epsom
Phone: 623 8899
The University of Auckland
Private Bag 92019
Auckland, New Zealand

**THIS CONSENT FORM WILL BE HELD FOR A PERIOD OF SIX YEARS**

**Participant:**
Digital Design Practitioner

**Research Project Topic:**
Conceptualising multi-media writing of primary school students. What is involved and how can it be assessed?

**Principal Investigator:**
Sue Bedford

**Supervisor:**
Professor Judy Parr

This project has been explained to me and I have read the participant information sheet. I have had the opportunity to ask questions and have them answered to my satisfaction. I understand that I am invited to participate as a Digital Design practitioner and I give my consent to be interviewed. The interview will take place at a place and time that is mutually agreeable and will last approximately 45 minutes. I am aware that my participation is voluntary and there will be no adverse consequences for me should I decide not to take part in the research.

- I agree to take part in this research
- I understand that the source of the data obtained is confidential to the research and that my name will not be used in any report
- I understand I am free to withdraw participation at any time, and to withdraw any data traceable to me up to 1 October 2011
• I understand that the information that I provide will be analysed and stored electronically in a secure data base at the University of Auckland until the project is completed in 2016 and thereafter all electronic data will be erased and paper data will be shredded
• I understand that I will have the opportunity to review and edit transcripts
• I understand that a third party who has signed a confidentiality agreement will transcribe the audio files

If you agree to take part in this research please, complete the consent form and hand it to the researcher or enclose and post it in the pre-paid envelope provided.

Name:________________________________________
Signature:_____________________________________
Date:__________________________________________

I agree/do not agree to the audio recording of the interview (delete which is not applicable)

I do/do not want to receive the electronic audio file when transcription is completed (delete which is not applicable)

I do/do not want to receive a copy of the transcript of the audio file

Signature_______________________________________
Email___________________________________________

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIPANTS ETHICS COMMITTEE

On _25/02/2011 for a period of 3 years until _25/02/2014. Reference number 2011/009
Appendix 6: Questions for Technology Practitioners

Background Information

1. Gender
2. Age bracket
3. Tell me about your role.
   - What is the broad area you work in?
   - How long have you worked in this area?
   - Have you worked in allied areas? Briefly describe.
   - Please could you describe for a lay person, what it is that you actually do currently?

Professional Skills and Knowledge: How communication is structured using text, pictures and sound

Let’s begin with a very basic and focused definition of what your understanding is of a multimedia document. Could you tell me what this definition would look like? What areas of meaning making do you associate multimodal documents with? Traditional pen and paper documents? (Probe: what does it look like, how does it differ from a text document?)

Describe your focus when designing a multimedia document. In your experience, what types of knowledge and skills are necessary to create multimedia documents? (Probe: technical skills, knowledge about how people learn or ‘get the message’, delineate knowledge from skills, what influences your choices when you look at image, text or sound)

How do these skills differ for you, from those that may for example be needed when you are making meaning using traditional pen and paper document? (Probe: technical and cognitive, level of complexity). Which do you think is more complex? Why?

Thinking about your intended audience in any given digital design what, for you, is involved in matching elements of design to intended audience? How do you decide which designs are most effective for particular audiences? (Talk about ideas such as attention guidance/direction methods, corresponding elements within text and diagram etc)

Thinking about presenting information in two different forms i.e. multimedia and traditional pen and paper, do you believe your approach to design in these two forms, differs in any way? If so how, if not why not?

If you had to choose a descriptor that encapsulates the nature of multimodal documents what would that be? Similarly pen and paper documents? (probe: what comes to mind when you think of multimodal documents/pen and paper documents)

Students in Years 1–8 should be taught elements of digital design commensurate with their age and ability and to enhance their learning in all areas of the curriculum.

Please tell me how much you agree with this statement.
<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Mostly disagree</th>
<th>Moderately disagree</th>
<th>Moderately agree</th>
<th>Mostly agree</th>
<th>Strongly agree</th>
</tr>
</thead>
</table>

Why did you give this rating?

Comments:
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________

Are there any other comments you would like to make about what you do and the place multimodal forms of communication have in the classroom.
## Appendix 7: Example of the coding process for Teacher Participants

### Question: What are some of the wider issues that impact on your use of multimodal technology in writing?

<table>
<thead>
<tr>
<th>Open Code</th>
<th>Properties</th>
<th>Examples of Participants’ words</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Curriculum</strong></td>
<td>Seeking guidance</td>
<td>...there is absolutely no guidance</td>
</tr>
<tr>
<td></td>
<td>Curriculum not keeping up with the real world</td>
<td>I think they need to relook at how it fits in today’s world.</td>
</tr>
<tr>
<td></td>
<td>Teachers plan and teach to the curriculum</td>
<td>We don’t know …no detail they just don’t mention it</td>
</tr>
<tr>
<td><strong>Leadership</strong></td>
<td>The quality of the leadership</td>
<td>I think there is an all-round lack of leadership and sharing of knowledge</td>
</tr>
<tr>
<td></td>
<td>Articulating a vision for multimodal writing</td>
<td>no leadership</td>
</tr>
<tr>
<td><strong>Technical infrastructure</strong></td>
<td>Networks, wireless high speed broadband, classroom design, building design</td>
<td>spend more money on wireless and setting up for our devices</td>
</tr>
<tr>
<td></td>
<td></td>
<td>With modern technology which you need a proper environment for it to work</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Can’t afford ongoing wireless just the ongoing monthly costs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>operationally too hard on our school with our numbers.</td>
</tr>
<tr>
<td><strong>Resourcing</strong></td>
<td>The extent to which the school and classrooms in particular had access to sufficient technological equipment.</td>
<td>we could have a lot more resources and do so much more with the children if we did have those resources. We don’t have a good range of technology</td>
</tr>
<tr>
<td><strong>Professional Learning</strong></td>
<td>Any training or learning teachers have taken part in either school wide or individually.</td>
<td>no promotion of e-learning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>We haven’t had any PD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Interacting with other keen people and just figuring it out ourselves.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>poor at the moment even though it has been done in the school quite recently</td>
</tr>
<tr>
<td><strong>Technical support</strong></td>
<td>The level and nature of support available to assist teachers with using multimodal resources.</td>
<td>it is hard to get the technician to update things and technical support</td>
</tr>
<tr>
<td></td>
<td></td>
<td>making sure we have the programmes on our computers</td>
</tr>
</tbody>
</table>
## Appendix 8: Axial and Selective Codes based on the open codes for Teacher Participants

<table>
<thead>
<tr>
<th>Open Codes</th>
<th>Axial Codes</th>
<th>Selective Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curriculum</td>
<td>Believing they were not well supported with curriculum and other documents&lt;br&gt;Difficult to guide teaching and learning outcomes&lt;br&gt;Lack of guidance, blaming curriculum content</td>
<td><strong>Influence of Systems Factors on Technology Use</strong></td>
</tr>
<tr>
<td>Leadership</td>
<td>School leaders were not sufficiently skilled to “lead”&lt;br&gt;Powerless to influence leadership</td>
<td></td>
</tr>
<tr>
<td>Technical Infrastructure</td>
<td>Often didn’t work, unreliable.&lt;br&gt;Poor planning</td>
<td></td>
</tr>
<tr>
<td>Resourcing</td>
<td>In sufficient to address the learning needs of all children</td>
<td></td>
</tr>
<tr>
<td>Professional Learning</td>
<td>Not appropriate&lt;br&gt;Poor quality&lt;br&gt;Not targeted&lt;br&gt;No say in school wide professional learning foci&lt;br&gt;Lack of agency</td>
<td></td>
</tr>
<tr>
<td>Technical Support</td>
<td>Use of technological tools&lt;br&gt;Don’t know how to use some tools&lt;br&gt;Lack of time and training to keep up</td>
<td></td>
</tr>
</tbody>
</table>
Appendix 9: Example of the coding process for Design Participants.

Question: What is your understanding of communicating multimodally?

<table>
<thead>
<tr>
<th>Open Code</th>
<th>Properties</th>
<th>Examples of Participants’ words</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple modes of meaning and media types</td>
<td>Using a combination of audio, visual, textual and textural resources</td>
<td>More than one form of media is used... you are drawing on images, sound, type, colour, that sort of thing... It could be images... it could be video footage... it could be text that you have written or has been sent to you</td>
</tr>
<tr>
<td>Specific modes for specific purposes</td>
<td>Different media and modes can perform different functions. A ‘horses for courses’ approach. Different media and modes enhance communication</td>
<td>I organise the advertising material and communication that we send out. I print newsletters for our customers and I maintain the website for the organisation and I look after the communication we have across Facebook and Twitter and that type of thing</td>
</tr>
<tr>
<td>Communicating = multimedia</td>
<td>Typically people communicate using multimedia. Main form of communication is by online multimedia</td>
<td>As far as I am concerned, people communicate multimodally most of the time. It’s not often that you sit down and write with a pencil and paper anymore.</td>
</tr>
<tr>
<td>Screen</td>
<td>Communication is screen based. The context of the screen was the interface when using digital media to create and distribute information.</td>
<td>Designing meaning is done on a screen.</td>
</tr>
<tr>
<td>Screen = intentional design</td>
<td>The screen has a number of properties that must be taken into consideration when designing meaning</td>
<td>Designing something for a screen you have to be very intentional about how it is going to look on the screen. People, for example, have lots of different kinds of screens, different sizes and you’ve got to take that into consideration like colours might look different on different types of screens and the way that it is laid out.</td>
</tr>
<tr>
<td>Complexity</td>
<td>Communication using multiple modes is more complex than using one mode</td>
<td>It’s getting that message across is a lot harder... With multimedia, you have to understand so many processes.</td>
</tr>
<tr>
<td>Open Code</td>
<td>Properties</td>
<td>Examples of Participants Words</td>
</tr>
<tr>
<td>------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Technological complexity</td>
<td>Designers face challenges in keeping up with constantly evolving technologies and the broad spectrum of possibilities contained within the notion of making meaning with multiple modes</td>
<td>I guess the whole notion of using multiple modes to communicate is continually developing especially the way the web is evolving. It could be anything from Web 1.0 to Web 3.0.</td>
</tr>
</tbody>
</table>
Appendix 10: Axial and Selective Codes based on the open codes for Design Participants

<table>
<thead>
<tr>
<th>Open Codes</th>
<th>Axial Codes</th>
<th>Selective Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple modes of meaning and media types</td>
<td>Meaning is made using multiple modes. These can be selected from multiple sources and use multiple media to effect communication</td>
<td>Practices of Design Involve the Use of Online Technology Enabled Multiple Modes of Meaning to Realise Communicative Purposes</td>
</tr>
<tr>
<td>Specific modes for specific purposes</td>
<td>The purpose of the communication will determine the selection the mode and media form. Different modes and media serve different communicative purposes.</td>
<td></td>
</tr>
<tr>
<td>Communication = multimedia</td>
<td>Multimedia and multimodal choices are implicit in the work that designers do. Textual and paper resources are still important but designers design multimodally.</td>
<td></td>
</tr>
<tr>
<td>Screen</td>
<td>The screen is the basic medium of design for digital designers. Information is distributed via a screen which could be computer, phone, hand held device or gaming console</td>
<td></td>
</tr>
<tr>
<td>Screen = intentional design</td>
<td>Design has to be intentional on a screen as it has unique characteristics. The screen could distract or redirect the attention of the user because the screen was not only the interface for digital media but also the conduit for online access</td>
<td></td>
</tr>
<tr>
<td>Complexity</td>
<td>Communicating multimodally has a complex structure as opposed to using a single mode. Many possibilities exist to make meaning multimodally. The challenge of the technology itself is complex as new ideas and tools become available.</td>
<td></td>
</tr>
</tbody>
</table>
References


Law, N., & Chow, A. (2008). Teacher characteristics, contextual factors, and how these affect the pedagogical use of ICT. In N. Law, W. J. Pelgrum, & T. Plomp (Eds.), Pedagogy and ICT use in schools around the world: Findings from the IEA SITES 2006 study (pp. 181–219). Hong Kong: Springer.


