Influences on preservice teachers' attitudes to ICT integration in and through visual arts education: A search for a creative synthesis

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

Ariadna (Arda) Culpan
Cert. Art,
Cert. Ed., Art and Craft Teaching,
B.Ed., M.Ed.

School of Education
College of Design and Social Context
Royal Melbourne Institute of Technology (RMIT University)

August 2012
Declaration

I certify that except where due acknowledgement has been made, the work is that of the author alone; the work has not been submitted previously, in whole or in part, to qualify for any other academic award; the content of the thesis is the result of work which has been carried out since the official commencement date of the approved research program; any editorial work, paid or unpaid, carried out by a third party is acknowledged; and, ethics procedures and guidelines have been followed.

Signed:

Arda Culpan

Date: March 27, 2013
Acknowledgments

This thesis would not have begun without the support of my first, albeit short-term supervisor Professor Nicola Yelland whose belief in the worth of the study and insightful feedback during its formulation provided the much needed courage to commence the Doctoral journey. I am also deeply indebted to Associate Professor Heather Fehring for her overall support and assistance with the RMIT Human Research Ethics application, and for her wise and warm encouragement after Professor Yelland left the university.

Gratitude beyond words is extended to my supervisor Professor David Forrest without whom this thesis would not be. He came to the rescue following a period of serious uncertainty after Professor Yelland resigned. Specifically, he steered me through turbulent times, and was the personification of tolerance as I went off on significant tangents until he reminded me of where I should be heading. His scholarship, expert guidance and trust has been my mainstay in working through this thesis whilst being a part-time student and fulltime teacher, and at times, a wife, daughter, mother, sister and friend.

Also highly valued is the contribution of the preservice teachers involved in the research. Rather than being just the subjects of the study, they were deeply honoured participants who exemplified the power of the individual and collective voice, and above all, the ethos of goodwill and the creative spirit that is so vital to learning and teaching in the 21st century. While I cannot reveal their names, their voices have been integral to the creation of the thesis. There are too many other people to be thanked individually here. Yet, special thanks must be attributed to colleague Andrew Scarborough who transcribed all of my hard copy data into Microsoft Word, Microsoft Excel and graph formats. Also to Louise Prentice who so graciously kept me on track with the administrative intricacies of my candidature.

This thesis would not have been completed without the support of my husband Peter who continued to believe in the importance of my work even when I was at the lowest ebb of the journey. Most importantly, I thank Peter for being an amazing and unwavering companion on this journey, especially for his enduring support, his close reading and his part of the other stories that paralleled the doctoral journey, but are told here.

I dedicate this thesis to the memory of my adored mother, Svetlana, Borisovna Sinayskaya (1925-2010) whose gift to me was my education, my love of art, and above all, her belief in my human qualities. Also to my sons Julian and Tim, may they tell their own stories and continue to speak with their own vibrant and creative voices.
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Abbreviations

The abbreviations used in this thesis are explained in the first usage or are generally self-explanatory from the text in which they appear. Exceptions to these maybe standard abbreviations such as:

ACDE Australian Council of Deans of Education.

ICT Information communication technology, which in the context of this study encompassed the Internet, and items such as one Mac 17’ G4 Power Book and two Mac G4 desktop computers, one Espson Stylus Photo 1290 colour printer, one Kodak Easy Share CX7430 digital camera, one Agfa SnapScan e40 flatbed scanner, one portable data projector, one Momobay Combo 3.5” Portable hard drive, CD Rom and floppy discs, digital print media, including standard Fuji Xerox plain white A4 and A3 papers, 3M Ink Jet Transparency Film, an assortment of textured and transfer papers, and in one instance a standard photo copy machine. The range of computer graphics software included: Adobe Creative Suite 2, KidPix Deluxe 3, Corel Painter X, Fractal Design Painter X, MicroWorlds2.0, iMovie4.0, iPhoto4.0. In addition to the aforementioned items, many preservice teachers independently accessed a range of software programs, and peripherals through their personal networks. During the course of this study, facilities such as an Interactive White Board, fixed Data Projector or wireless Internet connection were not available within the visual arts teaching space.

PP Professional Practice applies to all preservice teachers who undertake teaching practicum as a core component of the teacher education programs.


MIT Massachusetts Institute of Technology.

NGV National Gallery of Victoria

OECD Organisation for Economic Co-operation and Development.

RMIT Royal Melbourne Institute of Technology (RMIT University).

SoE School of Education, RMIT University.

UNESCO United Nations Educational, Scientific and Cultural Organization.

VCAA Victorian Curriculum and Assessment Authority

WWW World Wide Web
Definition of terms

Preservice Teachers: Students in a university teacher education program preparing for professional-level teaching positions. Within the context of this study these people are referred to as students or student teachers or preservice teachers as distinct from school students, pupils or children.

Blackboard: An educational e-learning program available to all staff and students for posting and accessing course information, including learning and teaching support materials.

Flatbed scanner: A scanner that provides a flat glass platen to capture images on paper, or small objects that can then be transferred to text or visual documents via specific software.

Visual arts: A philosophical definition of visual arts is beyond the scope of this thesis, particularly as this would “require a manuscript of book length” (Eisner, 1985, p. 190). Suffice to say that while the concept of art has various meanings depending on the historical and cultural context, in the context of this thesis, visual arts practice involves preservice teachers in creating two or three-dimensional works using a variety of traditional and digital processes and media. Allied to this they explore the work of artists from diverse past and present cultural contexts.
Summary
Influences on preservice teachers’ attitudes to ICT integration in and through visual arts education: A search for a creative synthesis

The study examines the emerging phenomenon of information communication technology (ICT) in education with specific reference to the influences on preservice teachers’ attitudes to ICT integration in visual arts education courses. The impetus for the study aligns with the overarching themes within the national and international discourse. First, the promised advantages of the vast, varied and range of ICT media to promote learning environments that are commensurate with the demands of the information age are not well reflected in art classrooms. Second, the real value of ICT in education is contingent on teachers being imbued with informed attitudes to its integration through access to resources and support, and opportunities for sustained exploration of its possibilities and limitations relative to their discipline area. Third, a logical step in reducing barriers to ICT implementation in art classrooms is to ensure that preservice teachers have opportunities to develop the necessary skills and understandings during their university courses. Implicit here is that art educators should develop their own technological-pedagogical acumen in order to promote preservice teachers’ attitudes to ICT integration both within and beyond the immediate university-based visual arts education courses. Specifically, with respect to their work as graduate teachers who are increasing expected to effectively incorporate ICT as an integral part teaching practice in the key learning areas. As such, visual arts educators need to be explicitly conversant with the intricacies of fusing art and technology and establishing ICT inclusive visual arts education frameworks that promote preservice teachers’ explorations of how ICT might support and extend visual arts trans-disciplinary learning and teaching.

The research design encompassed a qualitative practitioner-based model set predominantly within my own preservice teacher visual arts education courses specific to the RMIT University School of Education. The focus was on updating the traditional modes of learning and teaching within this domain through ICT integration. This involved bringing practice and research together through an exploration of the practical and pedagogical factors relative to establishing an ICT inclusive visual arts education environment. Central to this process was an extension of my own traditional visual arts knowledge base by developing art practice related ICT concepts and skills, before facilitating preservice teachers’ opportunities to: (a) collaboratively generate the technical and conceptual skills needed for making informed decisions about ICT use within the immediate visual arts education context, and their respective school settings; (b) freely ‘voice’ the influences on their perceptions of ICT integration, including the challenges,
limitations and possibilities they encountered. As such, the research is in line with the increased momentum in professional renewal in teacher education and the ICT related recommendations within the Australian Council of Deans of Education, New Learning Framework, and the RMIT, School of Education Plan for promoting ICT competencies within all discipline areas.

The associated multi-modal inquiry encompassed three interrelated phases that preceded the main study and followed a literature search within the fields of the education, visual arts education and the early phases of computer art. The first was the essential groundwork involving ongoing conversations with art teachers, educators and artists within my professional network. These enriched my understanding of the possibilities of ICT integration to stimulate curiosity, inquiry and creative practice in visual arts education, and the associated pedagogical considerations integral to activating its potential. The second used my own visual arts practice as a framework for synthesizing traditional art skills and materials and previously untested digital media. Within this context, my artist-teacher-researcher identity came to the fore through sustained exploration of computer graphics software and peripherals to gain essential insights for inspiring preservice teachers to form a creative synergy of traditional and new media concepts and processes. The third centred on establishing the necessary ICT resources within the visual arts education teaching space and reshaping the long-standing visual art education core and elective courses into ICT inclusive constructs. Collectively, these areas of inquiry, which formed the groundwork for the main study undertaken within my own visual arts teaching context, increased my sense of visual arts education specific ICT self-efficiency.

The main component of the study was designed to gain insight into the factors that shape preservice teachers’ attitudes to ICT integration both within the visual arts courses, and in their professional practice classrooms. To this end, the preservice teachers enrolled in the 2004 visual arts courses were invited to contribute their perceptions of ICT integration to the study. In all 107 preservice teachers participated voluntarily in one, two or all of the following ways: Responding to a written questionnaire; participating in an interview process; permitting aspects of their visual arts journals and creative artefacts to be included in the research data. The subsequent interpretive analysis of the data showed that most participants were initially quite apprehensive about ICT as a stimulus for creative activity, and especially concerned about the diminishment of opportunities to engage with traditional art practice.

The research highlights the importance of providing student teachers with explicit opportunities to generate informed attitudes to ICT integration in visual arts education through exploration in combining traditional art media within a collaborative learning environment. The most consistent
issues for ongoing investigation relate to: (a) time constraints and the inequity of access to resources; (b) minimal opportunities for student teachers to either observe ICT integration, or to test their own ideas in their professional practice school art classrooms. Significantly, very few schools have art room-based computers. Notwithstanding these limitations, the methodological contribution of the study is the establishment of a formative framework for building successively deeper levels of ICT integration and creative practice in the preservice teacher visual arts education courses.
Chapter 1: Introduction to the study

1.1 Preface
The study centred on an exploration of the influences on preservice teachers’ attitudes to ICT integration in and through visual arts education at RMIT University. This chapter states the purpose of the research, the aims, the need for the study to be conducted, and the research questions. The overview includes the background of the research context, including my professional background and philosophy, and the visual arts education context specific to the study. An outline of the methodology applied to the study, and the main areas of the literature covered during the course of the study follows. The chapter concludes with a summary of the limitations of the study, which are presented in terms of recommendations made for future research. The main contribution of this research resides not in its ability to provide directives, but its potential to provide new perspectives, new ways of looking at educational phenomena, and ways of asking new questions (e.g., Eisner, 1972).

1.2 Background to the study
The purpose of the study was to initiate ICT integration within certain visual arts education courses and to work closely with the preservice teachers in order to understand the factors that shape their experiences and perceptions of ICT implementation in and beyond the bounds of the course. In short, it was assumed that their increased skills and confidence in using ICT within the course would be reflected in the way they would integrate ICT in other university courses and their teaching practice. Ultimately, the study was designed in response to the ever increasing discourse within the national and international sphere of education around the imperative of harnessing the potential of ICT integration to advance learning and teaching practices within all discipline domains, including my own field of visual arts education at preservice teacher level. While the main elements of this discourse are threaded throughout the study, the following section outlines the basic features of the prevailing educational climate.

First, at the inception of the study the calls for higher education institutions to establish effective ICT integration strategies within their learning and teaching practices were particularly pronounced (e.g., Burbules & Callister, 2000; Franklin & Peat, 2001). Central to this expectation is the unprecedented availability of wide range of ICT educational resources. The subsequent demands of the information age where knowledge is distinguished by three characteristics, “is highly situated; rapidly changing; and more diverse than ever before” (ACDE, 2002, p. 5). Implicit here is the belief that “almost everything in a university depends on the inner motivation of teachers – their sense of pride, their intellectual involvement with their subjects, their
professional commitment to the role of the teacher, their love of students or of learning (Skilbeck, 2001, p. 87).

Second, the New Learning Principles (ACDE, 2001) became a prominent feature of educational discourse. These principles position ICT as a catalyst for educational reform and project notions of autonomous, collaborative and lifelong learning, and the implementation of ICT to support new approaches to teaching as an alternative to traditional teacher-directed paradigms in that new learning is:

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

Third, visions of reconceptualising the teacher education programs at RMIT University encompassed the call for educators to develop not only students’ skills in ICT use, but also “the potential of this medium for each specialist curriculum area” (RMIT, 2002, p. 21). From my perspective, this meant becoming explicitly conversant with the intricacies of fusing art and technology and to establish ICT inclusive visual art education frameworks (e.g., Whelan, 1991). Specifically, the visual arts education context within my ‘professional landscape’ (e.g., Clandinin & Clandinin, 1995) at RMIT University totally lacked ICT related resources and expertise. Allied to this, other researchers have argued:

Curriculum planners need to consider the importance of creative uses of information technologies…. Students should be undertaking more creative work per se in all subject areas, and should therefore also be undertaking creative work involving technology as a facet of this, if information technology is understood as integrated in and across the curriculum. (Meredyth, Russell, Blackwood, Thomas & Wise, 1999, p. 273)

In keeping with the above, the overarching theme within the education discourse is threefold. First, the advocacy for implementation of ICT in education has been invariably linked to reconstruction of the teacher-student relationship and the culture of the classroom learning environment, and students’ engagement in authentic multidisciplinary learning in all curriculum areas, including visual arts. Yet irrespective of the long-term advocacy for ICT integration, national and international researchers have observed that the promised advantages of the vast, varied and ever advancing range of ICT media to promote learning environments that are commensurate with the demands of the information age are not well reflected in art classrooms. Second, it has been argued that the real value of ICT in education is contingent on teachers
being imbued with constructive attitudes to its integration, not only through access to resources and support, but also opportunities for sustained exploration of its possibilities and limitations relative to the pedagogical considerations within their discipline area (e.g., Delacruz, 2004). Third, if art education ever expects to maintain a core position within the educational system, “it must utilize interactive technology to assume a leadership role in this transaction (Dunn, 1996, p. 11). Thereby, a logical step in redressing barriers to ICT implementation in art classrooms is, as Delacruz (2004) insists, to ensure that student teachers have explicit opportunities to acquire the necessary understandings during their university visual arts education courses.

While Delacruz’s advice reflects her lament about the lack of effective ICT use in the United States visual arts education context, it resonates with my own perspective formed through conversations within my immediate – local professional network, and with art educators during international conferences. Despite the ever-increasing emphasis on ICT integration in art education within the local curriculum publications and the national and international advocacy for ICT integration within the discipline, not withstanding some notable exceptions, the lack of effective ICT integration in art classrooms is quite pronounced. Similarly, in my capacity as a lecturer who routinely visits student teachers in a range of professional practice (PP) schools, I see that while most primary school general classrooms are increasingly implementing various forms of ICT to support learning and teaching processes, this rarely applies to art classrooms. This is not to say that the art teachers are not engaging children in exciting art learning processes. In fact, I have observed numerous exemplary art lessons, and many situations where highly inspiring art teachers have mentored RMIT student teachers. But, in most schools their practice is limited to traditional art practice.

1.3 Background of the research: My professional background and philosophy
Prior to the current emphasis on ICT in education, I qualified as a visual art specialist teacher, and after four years of teaching visual arts in primary, secondary and tertiary settings I commenced my present visual art educator position in preservice teacher education at RMIT University. I teach and co-ordinate numerous interdisciplinary courses, but maintain a constant focus on visual arts education. This commitment stems from my fine art studies, art specialist teacher education, and my art practice. The latter was driven by my innate curiosity about composing disparate aesthetic elements in new ways. It was also stimulated by the positive responses to my early exhibition work, and above all, my recollections of the wonderful guidance I received from my art educators and early career mentors. The enduring influence of these factors sustains my artist teacher identity which resonates with the concept of:
A professional who operates confidently as both an artist and as a teacher; a person who does not see ‘artist’ and ‘teacher’ as mutually exclusive concepts, someone who is a perpetual learner, in experimenting, testing, discovering, and wondering alongside students. (Cole, 2009, p. 6)

The fundamental beliefs that evolved through my professional life have influenced my interactions within it, my inquiry processes (e.g., Creswell, 1998; Denzin & Lincoln, 2000), and ultimately, the direction of the doctoral journey. The elements of my practical knowledge: “the teacher’s past experience, present mind … future plans and actions” (Connelly & Clandinin, 1998, p. 25) evolved through a rich mix of learning theories as indicated throughout the thesis. Allied to these, the research journey was underpinned by a synthesis of the Boyer Scholarship principles of Discovery (research creating new knowledge), Integration (synthesis and interpretation of new knowledge), and Teaching (communication of new ideas so learners can construct knowledge for themselves) (e.g., Glassick, Huber & Maeroff, 1997). Equally inspiring is the notion of the mutually enhancing teacher-student relationship where, through dialogue, “the teacher … is taught in dialogue with the students … students while being taught also teach and “become jointly responsible for a process in which all grow” (Freire, 1970, p. 53). This thought adds heart to my view of creative pedagogies as a mechanism for igniting students’ interest, effort and autonomous learning, particularly through elements of choice with control over challenge, and opportunities for collaborative work (e.g., Steers, 2006).

The pertinence of the above to the current research relates the fact that just before the genesis of the research my “intellectual and moral landscape”, comprising interactions between people, settings and effects” (Clandinin & Connelly, 1995, p. 4) was irrevocably reshaped for two reasons. In particular, due to numerous significant restructures within the Teacher Education sector, and subsequent attrition of the established Art Education Department along with the other long term visual art educators, I became, until recent years, the only constant visual arts person left to design, deliver and evaluate the visual art education art courses. Further, right at this time, the ICT agenda became particularly acute within the teacher education sector, as did the need for the current research. Significantly, the relative inquiry process needed to be managed without the privilege of the collegial interaction with immediate like-minded visual arts educators that I had become accustomed to.

Hence the Latin phrase Sapere aude – Have courage to use your own understanding came to the fore as did the view that research “breaks people out of their ‘sleeping’ assumptions” and prompts them “to begin the processes of work place or individual reform” (Wilkinson & Ehrich, 2000, p. 12) came to the fore. Likewise, the “need to break through the crust of
conventionalised and routine consciousness” (Dewey, 1954, p. 183) was amplified. Although it has been suggested that new technology causes anxiety and a sense of obsolescence for art educators whose teacher education preceded the computer phenomenon (e.g., Delacruz, 2004), I recognised the need for the spirit of “epistemological curiosity” (Freire, 1998, p. 12). Similarly, that “as times change, needs may change too. The genuinely competent educator makes judgements ... not merely on the basis of single convictions, but on an analysis of the context in which the program is to function” (Eisner, 2002, p. 233). Ultimately, the study signifies a constructive response to the call for visual arts educators who are entrenched only in traditional media “to shift beyond conventional approaches to include plural perspectives, and embrace new technologies” (Hickman, 2004, p. 18).

From the inception of my research, I moved from being a confident, independent practitioner and teacher within the spectrum of traditional art practice, to one that was propelled into a seemingly infinite spiral of discovery. In essence, the current research signified the necessity to be immersed in:

Existing knowledge as it is to be open and capable of producing something that does not yet exist.... These two moments of the epistemological process are accounted for in teaching, learning, and doing research. The one moment, in which knowledge that already exists is taught and learned, and the other, in which the production of what is not yet known is the object of research. (Freire, 1998, p. 15)

1.4 Defining the problem: Visual arts education specific ICT limitations

In line with the view that research starts with “problem definition and needs analysis within a particular setting” (Zuber-Skerritt, 2000, p. 48), where the necessity for improvement prompts a reconnaissance of the circumstances of the specific field, three context specific factors were considered:

1. Lack of ICT resources

As the lecturer responsible for the design, delivery, and resource management of the visual arts education courses within the Teacher Education context prior to the inception of the study, and throughout the study period, it was obvious that the existing visual arts education context was devoid of any ICT resources or the associated discipline specific expertise. Although notionally art related ICT could be accommodated in the two newly established computer laboratories within the main teacher education building, these are located three floor levels above the art education studio. In addition, while the Information Technology Services personnel were an indispensable source of support for general issues, they were not in the position of advising on the graphics software applications and the associated issues for visual arts practice. As an added complication, the computer laboratories were calibrated for general ICT activity rather
than specific discipline areas such as visual arts education. For instance, there was no access to digital cameras, a digital scanner or colour printer, and the standard software suite did not include graphics software until I had lodged a specific request well in advance of my class sessions. Even so, the software licenses at that time were limited to three computers whereas class sizes typically comprised around thirty students. As the computer laboratories were in high demand during teaching time, there was very little scope for visual arts education preservice teachers to apply sustained effort in learning graphics applications beyond specified class times.

Consequently, the concept of creating a synthesis of traditional and new technologies in visual arts practice (e.g., Hicks, 1993) was unsustainable. That is, seamless integration of ICT in visual art education requires teaching space for both traditional and ICT applications (e.g., Hubbard & Greh, 1991). In other words, central to flexible learning with technologies is careful planning which ensures that resources are placed in suitable spaces, thus the need “to work very imaginatively with spaces and resources and to convert, re-equip, build and newly equip the spaces needed to realise curriculum aims.… There is a nexus between innovative curriculum development … and planning at all levels” (Meredith et al., 1999, p. 276).

2. Coursework limited to traditional practices
As a result of the above restrictions any well-intended early attempts preservice teachers made to incorporate computer-based visual images and information in their coursework were not only at best of an ad hoc nature, but also revealed limited understanding of selective use of Internet based ideas for art activities suited to promoting appropriate forms of art based learning in primary school classrooms. The same limitations also impacted several purely practical, yet critical facets of facilitating visual arts education course design. First, the long-term provision of traditional learning resources, which was systematically updated, included a significant collection of written and visual resources, including comprehensive notes on various art practice concepts and techniques, as well as old technology projection slides and large art posters. Yet the collection excluded written and visual information on ICT use in the context of art education at school level and artists’ practice and links to Internet based learning and teaching resources. Second, the practice of preservice teachers engaging in the ethos of collaborative learning activity was limited to oral presentations, often supported through overhead projector transparencies or photocopied handouts that invariably included visual images from textbooks and such. Third, the preservice teachers completed two and three-dimensional practice work was essentially submitted for assessment in its entirety. Thus, from an art educator’s perspective, the awkward, albeit, long practiced process of storing the bulk
collection of preservice teachers’ folio work securely during the assessment process, and then returning each student’s work efficiently. The practice of displaying preservice teachers’ artwork in the spirit of honouring their accomplishments and sharing their learning within the broader community of staff and preservice teachers was of necessity limited to a confined wall-based display area within the School of Education building.
3. Lack of technological-pedagogical acumen

Given that people in a setting can solve problems by studying themselves (e.g., Patton, 1990), I acknowledge that my lack of self-efficacy in ICT discipline specific expertise, defined as “belief in one’s capabilities to organise and execute the course of action required to produce given attainments” (Bandura, 1995, p. 3) was another important factor. Until the need for ICT integration became paramount, my firm multi media traditional practice repertoire sustained my enthusiasm in addressing the multi faceted practical and pedagogical considerations of visual arts education. Nonetheless, the genesis of my interest in the fusion of digital technology in visual arts education dates back to 1998 when I was asked to review Frank Popper’s (1997) *Art of the electronic age* for the *Journal of Art Education Victoria* (Culpan, 1998). Furthermore, the concepts of scaffolding and creativity within a student-centred, collaborative environment with an emphasis on student autonomy and critical reflection (e.g., Berge, 1997) were well incorporated in my teaching practice, as were the principles of good practice in higher education (e.g., Biggs, 2003; Chickering & Gamson, 1987). Even so, the lack of technological-pedagogical acumen, which is now a vital component of teacher knowledge (e.g., Mishra & Koehler, 2006), had become a disconcerting feature of my professional identity.

1.5 Context and aims of the study

As described in the Methodology chapter, the main component of the research was applied within the RMIT University School of Education (primary) visual arts education method course for Bachelor of Education (primary) and the Graduate Diploma of Education (primary) students, and the visual arts elective courses available to third and fourth year. Prior to and during the course of this study, I was responsibly for the design and delivery of the above courses. In broad terms, the preservice teacher participants in the study, include male and females who are either Australian born citizens or come from diverse cultural backgrounds and those who entered RMIT University after completing year 12 in Australian schools to those who commence the education programs as mature age students with an undergraduate university degree. There are also the young and mature age International students. Other than acknowledging that study participant’s backgrounds varied considerably, the study did not seek make any distinctions between the participants in terms of their age, gender or cultural background, especially as they shared the common goal of becoming either generalist classroom or specialist primary school teachers.
The fundamental interrelated aims were to:

1. Introduce preservice teachers to the possibilities of ICT media to support and extend their learning of traditional forms of art practice and the associated research, curriculum planning and pedagogical considerations. This includes piquing their interest in the work of digital media artists, and ways in which the basic digital resources can be used in various facets of their coursework.

2. Engage preservice teachers in a shared exploration of the factors that shape their attitudes to ICT integration in their own visual arts education context, and their work in primary school art or generalist classrooms. More specifically, encourage preservice teachers to freely ‘voice’ their perceptions of the ICT associated challenges, limitations and possibilities they encountered.

3. Incorporate the above insights into a revision of subsequent visual arts courses, and contribute to the relevant knowledge base within the broader art education community.

1.6 Research questions

A challenge for any program related to education around ICT integration is to find ways to move beyond the inherent technical and practical elements and to consider the pedagogical, organizational, and critical dimensions of ICT implementation. As Meredyth et al. (1999) state:

An optimum scenario is to attain information technology rich learning environments in which the relationship between information technology and learning activity is not an ‘add on’ but part of an integrated curriculum model. The other is that information technology skills should be developed within such a context of situated learning relevant to the range of knowledge systems with which teachers and students are engaged. (p. 270)

With this in mind the overarching research question was: What are the factors that influence student teachers’ attitudes to ICT integration in and beyond visual art education coursework?

The contemplation of this question led to the formulation of three sub questions, to assist in forming a comprehensive response to the first question:

1. How do student teachers respond to the opportunity to use ICT in visual arts courses?
2. What do student teachers regard as being the key limitations and advantages of using ICT in their coursework?
3. How do student teachers relate this use of ICT to their work in primary school classrooms?

1.7 Groundwork for the study

The research comprised two key components. The first was the groundwork where the fundamental focus accords with Wilson’s (1992) call: “If we are to meet the challenge of the post modern era, those of us who work in higher education have the task of first transforming
ourselves and then transforming art education” (p. 99). In practice this entailed a significant extension of my own traditional visual arts knowledge base by developing art practice related ICT concepts and skills and an understanding of the fundamental requirements of an ICT inclusive visual arts education framework within a particular preservice teacher education setting. In keeping with calls for researchers to acquire significant knowledge about their particular research topic by becoming practitioners in the area they wish to address (e.g., Garfinkel, 1984), I acknowledged the complexity of implementing change and that external information and support, teaching knowledge and beliefs and professional experimentations all impact on the change process (e.g., Clarke & Hollingsworth, 2002). Accordingly, the groundwork involved:

1. Sustained conversations within my professional network with a focus on identifying the most appropriate ways of using ICT in a visual arts education context and basic ICT requirements in terms of hardware, software and peripherals before requisitioning these through the standard School of Education process. In order to establish the necessary ICT resources within the visual arts education teaching space one needs to negotiate with key administrators within the School of Education regarding the purchase and installation of select ICT resources in the visual arts education teaching space. This includes articulating the intended use and the location of the resources on the basis that the fusion of traditional and new technologies within visual arts education entails numerous adjustments to established practice, including a physical rearrangement in the art education space (e.g., Hicks, 1993). Previous studies indicated that the full potential of the advancements made in education technology cannot be achieved without senior management and organizational support (e.g., Cox, 2010; Laurillard, 1993). Basic ICT resources established at the start of the study, or soon after, included items such as one Mac 17’ G4 Power Book and two Mac G4 desktop computers, one Espson Stylus Photo 1290 colour printer, one Kodak Easy Share CX7430 digital camera, one Agfa SnapScan e40 flatbed scanner, one Momobay Combo 3.5” Portable hard drive. Additional ICT items commonly incorporated, in the visual arts learning and teaching practice where CD Rom and floppy discs, digital print media, including standard Fuji Xerox plain white A4 and A3 papers, 3M Ink Jet Transparency Film, an assortment of textured and transfer papers, and in one instance a standard photo copy machine. The range of computer software included: Microsoft PowerPoint 2004, Adobe Creative Suite 2, KidPix Delux 3, Corel Painter X, Fractal Design Painter X, MicroWorlds2.0, iMovie4.0, iPhoto4.0. In addition to the aforementioned items, many preservice teachers independently accessed a range of software programs, and peripherals through their personal networks. During the course of this study, facilities such as a White Board, fixed Data Projector or wireless Internet connection were not available within the visual arts teaching space.
2. Drawing on the expertise of several practicing artists who work with digital media, and were able to offer much practical advice with respect to my intense personal exploration of select ICT resources, including graphics software for art practice and teaching purposes. I was particularly interested in determining the technological possibilities in terms of how ICT could be used to promote creative practice and learning, rather than just using ICT in a generic sense to promote learning. Namely, the need for arts disciplines to move beyond privileging “technology without regard for artistic vision and content” (Dixon, 2007, p. 5) is clear. Allied to this, I identified a range of ways in which preservice teachers might be inspired, rather than directed, to use ICT to support and extend their learning through traditional modes of creative art practice.

3. Using my own visual arts practice as a framework for synthesizing traditional art skills and materials and previously untested digital media. Within this context, my artist-teacher-researcher identity involved sustained exploration of computer graphics software and peripherals in order to gain essential insights for inspiring student to form a creative synergy of traditional and new media concepts and processes. In this respect, arts educators working within the broader discipline of education are expected to be practitioners and experts in a particular field. Thus, visual research with a fine art focus is an appropriate form of creative work that aligns with the concepts of Discovery, Integration and Application within the Boyer (1990) classification of scholarship. My exploration of digital media for art practice informs my teaching practice and underpins my research field through direct experience and knowledge base. In essence, as arts educators need to make explicit to students the values of art making, their arts practice and teaching exemplifies the scholarship of integration as outlined in the Boyer Scholarship of discovery.

A revision of long-standing core and the elective visual arts education courses, and the relative teaching support materials to ensure that new kinds of capabilities are imbued in revised courses, especially to reflect new opportunities for preservice teachers to use ICT along side traditional media. In particular, after experimenting with a range of graphics software programs to ascertain their potential to stimulate a creative synthesis of traditional and digital media art practice I identified ways in which preservice teachers might be inspired to use ICT as a new dimension to: (1) Learning through creative art practice, (2) Devising art lessons for children, (3) Documenting and presenting their work, and (4) The associated research.

The above groundwork together with the initial literature analysis enriched my understanding of the possibilities of ICT integration to stimulate curiosity, inquiry and creative practice in visual
arts education, and the associated pedagogical considerations integral to activating its potential. I especially developed knowledge that was both context sensitive, practical and threefold in line with the growing emphasis on ICT in all areas of education (e.g., Board of Studies, Vic., 2000; VCAA, 2005). This included skills in using software programs for artistic practice, and devising ways to integrate ICT in art education courses, without compromising the inherent value of traditional modes of art practice and pedagogy. I also acknowledged the need to encourage sensitive and sensible approaches (e.g., Lankshear, Snyder & Green, 2000) to the incorporation of ICT. At the same time I determined the need to encourage preservice teachers to make their own decisions about what, when and how they would use ICT, and to generate artistic ideas, evaluate the resources used, to reflect critically on their learning and co-construct immediately relevant knowledge (e.g., Reason, 2002).

In keeping with my long-established practice I appreciated the value of cultivating learning environments where preservice teachers can take creative risks, raise questions, scaffold each others learning and openly discuss their experiences regardless of the media they used (e.g., Culpan, 2008). Rather than risk perpetuating any untested promises of new technology (e.g., Comte, 1993; Nora & Snyder, 2009), I drew on both the constructive and cautionary literature perspectives on ICT integration to guide the essential inquiry processes. Importantly, I recognised there was still much to learn about how preservice teachers might use ICT effectively and that there was no room for complacency in introducing them to ICT inclusive visual art learning experiences. Thereby, the clear need for the main component of the study, which responds to the call for preservice teacher curriculum to move beyond the ICT rhetoric and to translate theory into practice (e.g., Brown, 2001). Equally apparent was the need for a methodology of “inquiry-laden processes” (Irwin & Springgay, 2008, p. 111) specific to determining how student teachers might be best empowered to make informed decisions about using digital media for enriching the tasks at hand within their respective circumstances.

1.8 Methodology
The research, which was established within the paradigm of constructivist inquiry (e.g., Lincoln & Guba, 1985) using both quantitative and qualitative approaches and encompassed an art-based qualitative practitioner model methodology, was underpinned by the view that:

Good teaching cannot be shown to be dependent upon or underpinned by research in all cases but there is a widely shared view that a vigorous, broadly defined research culture should pervade all parts of the university and that there should be a constant endeavour to engage students at all levels in critical, systematic inquiry – which is the essence of research. (Skilbeck, 2001, p. 94)
As the notion of the preservice teachers’ voice was a fundamental component of the research methodology in this study, the research process relied heavily on discussing and interacting with the preservice teachers, sharing questions and critically analysing their actions and their statements about their ICT integration experiences. The very practices of discussing, questioning and asking the preservice teachers to reflect and articulate their beliefs were vital processes in the clarification of the factors that shape their attitudes to ICT integration, the generation of collective knowledge, and the drawing of conclusions (e.g., Reason, 2002). I understood that the nature of the research is important and findings are influenced by whether the use of ICT is studied in natural settings or whether the focus is on a new initiative designed to change practice. In particular, that the introduction of new ICT resources can potentially cause disruption to existing practice, affecting the settings in which ICT is used and “in turn, affect the research findings and influence the implications that follow” (Condie & Munroe, 2007, p. 10). However, while the purpose of the research was to introduce ICT and thereby disrupt, or transform traditional practice, the focus was more on understanding preservice teachers’ attitudes to ICT integration and enacting well-established learning theories than promoting ICT per se. The arts-based research approach applied to this study was:

Less concerned with the discovery of truth than with the creation of meaning rather than shedding light on what is unique in time and space while at the same time conveying insights that exceed the limits of the situation in which they emerge. (Eisner, 1985, p. 193)

Consistent with Eisner’s (2002) notion of arts-based educational research, the collective qualitative data was drawn from two class-based observations, one to one interviews with ten of the study participants, twenty participants’ visual journal and art practice artefacts, coupled with my researcher journal, and a quantitative component – a written questionnaire. It should also be noted that, as an extension to my researcher journal, I established four folders of written and visual material, including, as discussed within the Methodology chapter: (1) Annotated copies of artists’ digital media work; (2) Annotated copies of school students’ and young children’s digital media work; (3) Copies of my own conference papers and published articles; (4) A collection of art practice work developed through sustained personal exploration of digital media.

1.9 Key features of the study

The significant feature of the study is its alignment with the fundamental notion of student-centred pedagogy, which in broad terms, holds that students’ independence in learning is encouraged through discussion, debate and questioning among students (e.g., Prosser & Trigwell, 1999). Implicit here is that teachers’ knowledge, which encompasses rich relationships between content, pedagogy, and technology, has firm implications for teacher education.
Specifically, de-contextualized, didactic approaches to ICT integration that merely emphasize the acquisition of technology skills are inappropriate. “They do not address difficult but crucial relationships between technology and content, and technology and pedagogy” (Koehler, Mishra & Yahya, 2007, p. 744).

Consonant here is Hirumi’s (2002) advice against pedagogical practice where the teacher acts as the centre of epistemological authority in defining learning goals, organizing and presenting content information, and setting performance standards for students. Although such approaches allow students to develop basic computer skills, they often involve a lock-step fashion, moving from one technology to the next, emphasizing the use of different software applications. While this method is useful for short-term use of technology, it often fails “to develop educators' ability to become independent computer users or their ability to create innovative solutions to real-world problems” (p. 509).

Within the context of this study the aim of simultaneously promoting a student-centred learning environment and ICT integration in visual arts education was: "to excite students about learning and develop[ing] a passion for life long learning. The role of the teacher … is as facilitator, guide, co-learner and co-investigator” (Romeo, 2006, p. 153). Philosophically and pragmatically, this quest aligns with constructivist approaches and collaborative learning frameworks and the following interrelated visions of best practice in higher education. First, Barr and Tagg (1995) commend the move in undergraduate education from an ‘instruction’ to a ‘learning’ paradigm as this “ends the lecture’s privileged position, honouring in its place approaches that best prompt learning of particular knowledge by particular students. Accordingly, they cite Guskin’s (1994) premise on the shift from teaching to learning: "The primary learning environment for undergraduate students, the fairly passive lecture-discussion format where faculty talk and most students listen, is contrary to almost every principle of optimal settings for student learning" (p. 13). Second, Marchese (1997) reiterates Entwistle’s (1996) call for university faculty to build students’ sense of control over their work and their capacity “to exercise responsibility for their own learning” (p. 80). Evidently, Entwistle’s research found that tertiary students are more likely to engage in active forms of learning when they believe that their own effort, rather than external factors beyond their control, determines success. Third, Chickering and Gamson’s (1987) seven principles of best practice in higher education include the notion that learning is enhanced when “it is more like a team effort that a solo race…. Working with others often increases involvement in learning. Sharing one's own ideas and responding to others’ reactions sharpens thinking and deepens understanding” (p. 3). Fourth, as Farren (2003) notes, Barnett (2000) calls for university students to be provided with:
Space to make their own offerings, to formulate hesitantly their own insight, to contribute their own suggestions, to create their own products, to develop their own concepts and to engage in their own action. (Farren, 2003, p. 6)

The above perspectives are consistent with the inherent ethos of the study specific visual arts education context, and Eisner’s (2002) call for an “ambient” learning environment or classroom “milieu”, and consideration of its “modus vivendi”. Namely, the sense of “a community of practice”, and how this “relates to what students experience and learn” (p. 71). Also relevant is Craft’s (2003) emphasis on the importance of teachers’ and students’ shared ownership and construction of knowledge in the development of their creativity through a dialogical framework where the interactions of the students, teachers and artists are at the heart of learning. An all-encompassing lens of these concepts is evoked through White’s (2006) concept of a rich active learning environment that links the value of inclusiveness with breadth and variety in creative thinking. The focus here is on an ethical framework underpinned by the facilitator’s support and encouragement of students, especially when they are working in unfamiliar ways. A spirit of collegiality amongst the group is also critical, as is an inclusive atmosphere that embraces innovation and divergent thinking. As previously asserted though not with explicit reference to ICT use, if the celebration of creativity, of student-centred learning, and diversity of learning styles, is to be fostered in our schools, it is vital that creative collaborative learning communities form a central part of preservice teachers’ education in whatever learning domain they are engaged (e.g., Culpan, 2010; Culpan & Hoffert, 2009).

1.10 The Journey begins

Consideration of both the constructive and cautionary literature perspectives on ICT integration in visual arts education prior to the start of the research provided a high level of inspiration coupled with wise forewarning of the possible practical and philosophical complexities involved in a study on ICT use in the creative field of visual arts education. Allied to this, my sustained conversations with ICT using artists and art teachers, followed by an intense exploration of computer graphics programs, shaped my firm conviction that, under certain conditions, ICT can indeed provide exciting visual arts learning experiences for tertiary and school students alike. More specifically, the official discourse around ICT initiatives suggests that increased use of computer technology is the key to increased student engagement, quality learning and positive outcomes. However, my own perspective on the value of educational ICT leaned more towards the advice of Sutherland, Robertson and John (2009):

Learning is enhanced when teachers analyse and understand the potentialities of different ICT tools as they related to the practices and purposes of their subject teaching…. Teachers need to be bought into the
circle of knowledge production about their own practice rather than be bystanders in a process that treats them as objects. (p. 213)

A similar stance on the general education of preservice teachers is taken by John Steers (2006): “Pedagogy should promote interest, effort and self-sufficient learning through elements of choice of media and control over challenge, and opportunities for collaborative work” (p. 10). Accordingly, a condition applied within this study was that the preservice teachers should choose to use either ICT or traditional media or a combination of both in their visual arts practice. That is, rather than any expectation that they simply comply with or reiterate the ICT advocacy that is threaded throughout the curriculum policy documents. In practice, this meant that the preservice teachers were required to use the Internet for research on artists’ work, visual arts curriculum guidelines, and ideas for designing art lessons for children. They also needed to learn the basics of inserting examples of artists’ work, both the traditional and computer art genres and their own art practice into a Word document. With respect to their own art practice they were free to focus on developing conceptual and technical skills in using computer software graphics programs to create visual art compositions, which could be printed as hard copy output, or electronic works in PowerPoint or film format. Otherwise they could concentrate on using traditional media for drawing, painting collage and/or three-dimensional work such as clay or papier-mâché modelling. Alternatively, as indicated in chapter 7.11 ‘How ICT was used’ many searched for a creative synthesis of traditional and new technologies in visual arts practice through a combination of traditional and ICT media. For instance: (1) By creating a paper-based collage, which could then be scanned and imported to Adobe Photoshop for further development. (2) Forming a clay model, which could then be photographed and variously manipulated by use of a graphics program or incorporated in a film format. Of course, I had anticipated that their decisions about their use of ICT for art practice would be based on the preliminary guided explorations, observations and readings rather than on any preconceived ideas about the advantages of ICT within the discipline or otherwise. The key criteria for determining the rigor of their engagement centred on how each person stepped beyond their perceived comfort zone to extend conceptual and technical skills in their chosen media, and their ability to reflect critically on their progress within the written component of their visual journals as well as the class-based discussions of their final work.

Implicit above is the notion that many preservice teachers enter education programs with a wide range of preconceptions and misconceptions about ICT implementation (e.g., Compton, Davis & Correia, 2010). Thus, it follows that the preservice within this study required opportunities to access, engage, and activate their basic beliefs “about technology and its role in teaching and learning” (Sadera & Hargrave, 2005, p. 297). This includes opportunities to
acknowledge and understand their previously unexamined tacit beliefs and to “develop alternative beliefs” (Knowles & Holt-Reynolds, 1991, p. 103). As Hooper and Reiber (1995) note: “one of the hallmarks of a master teacher is the ability to recognize and repair students’ misunderstandings and misconceptions” (p. 165).

In contemplating these concepts in relation to the quest of promoting preservice teachers’ attitudes to ICT integration in visual arts education, I came across Coleman’s (1987) quotation from Elizabeth Janeway’s (1974) writing on change, and was taken by the resonance it held for my thinking about the wisdom of facilitating ICT use within my own visual arts education context:

The movements to retrieve old skills and to live and work according to old work patterns are exercises in nostalgia. The huge and challenging task for art today is … to catch the spiky monstrosities spawned by technology and learn how to integrate them into a human world. (Coleman, 1987, p. 239)

In a similar way, but more specific to the general use of technology in education rather than art practice, Howard Gardner (2012) advises:

What the future requires is being part of our computerized world and being on the cutting edge of having a “disciplined mind” thinking like an expert…. With the guidance from teachers, the students have got to start disciplining the mind to take advantage of how to solve problems in multiple ways and the use of computers enhances that ability. We need not to hold back the curious; eager disciplined thinking minds wanting to stretch beyond the set boundaries. (p. 4)

Gardner’s (1993) theory of multiply intelligences (MI) was also applicable, and in line with Kezar’s (2001) acknowledgement that meeting the learning needs of diverse students is the area with the greatest implications for higher education. As such, she recommends the application of MI in tertiary education, and the use of computers to: “aid in providing alternative work spaces and stimulus in higher education” (p.150: “The contribution of Gardner’s theory is the pluralistic view of the mind; it invites us to recognize and nurture the varied human intelligences” (p.143). This reference to Gardner’s work resonates with my own view of its relevance to education in that all disciplines need to strive more than ever to honour the values evoked in Gardner’s (2007) *Five minds for the future*, which synthesises his earlier MI perspectives and centres on the “pentad of minds” encompassing the “disciplined mind; the synthesising mind; the creative mind; the respectful mind and the ethical mind” (p. 163).

The research journey began tentatively, albeit with an unreserved commitment to facilitating the best possible learning opportunities for preservice teachers to develop understandings about ICT implementation in and through visual arts education. Although as Hennig (2000) notes, the
idea of teachers as participants in the learning process, in the same classroom as their students, “is discomforting for some people” (p. 40), I welcomed the opportunity to work with the preservice teachers through a process of integrative collaborations which:

Thrive on dialogue, risk-taking, and a shared vision. In some cases the participants construct a common set of beliefs, or ideology, which sustains in periods of opposition or insecurity. Integrative partnerships are motivated by a desire to transform existing knowledge, through styles, or artistic approaches into new visions. (John-Steiner, 2000, p. 203)

Despite my sustained exploration of ICT for art practice purposes, and ongoing commitment to student-centred and collaborative pedagogy, I had no prior experience with ICT in the visual arts education context on a whole class basis. Yet, I sensed that this could be a mutually rewarding opportunity for the preservice teachers and myself to search: “for occasions for listening to a blue guitar, to imagination working in novel ways with materials not ordinarily well-known” (Greene, 2001, p.152). In other words, “teachers themselves need to feel free to innovate, to explore, and to play. Teaching is not an act modelled after a sequence of a highly efficient assembly line” (Eisner, 1979, p. 161).

A pertinent consideration was Papert’s (1987) advice that teachers’ need to acquire the ability to critically assess the value of computers in their respective settings: “The purpose of computer criticism is to understand…. The result may well be to debunk. But critical judgment may also open our eyes to previously unnoticed virtues … the critical and creative processes need each other” (p. 22). Thus, the importance of assisting teachers to develop “computer software assessing and selecting skills at pre-service level” (Squires & McDougall, 1994, p. 1), particularly as in-service professional development programs generally lack well designed computer literacy programs related to art education pedagogy (e.g., Dunn, 1996).

Furthermore, the impediments to art teachers’ acquisition of new technology skills after they graduate often include their isolation from teachers in other learning areas. Therefore, they may have inadequate access to relevant peer support and inspiration (e.g., Hubbard & Greh, 1991). In addition, while art teachers typically rely on an established body of documentation on traditional art practices to support their teaching, the information on the relatively new genre of computer-mediated art is quite limited (e.g., Culpan, 2004). Also of course, the visual arts software and peripherals are quite different to those typically used in general classrooms, thus teachers working in other learning areas do not necessarily have the appropriate skills, interests or time to provide the art teacher with visual art specific peer support. An equally important view is that professional credibility in any area of education requires teachers to understand that:
Computers are never a panacea. They cannot carry on good conversations, which is the essence of good teaching…. Computers may multiply the teacher’s effectiveness, but they do not replace him/her. Computers serve learning best when they link teacher, student and information in new, more effective ways (Wilson & Davis, 1994, pp. 187-188).

With reference to visual arts practice an apt lens for encouraging preservice teachers to broaden their perceptions of visual arts practice beyond the traditionally validated media holds that: “Technology in its relationship with art should be adventurous rather than mechanical” (Davis, 1973, p. 139). The same view has reverberated through the art and technology literature ever since the time of the pioneering computer artists. For instance, the art historian Jeremy Kingston (1980) called for a creative synthesis of art and computer technology: “Artist’s creative powers must face the supreme challenge. The time for experimentation has come, and a new interpretation or means of expression must be sought” (p. 17). Above all, the approach to introducing preservice teachers to the multi media capabilities of computer software programs and peripheral devices for art practice drew heavily on the notion of co-operative inquiry where researching with people means that they are: “engaged as full persons, and the exploration is based directly on their understanding of their own actions and experience, rather than filtered through an outsider’s perspective” (Marshall & Reason, 2007, p. 373).

**1.11 Significance of the study**

The study adds to the literature on the integration of technological innovations where the consequence of its implementation in education is the prime focus. As little material was found relating to this area in visual arts education at preservice teacher level, the study makes a valuable contribution. As a critical element in the thinking of teachers about using computers for education appeared to be the consequences for the children in their respective classrooms, this seemed to be a vital avenue to pursue. The value of a research focus that facilitates student teachers’ engagement in a co-inquiry approach is that, as this study has shown, it enables shared understandings of the factors that shape their perceptions of ICT implementation in and through visual arts education. This perspective aligns with the ever increasing focus ICT use in the Australian visual arts curriculum documents as outlined in Chapter 3.15 ‘ICT influences on national and state curriculum perspectives’. It is also consistent not only with calls for concerted approaches to ICT integration in preservice teacher education, but also for research on teachers’ attitudes toward ICT integration in their early stages of technology implementation (e.g., Rogers, 1995). As understood from the literature, earlier research studies sought to understand the cause of the predominantly ineffective ICT integration in schools by focussing on the influences on inservice teachers’ ICT practice in
The importance placed on promoting teachers’ attitudes to ICT implementation is based on the belief that their attitudes, ideals and prejudices assert significant influences on students in that negative teacher attitudes limit students’ progress in ICT education, which is a vital area in a changing society. In this light, Meredyth et al. (1999) suggest that ICT integration necessitates developing not only of technical skills, but also understanding of the social and cultural relevance of learning activities, the capacity to transfer knowledge and skills to new tasks and situations, and the ability to think broadly and critically about the impacts of human activities on each other and the environment. They also remind us that Carlson (1994) who, believes that more than any other single factor, teachers’ beliefs influence what they do in the classroom, highlights the need to:

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

The relevance of this advice to preservice teacher educators resides in the fact that effective teacher preparation increases the confidence required for successful classroom practices (e.g., Darling-Hammond, 2000). Similarly, that student teachers’ visual arts education has a powerful influence on their art education beliefs and values, and their receptiveness to new ideas (e.g., Eisner, 1972; Grauer, 2000). Despite this and the reasons stated within the curriculum documents and the literature regarding the need for art educators to generate the knowledge and skills required for promoting student teachers’ attitudes to ICT, there is at best, meagre mention of how this might be done. In addition, very little is known about preservice teachers’ beliefs about ICT integration in visual arts education.

In addition, the urgent need for Australian research to inform educational practice in relation to ICT use is well noted (e.g., Yelland, 2001) as is the fact that despite the central role of
educational applications of technology, there has been relatively little research on how and why Australian teachers use ICT (e.g., Abi-Raad, 1997). Also known is the enormous variance in the ICT competency of entry student teachers’ skill levels, preconceived ideas about the use of ICT in the classroom, and diverse attitudes towards computers (e.g., Romeo, 2006). Yet little is known about the nature and extent of ICT integration in various teacher education courses or how the associated challenges are managed. Accordingly, Aland (2004) calls for more concerted Australian research on ICT implementation in visual art education, and other Australian art educators note that the current international enthusiasm for arts education research is not reflected with the same zeal by Australian educators (e.g., Gibson & Anderson, 2008).

With respect to the scarcity of Australia research on ICT integration in visual arts education, I suggest that this might also reflect a range of practical challenges faced by visual arts educators, such as those that I have experienced throughout and beyond the study period. Specifically, in terms of the inherent demands of organising computing facilities, technical support and software availability, as well as attending to the required traditional arts practice amenities. As observed with respect to other Higher Education contexts, university infrastructure is invariably challenged in keeping abreast of rapid developments in ICT (e.g., Candy, 2004; Laurillard, 2002). Thus, while the implicit purpose of implementing ICT is to enhance learning and teaching practices, increasing responsibilities for teaching and research can pose substantial challenges for academics needing to design, and make possible new kinds of resources and interventions (e.g., Applebee, Ellis & Sheely, 2004).

Irrespective of the above, this study has addressed the aforementioned gap in the research and identified classroom practice, influences and motivations to use ICT with student teachers. In addition to presenting a wide range of literature perspectives on the ICT advocacy in education, including the perceived advantages and cautionary facts of ICT integration in the broad sphere of education, and visual arts education, the study has identified a sphere of overlapping influences on student teachers’ attitudes to ICT integration in visual arts education. The study also demonstrates the depth of change that can occur within a learning context when a critical, pedagogical perspective guides the learning process. Despite the numerous inherent challenges, especially as ICT integration in visual arts practice is vastly different to general learning and teaching activity the rewards are clearly evidenced. Students now systematically use ICT in a more seamless manner for researching information, keeping visual journals, creating electronic presentations and sharing learning experiences with class peers as well as the broader community of education students. They incorporate ICT learning tasks in cross
disciplinary lessons for children, use software to create ‘still’ or animated visual images, manipulate images created through traditional means and learn about ‘new media’ artists alongside ‘traditional media’ artists. The process of ICT integration continues to stimulate peer scaffolding and collaborative learning. Another advantage is that the students now use ICT with more discernment and find ways to integrate their arts learning across disciplinary boundaries, and in preparing their Professional Portfolios. This is well evidenced by third and fourth year where students devise projects with relevance across the primary school curriculum and engage in creative, purposeful and experimental learning with ICT.

At a result of applying a critical perspective to such practice, future recommendations in relation to ICT use in classrooms have been identified through a co-inquiry research process that aligns with Senge’s (1994) vision of learning organizations: “where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning how to learn together” (p. 3). In the same way, it highlights that while constructive dialogue can not be forced, it can be nurtured through conditions under which it can occur. These include the internal climate where the dialogue initially requires:

A facilitator, who can help set up this field of inquiry, and who can embody its principles and intention. But … the facilitator should not be seen as the "prime mover," "leader," or "cause" of the dialogue session. Instead, it's helpful to think of dialogue as a process with no single "cause" or "prime mover." Putting the conversation together is a collaborative effort. It doesn't depend on any individual's intelligence. Over time the process should evolve toward a collective facilitation, with reliance on the dialogue "expert" diminishing to nothing. (Senge, Roberts, Ross, & Smith, 1994, p. 356)

The ways in which students access information, and prepare and present course material, the study also shows that: (1) The fundamental skills in appropriate ICT use broadens student’s conceptions of art beyond the traditionally validated art forms. (2) ICT integration provides students with opportunities to work with diverse combinations of traditional and ICT based media. (3) These skills are essential to promoting their confidence and discerning use of ICT in either art or generalist classrooms at primary school level. In particular, when a more complete understanding of traditional art tools and techniques is acquired, the artistic mind can explore variations on the techniques. So it is with the spectrum of computer imagery.

The co-operative inquiry paradigm applied within the specific visual arts education setting has highlighted the importance of harnessing the power of the students' voice through explicit opportunities to develop informed attitudes to ICT integration. It also marked the beginning of a fluid and flexible interplay of students’ learning of traditional art concepts and practice, and
stimulating use of ICT resources. In effect, it facilitated a substantial start to taking visual arts education in a new direction, utilising ICT to foster new approaches to the learning and teaching of visual arts rather than undermining the fundamentals of traditional art practice. The co-operative inquiry approach has also demonstrated how a preservice teacher education environment might truly become a community “in which each co-operative learner, including the teacher, shares equality in the inquiry and discovery process” (Dunn, 1996, p. 11).

Finally, this study has responded to the call for more research in preservice visual arts education and identified classroom practice, influences and motivations pertaining to students’ use of ICT. It has considered a wide range of literature perspectives on the advantages and cautionary facts of ICT integration in the broad sphere of education, and visual arts education. Of equal resonance is the description of an effective learning organization as:

One that learns continuously and transforms itself. Lessons must be captured, shared, and used … so that this collection of people, working together, join in charting the way they respond to challenges within and outside their institutions… individuals can join together to mutually create new knowledge. (Marsick & Watkins, 1996, p. 18)

1.12 Outline of the thesis chapters
The conceptual underpinning of this study is threefold. First, tertiary education has a significant role in developing beliefs and attitudes about teaching art in the primary school. Second, an infusion approach in preservice teacher education is more likely to lead graduate teachers’ effective use of ICT to support school students’ learning (e.g., Downes, Perry & Sherwood, 1995, p. 34). Specifically, explicit learning experiences with new technology should enable student teachers to be well informed about incorporating ICT in their teaching contexts, and thus assist in contributing to the pedagogical changes that have long been anticipated in schools. Third, the long-standing view within the national and international discourse of visual arts education that the discipline does not exist in a vacuum, separate from the current cultural epoch emanating from the overwhelming impact of the rapid advancements in ICT on society, the broad sphere of education and artists’ practice (e.g., Grenfell, 1991). Therefore, the intricacies of enacting recommendations for ICT integration, and achieving a creative synthesis of ICT with visual arts education are explored in the context of the following chapters:

• **Methodology.** The chapter, which precedes the literature review that is integral to the study, describes the alignment of the methodology with the constructionist epistemology, and recapitulates the purpose of the research and the questions posed. It also shows that the theoretical perspective underlying the study encompasses the ethos of interpretivism. Allied to this is a discussion on the rationale for selecting the specific study context and how the data
were generated, gathered and analysed. Also described are the considerations specific to the issues of my own subjectivity and bias with reference to human research ethics.

- **The impact of the ICT phenomenon on the broad context of education, and visual arts education: An overview of the ICT advocacy.** This chapter explores the increasing belief in the potential of implementation of ICT in education to promote a wide range of universally appealing learning and teaching concepts across a range of educational levels and discipline areas, including visual arts.

- **The cautionary perspectives on the ICT advocacy.** The literature covered in this chapter precludes any naïve assumptions of the advantages of ICT, least of all for visual arts education. It also illustrates the importance of careful ICT implementation planning, and raises concerns around how technologies are being used in schools and whether they are simply reinforcing old forms of pedagogy. Similarly, that the focus on ICT in education integration might overlook issues of the appropriate uses of new media. In all, it seems that ICT advocacy is at odds with realities of many art education contexts.

- **Constructive perspectives on ICT integration.** Essentially, readings cited in this chapter underline the need for a focus on establishing pedagogically rather than technology-driven methodology for integrating ICT, in all discipline areas including visual arts, into courses at preservice teacher education level. Associated here is the importance of arts educators’ firm knowledge base in scaffolding student teachers’ ICT integration fluency within the discipline.

- **A historical perspective on computer art.** The essence of this chapter aligns with calls for new ways of perceiving and conceiving visual arts and the need for art educators to gain insights into the ways in which computer art, through its pioneering practitioners, exponents and critics, set the foundation for the current thriving field of art and technology with respect to the current possibilities for artists’ practice and visual arts education. Furay and Salevouris (2000) agree that through studying history, we may better understand the present. Thus, it follows that the past and present should inform the future remains true in an educational ICT context despite the transience of the media itself.

- **Findings of the study.** This chapter relates to conclusions drawn from the data, restates the research questions and the purpose of the study, the visual arts education context specific to the study and the underpinning pedagogical concepts. In particular, it discusses the data drawn from the written questionnaire responses, interview conversations, class-based observations, and the participants’ visual journals and art practice artefacts. As such, it shows how the study was able to determine not only the relevance of ICT in visual arts education, but also the importance of underpinning ICT integration with well-formed pedagogical principles. Specifically, the students’ new learning opportunities and experiences were situated within a complex framework of practice.
• **Reflections on the research journey and conclusion.** The chapter revisits the study from a personal perspective and attempts to make more transparent the impact of a researcher working within a co-inquiry process with students. The value of promoting the students’ voice through the opportunity to experience and contribute to the task of constructing a mutually beneficial knowledge base is quite apparent.

![Figure 1: Visual representation of the study](image)

1.13 Limitations of the study

Notwithstanding the value of the study with respect to advancing my own and the students’ knowledge and skills in ICT integration in visual arts education, and the identification of factors that shape students’ attitudes to ICT integration, the limitations of this study are clear, as defined in the following four stands:

First, the focus was on identifying the factors that impact on student teachers’ attitudes to ICT integration in visual art education within two visual arts education courses specific to one school of preservice teacher education rather than across a range of courses and institutions. Although it is hoped that the current study will provide valuable insights for both national and international art educators who are grappling with ICT integration, there is scope for a broader study that captures the state of play across both national and international boundaries. Specifically, the characteristics of the study context, and the study participants may not be fully representative of learning needs and interests of preservice teachers in the broader sphere of the discipline.
Second, the study did not extend to tracking the ICT implementation practices of the student teachers after they graduated. Therefore, a challenge for future researchers is to investigate the ways that graduate teachers, across a range of national and international contexts, are able to retain and extend their enthusiasm for taking either an art specific or cross-curricular approach to ICT integration in their respective classrooms. Ideally, this would be a longitudinal study that captures the factors that shape student teachers’ attitudes from the start of their education course through to the early years of their teaching careers. This might include exploring whether or not any graduate teachers have been able to gain positions in art classrooms that are well resourced with ICT, or to redress the lack of ICT resources in art classrooms within their schools. Also where applicable, how this was done, and what type of school management support was required. In fact the support of my own senior management was critical to my acquisition of the ICT resources needed to integrate ICT within the visual arts education courses specific to this study. An equally relevant exploration would be around the graduate teachers’ opportunities to keep abreast of technological developments in the field of arts education and artists’ practice.

As Sime and Priestley (2005) point out, even the student teachers with sound ICT skills will hesitate to apply them in teaching if the physical, human or cultural factors in the school are not adequate for an efficient integration of ICT in classes, especially if their prior experience of using ICT has been troubled by technological problems. They also note that Doyle and Ponder (1977) assert that even where pedagogic use of ICT within a school is strongly congruent with the values of the novice teachers, “a lack of instrumentality and potentially high professional and personal costs are clearly issues facing them” (Sime & Priestley, 2005, p. 131). As such, continuing research is needed to explore how graduate teachers adapt to the school culture within their respective schools, and how the schools harness the knowledge and skills that the newly qualified teachers bring to the profession. In light of the limited access that the student teachers within this study have had to ICT inclusive art classrooms, future research might also seek to identify ways in which the graduate teachers, who have managed successful ICT integration in their respective schools, might be engaged in forming a community of practice that can contribute to the technological-pedagogical knowledge of the students within their local schools of preservice teacher education.

Third, the data generated by this study revealed that the students were willing to utilise their learning of ICT in more ways than I had anticipated. As such, their collective visual journals contained a diverse collection of informative photographs of themselves and their peers in
varying stages of their in-progress work and presentation sessions. These included self-portraits based on digital photographs that were then digitally manipulated in numerous ways to show how certain software programs can serve to enhance, distort or exaggerate their own physical features. There were also many photos taken of the children as they worked in the professional practice school classrooms, and photos of children’s art related work, including a few children’s computer aided self-portraits. However, as I had not anticipated the emergence of the wealth of visual data, I made no provision for the inclusion of this in the thesis with respect to my human research ethics application. Hence, my application was approved on the basis that the identity of all study participants would remain anonymous.

1.14 Final word
It is important to note that while the actual data collection phase of the study was conducted during 2004, my commitment to promoting students’ skills and knowledge in ICT integration, has been a continually evolving process ever since.

My exploration of the pedagogical and artistic relevance of ICT integration and the factors that shape students’ attitudes in this regard continues to be my primary research focus, and is totally consistent with the following advice:

A core series of appropriate skills and knowledges provides a lasting baseline of abilities – lifelong skills – that can be enhanced with further learning…. This should not diminish the attention given to the continual acquisition of specific skills and knowledges necessary for using more recently developed tools. (Meredyth et al., 1999, p. 291)
Chapter 2: Methodology

*The practice of science is itself an art pervaded by passion, dependent upon imagination, filled with uncertainty, and often motivated by the challenge and joy of the journey.*

(Eisner, 2002, p. 379)

2.1 Introduction

The focus of this chapter resonates with Eisner’s view of research as being full of uncertainty and stimulated by the inherent challenge and thrill of the journey. The chapter begins by outlining the purpose of the study, and restating the research questions. A description of the methodology adopted for study, the rationale for selecting the specific study context, the basic characteristics of the study context and the participants follows. Allied to this is an account of how the data were generated, gathered and analysed. The considerations specific to the issues of my own subjectivity and bias, and research ethics are interwoven throughout the text and discussed more explicitly near the close of the chapter.

2.2 Purpose of the study

The curriculum documents, and the literature within the national and international field of education and art education, illustrate the myriad calls for visual arts educators, to acquire the skills and knowledge necessary for promoting student teachers’ attitudes to ICT implementation in and through their discipline field. These calls, coupled with the fact that the visual arts education context within my “professional landscape” (Clandinin & Connelly, 1995) totally lacked ICT related resources and expertise, fuelled the impetus for the study. In short, the study centred on building a viable ICT inclusive visual arts education framework, and gaining insights into the factors that influence student teachers’ attitudes to ICT integration within a particular preservice teacher education setting. Despite the increasing emphasis within the literature regarding the imperative of effective ICT integration in visual arts education at school and preservice teacher education level, there is little mention of how student teachers might be scaffolded in developing a firm understanding of the artistic and pedagogical potential of digital media.

In light of the above, the research comprised two key components. The first, as explained in the introductory chapter, entailed the groundwork, including a careful revision of both the core and the elective visual arts education courses. Allied to this was the establishment of teaching support materials to reflect the first time opportunities for students to explore the potential of ICT to support and extend their course-based learning. Importantly, the insights I had gained into both the advantageous and cautionary facets of ICT in education though the initial literature search, coupled with the groundwork, formed my nuanced understanding of the complex
relationships between technology, content and pedagogy, and the need to develop appropriate context specific strategies. This meant that I was able to identify the most appropriate ICT hardware, software and peripherals required for ICT integration in visual arts education. My understanding of the artistic and pedagogical relevance of specific ICT resources was especially vital in substantiating my negotiations with key administrators within the School of Education regarding the purchase and installation of select hardware, software and peripherals in the visual arts education teaching space, and the subsequent establishment of basic ICT resources in the visual arts education teaching space at the start of the second component of the study.

Above all, the groundwork enriched my understanding of Cerych’s (1985) advice that education should counter balance some of the over-optimistic propositions about the magic powers of information technologies. “Such propositions, however true … lead almost inevitably to disappointment…. Desirable computer education will not come into being spontaneously, nor will it be the result of a foolproof plan” (p. 9). Thereby, I developed my technological-pedagogical acumen before attempting to encourage students to take sensitive and sensible approaches (e.g., Lankshear et al., 2000) to incorporating ICT. I recognised the need to only model selective use of ICT in my course delivery, but also inquiry behaviour, and to explain my own action choices about ICT use to students (e.g., Reason & McArdle, 2004). Encompassed here is the view of engaging the students as co-researchers through mutually supportive discussions about both the inspiring and cautionary facets of ICT integration as they applied to their own coursework and their work in school classrooms.

At the same time, I needed to promote their confidence in making decisions about what, when and how they would use ICT, generating artistic ideas, evaluating any resources used, reflecting critically on their learning and co-constructing immediately relevant knowledge (e.g., Reason, 2002). Thus, the importance of cultivating a collaborative learning environment where students take creative risks, raise questions, freely scaffold each other’s learning and openly discuss their experiences regardless of what media they use (e.g., Culpan, 2008a). Essentially, the teaching and research nexus in higher education involves students in not only meeting pertinent course objectives, but also in attaining the level of autonomy that enables them to engage with articulate discourse and critical self-evaluation (e.g., Barrow, 1991). In all, this approach aligns with the aforementioned New Learning Framework (ACDE, 2001) proposed as an alternative to the traditional teacher-directed paradigm. This framework underlines the increasingly diverse nature of the student population and the wide-ranging competences
required for successful functioning within an ever-changing society. In particular, it encompasses notions of autonomous, collaborative and life-long learning, creativity, and ICT integration, as essential elements of New Learning.

2.3 The research context: Visual arts education coursework

The main component of the study encompassed two visual arts education courses:

The first was the three hourly six-week visual arts education method course within the first year of the four-year Bachelor of Education program, and the one-year Graduate Diploma of Education program. This course, which was designed to facilitate students’ guided and autonomous learning through a synthesis of learning theories and open-ended visual arts practice experiences, encompassed a trans-curricular approach to teaching visual arts in primary school settings, and involved students in:

1. Fundamental research of text and Internet based information on artists and art practices across a range of historical and cultural contexts, including not only the traditionally validated art genres, but also the computer art variety, and learning theories. Apart from learning about art and artists, this research component was set to support students in extending their general discipline based knowledge. Of equal importance was the generation of ideas for their own art practice work, as well as those for designing art-based lessons for either general or art specific classrooms in primary and middle years of schooling.

2. Introductory, open-ended, studio-based two and three-dimensional traditional art practice in the fundamental areas of drawing, painting, collage, paper weaving and papier-mâché or clay modelling. Here the focus was on: (a) exploring the key visual design principles such as line, shapes, colour, tone, texture, balance and form; (b) developing aesthetic sensitivities; (c) generating conceptual and technical skills through a range of traditional, and where possible, digital media.

3. Using simple software programs, digital cameras or scanners to document, in both written and visual form, their research and the key aspects of their art practice work, as well as their ideas of how these experiences might inform their planning of art-based lessons for the students in their practice school settings.

The second course was an optional visual art elective comprising twelve weeks of three hourly classes for third and fourth year Bachelor of Education (primary) students. The important distinguishing features between this and the method course are that apart from this being a twelve week rather than six week course comprising 25 students rather than 30 students, it was expected that the majority of the students had at least some background knowledge of both art practice and ICT, as well as more experience in PP school settings, both as observers and
novice teachers. In addition, as this is an optional course, it seems to attract students who have a particular affinity for art practice for their own personal development, and/or for enhancing their capacity to teach art. This course was designed to build on students’ prior learning and to promote higher levels of creative activity and student autonomy. Students were scaffolded (e.g., Culpan, 2008) in initiating arts-based projects that were based on either an individual or small group-based basis. In broad terms, their work entailed:

(i) Research on a specific self-selected topic related to any one or more of the following areas: (a) artists and art practices; (b) developing ideas for their own art practice; (c) generating information and ideas for designing art-based learning and teaching materials for either general or art specific classrooms in primary up to the middle years of schooling.

(ii) Studio-based work in a self-selected media, or as an alternative, creating an art-based teaching resource such as a booklet or a multimedia product on a particular topic, or a combination of selected art-based learning and teaching resources.

(iii) Documentation of their research and their evolving art practice, or where applicable, their processes in developing teaching resources.

(iv) The class-based presentations of: (a) the initial project proposal; (b) mid-semester progress report; (c) the culmination of their learning processes, including the sources of information/inspiration, the challenging or frustrating elements of their learning journey, as well as critical reflections on their working processes.

2.4 Research questions

Following the groundwork, the study addressed the overarching research question:

1. What are the factors that influence student teachers’ attitudes to ICT integration in and beyond visual art education coursework?

The setting of this question considered the need for flexibility in responding to an evolving research context where: “We refrain from assuming the role of the expert researcher with the ‘best’ questions” as questions change during the research process to reflect, “increased understanding of the problem” (Creswell, 1998, p. 19). As sub questions can facilitate systematic exploration, and a well-informed albeit flexible approach to the study (e.g., Polit & Hungler, 1999) questions 2, 3 and 4 emerged to assist in forming a comprehensive response to the first question:

2. How do preservice teachers respond to the opportunity to use ICT in visual arts courses?

3. What do students regard as the key limitations and advantages of using ICT in their coursework?
4. How do preservice teachers relate these factors ICT to their work in primary school classrooms?

2.5 Rationale for the study
The main premise of the study is that investigations might encompass ideas, theories, concepts and procedures coupled with the act of inquiry where there is an underlying assumption “on the part of the researcher that things are not right as they are or, most certainly, are not as good as they might be” (Wolcott, 1992, p. 15). However, given that the quest of facilitating the first ICT integration visual arts education courses required a move on my part that was well beyond my traditional sphere of knowledge and experience, I contemplated the risk taking that the research would involve with reference to Gadamer’s (2001) advice:

Today … one cannot readily go against the trend if one cannot substantiate it with a citation. One must, however, be able to take a risk, even when the outcome is not clear. That is a concern that we hear a lot today, that … there is far too much rule following and avoidance of risk … I still maintain that the humane capabilities are the ones to stress if one is to educate and to cultivate oneself, and that only then, when we succeed in that, will we also survive without damage from the progress of technology and technicity. (p. 573)

2.6 Establishing a research paradigm
In keeping with the purpose of the study, I viewed research methodology as a way of thinking about and studying social reality, and the methods and the procedures and techniques applied for gathering and analysing data (e.g., Strauss & Corbin, 1998). Yet, the practice of choosing a paradigm, methodology and the research methods suitable for collecting the data relative to a specific research question was, as variously noted, a particularly challenging task (e.g., Berg, 2004; Fehring, 2002). However, as the process began to unfold, the study signified not only a collection of methods and techniques, but also my certain way of being attuned to and involved in the world, or in the terms of a long forgotten source, “one that is just as full of passion as it is of reason”. In this regard, Green’s (2002) sentiment holds resonance:

What counts most with respect to research is passion. The focus of the research must provide such interest that, in the face of adversity or the problematic, the passion will carry me through…. The passion … comes from the research topic or focus, and from the mode of inquiry. (p. 15)

Likewise, I conceptualised a paradigm as a “basic belief system or world view that guides the investigator, not only in choices of method but in ontologically and epistemologically fundamental ways” (Guba & Lincoln, 1994, p. 105). Above all, it is a human construct that changes as more comprehensive views emerge to aid analysis and argument, and shapes what we regard as problems worthy of investigation and what methods we choose for investigation and action (Maguire, 1987). While “few pieces of research are ever ‘pure’
examples of one paradigm, fitting unequivocally into one category to the excusing of others" (Candy, 1989, p. 9), I recognised that researchers can form a central perspective that aligns with the research and the specific research questions posed in the study. Yet, after traversing the intricate terrain of paradigm options for educational research within my field, I appreciated the following notion:

No one has ever devised a method for detaching the scholar from the circumstances of life, from the fact of his involvement (conscious or unconscious) with a class, a set of beliefs, a social position, or from the mere activity of being a member of society. (Said, 1979, p. 10)

Nonetheless, it became clear that a qualitative research paradigm was appropriate for researchers like myself who linger in the in-between spaces of arts-based and traditional qualitative methods, and are “are interested in understanding the meaning people have constructed” (Merriman, 1998, p. 6). Similarly, that qualitative research is not a soft alternative to the quantitative mode, it involves processes that appreciate, if not welcome complexity. Importantly, it recognises that, “like the human life, topics worthy of exploration are often influenced by a gamut of seemingly extraneous factors that cannot necessarily be segmented into palatable portions” (Dadich & Fitzgerald, 2006, p. 5). “It is [also] a way of looking at the world and a constellation of approaches used to generate knowledge about the human world” where one’s professional practice is: “the enactment of the role of a profession or occupational group in serving or contributing to society” (Higgs, McAllister & Whiteford, 2009, p. 101). Of particular relevance is the scope it allowed for “discovery, insight, and understanding from the perspectives of those being studied” (Merriam, 1998, p. 3).

In Yin’s (1994) view, qualitative rather than quantitative approaches allow researchers to work directly with participants within an institute and gather information regarding their specific thoughts and experiences. Thereby researchers can understand complex social phenomena and seek knowledge about the fundamental characteristics of a phenomenon being studied before theorizing about it. The unifying term ‘qualitative’ refers to several different methods of research with shared characteristics. These include, rich descriptions of people, settings, and dialogue, “that are not readily managed by statistical procedures and research questions that are not formed by operationalizing variables, but are “formulated to investigate topics in all their complexity, in context” (Bogdan & Biklen, 1998, p. 2). While a precise definition of qualitative research is quite elusive, it is not limited to a specific set of methods. It can involve a wide range of methodologies (e.g., Denzin & Lincoln, 1994), including a combination of a quantitative and qualitative approach to various research paradigms. The characteristics common to all qualitative research include: understanding the phenomena from the emic rather than etic
perspective (e.g., Wagner, 2003); the researcher is the instrument for collecting and analysing
data; fieldwork is conducted in a natural setting; the use of an inductive rather than deductive
research strategy; research is reported in terms of rich, thick description (e.g., Merriam, 1998).
Allied to this, qualitative inquiry methods are most appropriate for determining teachers’
assumptions and perceptions related to the research topic and for clarifying any of the
researcher’s initial conceptions (e.g., Denzin et al., 1994; Guba et al., 1994). The usual data
sources are observation, including participant observation, interviews and questionnaires,
documents and texts, and the researcher’s impressions and reactions (e.g., Myers, 2009).
Those specific to arts-based research, as in the case of this study, can also comprise arts-based
artefacts and narratives, and a field journal in which the researcher captures a wide
range of perspectives on an arts-based subject (e.g., Eisner, 2002).

Taken together the fundamental features of qualitative research fit firmly with the purpose and
the epistemology of the study, in that epistemology is defined as a strand of philosophy that
explores the origin, methods and limits of human knowledge (e.g., Strauss & Corbin, 1998).
Essentially, qualitative research is suited to gaining the participants’ perception of the truth of a
given situation (e.g., Burns, 2000), particularly in gaining insights into how they make sense of
their world, and construe something within their experimental world (e.g., Schwandt, 2000). As
previously noted, in this particular study the participants include the students engaged in the
visual arts education courses where opportunities for ICT integration were introduced for the
first time. Hence, as a means of accessing their perceptions of an ICT inclusive visual arts
education construct, and building a relevant knowledge base, a qualitative research approach
was adopted within a constructivist framework, which draws on the tradition of hermeneutics,
and is outlined as:

One of a set of emergent paradigms which can be rightfully considered either
poststructuralist or postmodern, or both. It rejects modernism’s Grand
Narratives, and focuses on the re-creation and re-presentation of multiple,
socially enacted realities, created by multiple stakeholders and participants.
(Lincoln, 1993, p. iii)

Within the central principles of constructivist epistemology knowledge is not merely gained
inertly through the senses or through communication, but is actively construed by the knower
(e.g., Bogdan et al., 1998). These principles relate to the underlying philosophical assumption
about the researcher’s view of the world and the social life within this world where all
knowledge, “and therefore meaningful reality … is contingent upon human practices being
constructed in and out of human interactions, and developed and transmitted within an
essentially social context” (Crotty, 1998, p. 42). Here, individuals construe meaning differently,
even with respect to the same phenomenon. The essential theoretical basis of constructivism
allows researchers a choice of three constructs, depending on their underlying philosophical assumptions: positivist, interpretive and critical (e.g., Crotty, 1998; Guba et al., 1994).

In considering Crotty’s (1998) account of each category, I was drawn to the interpretive philosophy based in hermeneutics and phenomenology (e.g., Boland & Day, 1989), and even more so through considering others’ perspectives. For instance, for Denzin et al. (1994) interpretivism is invaluable for understanding a phenomenon through inquiry and the practice of meaning making, in that meaning is “determined by the way the act is interpreted” by those engaged with the activity (Feinberg & Soltis, 1998, p. 85). This entails seeking “an explanation within the realm of individual consciousness and subjectivity, within the frame of reference of the participant as opposed to the observer of action” (Burrell & Morgan, 1989, p. 28).

These views accord with concept of interpretivism as a theoretical perspective that allows researchers to gain access to the ‘meaning’ behind people’s actions, particularly the “culturally derived and historically situated interpretations of the social life world” (Crotty, 1998, p. 67). As such, interpretive researchers accept that patterns are created out of evolving meaning systems, or social conventions that people generate as they interact. They also assume that entrée to reality is solely via social constructions, namely shared meanings, and endeavour to comprehend phenomena through the meanings that people consign to them rather than predict dependent and independent variables. In short, interpretative research concentrates on the full complexity of human sense making as the condition emerges (e.g., Kaplan & Maxwell, 2005).

In keeping with the constructionist epistemology, the purpose of the research and the questions posed, the theoretical perspective underlying the study encompasses the ethos of interpretivism. Specifically, the study involves many participants, who individually construct reality in different ways. As well as other factors, such as context and background values, their individual concept of situations can be ascribed to the type of engagement that takes place, and manner in which they direct attention to them (Denzin et al., 1994). Each study participant invariably brings their own understanding of reality resulting in diversity of opinion and view of the world around us, “truth, or meaning, comes into existence in and out of our engagement with the realities in our world. There is no meaning without a mind. Meaning is not discovered, but constructed” (Crotty, 1998, p. 8). A further perspective that aligns with the current study, defines the philosophical underpinning of interprative research as being a deeply hermeneutic and postmodern stance suited not only to acknowledging the importance of self and collective interpretation, but also for deeply understanding “that these interpretations are always in a state of becoming and can never be fixed into predetermined and static categories” (Carson & Sumara, 1997, p. xvii).
Overall, interpretive inquiry (e.g., Lincoln & Guba, 1985) suited my theoretical position, and what I envisaged as a viable way of creating a dynamic, flexible, yet guided approach to the research. The following tripartite model succinctly illustrates how the naturalistic inquiry was positioned within a theoretical frame and practical base for this study:

<table>
<thead>
<tr>
<th>Theoretical perspective: Interpretivist</th>
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<tbody>
<tr>
<td>Methodology: Naturalistic Inquiry</td>
</tr>
<tr>
<td>Methods: Qualitative (with a quantitative component)</td>
</tr>
</tbody>
</table>

*Figure 2: Tripartite model of locating naturalist inquiry within a theoretical framework adapted from Green (2002, p. 6).*

2.7.1 Developing a multi-method construct

I determined that the study could be philosophically infused with the complementary elements of action-arts-based research (Eisner, 2002), and a/r/tography (e.g., Irwin et al., 2008). While Eisner’s arts-based research paradigm is not a synonym for a/r/tography or vice versa, both paradigms are generally concerned with participants’ perspectives, and may involve creative engagement by the researchers and the participants, as is the case in this study. The fusion allowed a mixed method approach (e.g., Denzin & Lincoln, 2011) to the study, a search for a creative synthesis of traditional and digital art practice, and an interpretive understanding of human experience, specifically within an interdisciplinary, transdisciplinary and sometimes counterdisciplinary field” (Denzin, et al., 2011, p. 6).

2.7.2 Infusing the basic tenets of action research

Although I did not adopt a full action research approach in that time constraints precluded in-depth monitoring of successive cycles of action, the basic tenets of contemporary action research as outlined next, align philosophically with the current research that is predominantly concerned with insight, discovery and interpretation rather than hypothesis testing (e.g., Kemmis & McTaggart, 2000). In contrast to the early modes to action research, contemporary perspectives that accentuate full integration of action and reflection and increased collaboration among all involved in the inquiry venture (e.g., Dick, 2000; Reason et al., 2004) are in keeping with the spirit of the current study. Specifically, in seeking to develop knowledge within a collaborative learning and teaching context as: “people in an organization shape the reality in different ways” (Schön, 1987, p. 322). Thereby, the knowledge developed through a process “conducted by, with and for people, rather than research on people” (Reason et al., 2004, p. 1) needs to be pertinent to the people involved: “by drawing people together in action, reflection, theory and practice” (Reason & Bradbury, 2001, p. 1) for the improvement in their educational practices (e.g., Kemmis et al., 2000).
The pertinence of the link between practice and reflection within the current study relates to Schön’s (1983) sense of practitioners’ reflection-in-action when they cope with difficult ‘divergent’ situations of practice: “when someone reflects in action, he becomes a researcher in the practice context … not dependent on the categories of established theory and technique but constructs a new theory of the unique case” (p. 68). As in the context of this study, a reflective practitioner must be attentive to patterns of phenomena, skilled at describing observations, presenting bold and sometimes radically simplified models of experience, and adept “in devising tests of them with the constraints of an action setting” (p. 322). Similarly, the collective reflective practice approach is a basis for implementing changes by increasing awareness, critical exploration of values and continual modification of interpretations (e.g., Burnard, 2006).

2.7.3 Applying an a/r/tographical lens

The art education discourse around practice-based research concedes that the nexus between theory and practice has long been a debatable topic in Australia and overseas (e.g., Carson et al., 1997; Stewart, 2001). Even so, it confirms that the practices inherent in the role of artist-educator-researcher, as is the case in the current study, constitute valid research when the underlying structures comprise a base that is informed, purposeful, rigorous and ethical. In support of arts-based research and practice, arts theorist Elizabeth Grierson (2005) states: "Essentially the arts work through practice – theirs is a practice-based or materially-based knowledge formation" (p. 2). Allied to this, Irwin et al. (2008) advocate a complementary, albeit relatively recent, concept of arts-based research, defined as A/r/tography. The key distinction between the commonly known arts-based methodologies and a/r/tography is that the former focus on the end result or representation, whereas a/r/tography, is more “concerned with inquiry, the mode of searching and probing in and through the arts” (p. 159).

The term “living inquiry” (e.g., Irwin et al., 2008, p. 116) denotes the ongoing living practices of being an artist, educator and researcher whose embodied art making and writing explore phenomena through concepts and processes of constructing new knowledge as distinct from adherence to specific methods or conditions of an established research methodology. In the current study, the artist-educator-researcher identity is simultaneously concerned with learning, change, understanding, and interpretation (e.g., Denzin et al., 1994; Irwin et al., 2008) and positioned within the “complex space of the in-between that the disposition of inquiry brings us to a researcher identity. This occurs through an implicit and explicit commitment to ongoing inquiry across the domains of art and education” (Irwin et al., 2008, p. 113).
Within this lens, the artist-teacher-researcher position entails research where the creative work is underpinned through ongoing forms of recursive and reflexive inquiry engaged in theorizing for understanding in ways that can be individually liberating and culturally enlightening (e.g., Sullivan, 2004). The inquiry encompasses drawing upon personal art practice experiences to contemplate and theorize new questions and avenues, regarding art practice processes as acts of research. In the main, it involves the researcher in “creating the circumstances to produce knowledge and understanding through inquiry-laden processes” (Irwin et al., 2008, p. 111). This feature relates directly to the current study where the introduction of ICT in the visual arts education courses exemplifies the notion of “creating the circumstances” where student’ perceptions of ICT integration can come to the fore. This approach not only facilitates description and interpretation of the intricacy of experience among researchers, artists and educators, but also their working context and the individuals within the communities they interact with.

Clearly, at the heart of a/r/tography is a concept of communities of practice, similar to that commended by Schön (1987). People, as in the current study, engage in shared inquiries, critical friendships, and articulation of evolving research questions, and presenting the collective works to others (Irwin et al., 2008). In other words: “Experience does not occur in a vacuum. There are sources outside an individual which give rise to experience” (Dewey, 1938, p. 40). With respect to their art practice, the participants, like other researchers, do not create in a vacuum, their inquiry and work stems from encounters with others. It is “this with that creates the contiguity and distinctiveness of aesthetic forms” (Irwin et al., 2008, p. 114 – italics in original). Therefore, although as Pourchier (2010) notes, it maybe assumed that self-indulgence fuels artistic endeavours, within the spirit of practice-based research all works that entail some form of exploration such as analysing the literature on artists’ work and research in education and visiting exhibitions, are followed by the mandatory citation in documenting one’s own work.

The culminating rigor stems from a constant reflective, reflexive approach to engagement, analysis, and learning that can be drawn from any form of qualitative data – interviews, field notes artefact collections; any form of artistic inquiry such as painting and educational inquiry in the form of students’ journal writing (e.g., Irwin et al., 2008). Each of these forms is employed in the current research. As a/r/tographical work needs to be pursued continuously over time while searching for ways to refine and disseminate aspects of the work, when the products of the inquiry are shared, the living moments of inquiry are not intended to be seen as end results, but as understandings of experiences along the way.
This concept applies to the current study participants whose work was confined to the embryonic phase of developing a creative synthesis between old and new art practice technologies, and is thus regarded as a search for future possibilities rather than finished products in their own right. In this regard, Sullivan (2004) contends that if the value of research is gauged on the capacity to create new knowledge that is individually transformative, criteria need to focus on possibility rather than probability or plausibility. Carson et al. (1997) add that an artistic shift in modes of expression stimulate practices that are not routine ways of being, but processes of learning to perceive in a different way within every day practices. Indeed, the utmost challenge throughout this study pertains to disrupting regular ways of perceiving; understanding and art practice as the use of new tools and new forms of representation “cause us to look for different things and to ask new questions” (Eisner, 1993, p. 380).

In Eisner’s (2002) terms, the associated cognitive skills entail complex and subtle forms of thinking, and “noticing subtleties, conceiving of imaginative possibilities, interpreting metaphorical meanings, exploiting unanticipated opportunities” (p. 35). This includes the improvisational aspect of one’s intelligence or flexible purposing that calls for the ability to change directions and redefine goals. More comprehensive accounts of artist-researcher-teacher activities that exemplify inquiry and a/r/tography as an alternative to traditional concepts of methods within the qualitative research sphere are presented in Being with A/r/tography (Springgay, Irwin, Leggo, & Gouzouasis, 2008).

2.8 Rationale for selecting the specific study context
As a researcher working from a constructionist epistemology, my research approach is best defined as quest to discover the interpretations of reality within social contexts. I thought carefully about my teacher/researcher identity as one that is always in an active state of renegotiating perceptions of self in conceptions of context (e.g., Rogoff, 2000), and the issue of “localisation and subjectivity” (Freebody, 2003, p. 84) with reference to the purpose of the study, and the choice made regarding where I was to work and with whom (e.g., Patton, 1990). I also understood, that researchers, invariably confront some level of uncertainty about their choices and interpretations, involving interpersonal relations, identity construction, and convincing not only others, but also themselves, that their propositions are sound (e.g., Alvesson & Skoldberg, 2000).

The quest to undertake the research within my own setting was a criterion-based selection (e.g., Le Compte & Preissle, 1992) where the researcher “makes a deliberate decision to acquire “information rich cases” (Patton, 1990, p. 169) on the basis of that the attributes of the
setting and participants are appropriate for the context and purpose of the research (e.g., Wiersma, 2000). As such, it was essential to call for participants from the body of students who were best positioned to offer information relevant to the purpose and questions of the research (e.g., Denzin et al., 1994). The most critical factor in deciding to conduct the research within my own professional landscape was my commitment to promoting student teachers’ critical perspectives on ICT along side their learning of traditional media. In turn, this meant creating the circumstances to produce the relevant knowledge and understanding through inquiry-laden processes (Irwin et al., 2008, p. 111) that are “conducted by, with and for people” (Reason et al., 2004, p. 1). In this study, the ‘people’ are the students within the setting that required action. Thus the process of engaging them in the co-construction of knowledge (e.g., Hampston & Murdoch, 1996) and the notion of ‘reciprocity’ is consistent with the epistemological framework underpinning the study (e.g., Creswell & Miller, 2000).

Allied here is the view that the construction of knowledge may well necessitate teachers to become research active (e.g., MacFarlane, 1995). My approach to the research within my own learning and teaching context can also be considered in terms of Boyer's (1990) mutually inclusive concept of scholarship as being for and of teaching. This inclusive perspective of scholarship, which signifies a shift beyond the traditional teaching verses research discourse, has a broader and more sizable meaning by encompassing four discrete, yet overlapping forms of scholarship, namely that of discovery, integration, application, and teaching.

In choosing to conduct the study in the context as described, I was instinctively drawn to the concept of Appreciative Inquiry, as distinct from regarding the research as being predominantly problem-based. Importantly, an appreciative research inquiry approach originates, as explained by Ludema, Cooperrider and Barrett (2001), from Cooperrider and Srivastva's (1987) response to the emerging dominance of research approaches, which focused on a problem-orientated approach characterised by ‘the identify the problem and fix what's broken model’. The dual facets of the concept follow:

Appreciation - If we devote our attention to what is wrong with organizations and communities, we lose the ability to see and understand what gives life to organizations and to discover ways to sustain and enhance that life-giving potential.

Inquiry - It all begins with the unconditional positive question … that guides the inquiry agenda and focuses attention towards the most life-giving, life-sustaining aspects of organizational existence. (p. 189)

Finally, as there is always some degree of influence stemming from the researcher's presence and interaction with the field (e.g., Walsham, 1995), the possibility of researcher bias emanating
from the reasons for conducting the study was a serious consideration. Yet from an interpretive standpoint, rather than remove such biases, I aimed to ensure the visibility though personal disclosure in ways that can be taken into account by the relative readers "regarding what will be accepted as truth" (Lincoln, 2005, p. 177). That is, all research is considered as one depiction among the many possible, researcher’s representations are subject to the reader’s interpretation (e.g., Hardy, Phillips & Clegg, 2001). Therefore, I needed to trust that my background, inclinations and subjectivities embodied in this study are made sufficiently transparent within the thesis. Now it is appropriate to outline the general characteristics of the student body from which the study participants were drawn and the general study context (e.g., Mertens, 1998).

2.9 Broad characteristics of the student teacher population
In broad terms, the students entering primary teacher education programs at RMIT University over recent years include local and international people that enrol in either the Bachelor of Education or the Graduate Diploma of Education. As the visual arts education method course is a core component of the teacher education programs, it needs to accommodate students from varied backgrounds with wide-ranging skills and interests, who nonetheless share the aspiration of qualifying as primary school teachers. Notwithstanding some notable exceptions, upon entering the course, the students often seem to be apprehensive about their capacity to engage with visual arts learning experiences that involve either traditional or digital media, and freely reveal that they are not “creative”, “imaginative” or “talented”, or “never any good at art in school”, or “not technological” That is, without considering that their school environment might have negated their chance to develop the conceptual and technical skills required to explore their sense of creative being.

Therefore, the clear need to scaffold students through various levels of student-centred inquiry (e.g., Murdoch & Wilson, 2004) in a way that synchronises Banks’ (1996) notion, of equitable pedagogy, which entails teaching strategies that promote the unique talents, needs and differences of a diverse student body. Specifically, to counteract any negative perceptions individuals might have regarding their potential to engage with the constructivist pedagogy and practice specific to visual arts education coursework. Implicit here is view that preservice teacher education can promote students’ sense of self-efficacy – the belief in one’s ability to manage prospective situations as a vital part of promoting their confidence in, among other things, utilising ICT effectively in classroom contexts (e.g., Littrell, Zagummy & Zagummy, 2005). While graduate teachers are expected to implement teaching practices that are commensurate with the current expectations of the teaching community, without acquiring
relevant knowledge and experience during their teacher education courses, they can do little, but perpetuate old methods (e.g., Kowaichuk & Stone, 2000).

Allied to the university coursework, professional practice (PP) school-based practicum is a core component of the teacher education programs. As school-based learning experiences are expected to contribute to students’ professional skills for real-world teaching within the key learning areas, including visual arts, ideally, students can build on their university-based learning. First, by observing the practices of experienced art teachers. Second, by engaging with a range of practical applications to gain experience in designing and implementing art education programs (e.g., Ganser, 2008). So it follows that the students can be encouraged to share their school-based experiences, and newly found ideas with peers in the university-based visual arts education classes.

2.10 Research participants
A total of 107 voluntary research participants where drawn from a total of 205 students engaged in either one of the following two 2004 courses as described in chapter 1.
1. The visual arts education method course comprising four class groups of students within the first year of the Bachelor of Education (B.Ed. Primary) program, and two class groups of students within the Graduate Diploma of Education (Primary) program. In all, six class groups were involved in a six-week course of three hourly classes, with an average class size of 30, and a total of 180 students.
2. The visual arts elective course comprising one class group of 25 students in the third and fourth year of the B.Ed. primary program.

2.11 Conceptual underpinnings
Within both of the above courses, the process of gradually introducing more diverse forms of art practice, teaching methodologies, and ways of defining art, accords with advice that “evolutionary change is gradual, internally planned, in harmony with the organic system, and adaptive to the habitat” (Stake, 1989, p. 55). The teaching involves cultivating a context where students engage constructively with subject specifics, and the emphasis are on the students’ learning regarding what they do and why, rather than on what the teacher does (e.g., MacFarlane, 1994). In this context, the teacher-researcher needs to communicate their ideas within an environment where students can not only explore pertinent questions, but also freely communicate their findings (e.g., Roland, 1996) in line with Dewey’s (1916) vision:

The development within the young of the attitudes and dispositions necessary to the continuous and progressive life of a society cannot take place by direct
conveyance of beliefs, emotions, and knowledge. It takes place through the intermediary of the environment. (p. 22)

The associated aim was to promote directly relevant knowledge and action to allow the students to see that they can construct and use their knowledge in appropriate ways. This meant promoting an attitude of inquiry (e.g., Reason et al., 2004), critical reflection on learning processes and the co-construction of knowledge. The students were introduced to basic ways of incorporating ICT for research; creating electronic presentations of their work; incorporating ICT in art specific, or cross disciplinary lessons for school children; using ICT for creating ‘still’ or animated visual images, and manipulating hand drawn images. Importantly, they were encouraged to share their experiences through class-based dialogue. While these courses provided students the first time opportunities to explore ICT applications in various aspects of their coursework, and offered an ideal opportunity to gain insights into the influences on their attitudes to ICT integration, the assessment requirements did not include any form of ICT use.

2.12 Data generation and collection units
The use of a multi-modal approach to the investigation acknowledges that, “listening means receiving information through multi modalities” (Yin, 2003, p. 60), especially as the use of multi modalities “prevents the investigator from accepting too readily the validity of initial impressions” (Burns, 2000, p. 419). Consistent here is Eisner’s (2002) notion that arts-based educational research which explores concepts of multiple realities and meanings through layers of interpretation, necessitates multiple modes of qualitative investigation to capture a wide range of perspectives on the topic. The data collection comprised five key units, including a quantitative data element as well as qualitative modes to allow for breadth and depth in the investigation specific of ICT integration practices in visual arts education. Approaching a study from either a qualitative or quantitative perspective need not exclude the other, as these can coalesce and complement each other (e.g., Wiersma, 2000). As seen in the following diagram the qualitative data collection was used to gain insights, and understanding from the perspectives of the participants, (Merriam, 1998, p. 3). The quantitative component allowed valuable information on the participants’ background to identify influences of particular variables on their understanding of certain matters.

<table>
<thead>
<tr>
<th>Field journal</th>
<th>Questionnaire</th>
<th>Observations</th>
<th>Interviews</th>
<th>Visual Journals &amp; Art Practice Artefacts</th>
</tr>
</thead>
</table>

*Figure 3: Five data units of the study*
Each of the data units were devised in line with the constructionist epistemology, and administered with reference to Eisner’s (1991) concept of ‘connoisseurship’ research where, with enlightened eyes the researcher strives for “fine grained discriminations among complex and subtle qualities” (p. 63). This requires the researcher’s attention to the subtleties and nuances of educational materials, settings and events and an unconditional openness to the emerging phenomenon and its meanings, and acceptance of the participants’ experiences in an unprejudiced and reflective manner. ‘Openness’ can be understood “as a state of mind in which one, in a self-aware way, is sensitive to the other’s experience … the capacity to be surprised and sensitive to the unpredictable” (Dahlberg et al., 2001, p. 22). ‘Surprise’ can cause the discomfort required to move beyond the terrain of familiar beliefs to explore riskier critical or ethical and moral differences (e.g., Boler, 1999).

The allied aim of achieving a purposeful sample was to allow “for the maximum opportunity to learn about the phenomenon (Merriam, Mott & Lee, 1996, p. 9). Given that research is not only about sampling people but also settings, events and processes” (Miles & Huberman, 1994, p. 41) the following section outlines the context of each of the aforementioned information rich units of inquiry (e.g., Wiersma, 2000). While each of these units was designed to align with the philosophical and practical aspects of the study, I aimed to reflect the interconnectedness and interdependence of the processes involved in research (e.g., Neuman, 2003).

### 2.12.1 Field journal

The field journal unit corresponds with recommendations to use research notebooks, which "incorporate visual exploration, contextual research, critiques and other visual and verbal forms of art criticism, aesthetic inquiry, and above all personal reflection" (Anderson & Milbrandt, 2005, p. 237). The journal can support claims of credibility, transferability and dependability as it provides an audit trail of the researcher’s ideas, and insights that emerge throughout the investigation (Lincoln et al., 1985). The associated notion is that of a portfolio, a space for documenting not only the successes, but also the failures and why something occurred and the role one played in the situation (e.g., Shulman, 2004). The journal entries, which were made throughout the study, include myriad notes and clippings that collectively chart the evolving nature of the inquiry processes undertaken throughout the research journey. Collectively, they signify the multilayered insights I gained through sustained observations of students’ responses to ICT related opportunities in visual arts education classes. In addition to the new ideas, cues and information was gathered during conversations with art teachers, art educators and practising artists, and some email communications, especially those that related to communications with people either interstate or overseas. That is, the current Sykpe and the
Face Time applications were not readily available within the research timeframe. All of these entries relate to the continuous process of gathering insights into the possibilities and cautionary aspects of ICT integration in the selected visual arts education setting. At times, these represent short narratives of specific experiences, or fine stories, which like art do not conclude, but suggest subtle “hints about theme and thesis” (Barone, 1997, p. 224). They also provided vignettes to be distilled from the data as the “essence of what the researcher has seen and heard over time” (Ely, Anzul, Friedman, Garner & Steinmertz, 1991, p. 154).

The process of collecting numerous facets of rich data, included entering notes directly after engagement to capture important information and retain aspects of the lived world well beyond the words spoken (e.g., Miles & Huberman, 1994). As these field notes comprising my various insights and “researcher reflections” (Minichiello, 1995, p. 216) were to be synthesised and summarised after collection (e.g., Wiersma, 2000), I endeavoured to enter these systematically by colour coding according to each of the various themes that emerged. As an extension to the field journal, I developed, as stated in the introductory chapter, four folders of written and visual material. The collective value of the following items related to my own quest for more information on ICT use in visual arts education, which centred on the perceived need to gather both visual and written visual arts education relative ICT material that could be discussed with the study participants. That is, as a part of gaining insights related to the overarching research question specific to understanding the influences on their attitudes to ICT integration in their own visual arts education, and their related work with school children:

- The first contains annotated samples of artists’ work that infused some form digital media. Several of these were collected during my personal communications with artists that I have known within my professional network for sometime. The same artists provided much support throughout my initial stages of learning to use digital media for art practice. In addition there are other digital art samples that were created by artists who I know only by reputation, and collected from various sources along the way.

- The second comprises annotated digital artworks created by children. Apart from the examples of computer-aided child art provided by an overseas art educator, these include hardcopy prints of computer-aided visual images created by one of the student’s children. These were freely offered in the context of the student’s explanation that irrespective of her efforts to engage this child with creative exploration of concrete materials, the child is only interested in using the computer for such activity. The collective value of the above items and related to the perceived need to gather both visual and written visual arts education relative ICT information to discuss with not only the immediate study participants, but also the wider preservice teacher education community at opportune times.
• The third holds the published articles I wrote in the context of the research related inquires I made within my professional network. This collection includes several book reviews on art and technology related topics and reviews on several of the professional teacher development digital media workshops that I observed.

• The fourth represents an extensive body of art practice-based work I developed through sustained personal exploration of digital media in the process of searching for a creative synthesis between traditional and new art practice media. While the folder simply represents the early phase of my inquiry in and through art practice with respect to combining traditional and digital media in the search for future possibilities, rather than producing finished products of exhibition standard, it includes a number of images that were published either as book or CD covers. These were created in the spirit of a/r/tographical research where one’s work needs to be pursued continuously over time while searching for ways to refine and disseminate aspects of the work at opportune moments in time (e.g., Irwin et al., 2008).

2.12.2 Questionnaire
The quantitative study data unit involved the administration of a student questionnaire whereby in order to maximise the response rate, the questionnaire was group administered in line with the recommendation for researchers to “cast a wide net” (Glesne & Peshkin, 1992, p. 18) to gain an array of perspectives. Thus, the questionnaire was made available at the end of semester to all students within the two visual arts education courses who were asked to collect a copy of the questionnaire from my office if they were willing to participate. Specifically, within the context of interpretive research, a questionnaire is a qualitative mode of data collection that can add credibility and authenticity to the study, and introduce the students to the ideas of the research process (e.g., Neuman, 2003). The questionnaire – designed as the instrument to limit data collection to certain analysis categories (e.g., Patton, 1990) aimed to provide the visual arts education students the opportunity to contribute their perspectives of their background in visual arts education as well as their perceptions of ICT use within the visual art education course work and where applicable, their work in professional practice schools.

As the questionnaire also aimed to gain participants for the one-one interviews, and needed to incorporate leads for the design of interview questions it included 24 questions requiring yes/no answers and spaces for written explanations where applicable so that respondents could describe specific points of view (e.g., Usher, 1996). The questionnaire aimed for:
1. Broad ideas of whether or not they used ICT in the course, and if so what resources they used and why and how they were used.

2. An understanding of which ICT resources were readily available to them for art education purposes either within the relative class settings or at home.

3. What they had seen or experienced in terms of ICT use in art classrooms and whether or not they perceived particular changes in the way art can be taught and learned.

Of the 200 questionnaires printed, 160 were collected, of these 107 were returned either through my secure mailbox or in person within a period of two weeks. Although I had inadvertently omitted to specify a closing date, I chose not to chase more returns for two reasons. First, by this time, as the participants where all involved with other pursuits, it would have been difficult to capture their attention. Second, the notion of chasing their input ran against the spirit of voluntary participation that I wished to engender. Although the questionnaire did not require students to identify themselves, question 24 (Q. 24) asked the respondents enter their contact details, or make contact either in person or email if they were willing to either participate in a one to one interview for the purpose of the study.

The purpose of administering the questionnaire was to build on the insights I had gained through my literature analysis and allied inquires as well as those gained during my class-based observations. It should be also noted, that as I required a colleague to assist in translating the written questionnaire responses into graph form, he had temporary access to the hard copies which he stored in-line with ethics guidelines. Specifically, he transferred the questionnaire information into colour-coded pie and bar graph format, whereas the hand written responses of a qualitative nature were entered in both Microsoft Word and Excel formats.

2.12.3 Observations of students’ class-based end of semester presentation

Patton (1990) commends inquiry by participant observation where the purpose of observational analysis is to take the reader into the setting that is observed. This means that observational data “must be sufficiently descriptive that the reader can understand what occurred and how it occurred” (p. 26). The key observations units were untaken within the context of the end of semester class-based student presentation sessions that apply to both of the relative courses. The scheduling of these sessions was totally consistent with the long established visual arts course practice where students manage the time as a forum for "art talk or the verbal aspects of art education" (Althouse, Johnson & Mitchell, 2003, p. 9), and understand that their associated presentations are not assessed or subject to any assessment criteria. My standard role within this context is to observe the preservice teachers as they freely participate in
interactive conversations about their learning experiences. The significance of observing these sessions through a researcher’s lens related to the need to “capture the social reality of a group” (Burns, 2000, p. 395), and to gain insights into students’ perceptions of their presentation experiences that could not be otherwise gained from the previously mentioned visual journals. That is, as the visual journals were completed before the presentations, they did not reflect on actual presentation experiences, that often included ICT use. At the same time, I considered that the cautionary facets of participant-observation is the uncertainty “whether the process of observing affects what is observed” (Merriam, 1998, p. 103), especially as even subtle researcher feedback can influence the conduct of those observed. While this situation involves bias and reactivity where a researcher may influence the participants, either by presence or action, eliminating bias or reactivity may not be possible; researchers should aim to communicate their biases and attempt to address them (e.g., Maxwell, 2004). As “the ideal observation tool does not yet exist” (Boehm & Weinberg, 1997, p. 78), I viewed the presentation session as an opportunity to be immersed in an authentic setting (Neuman, 2000, p. 377) where I could collect rich, naturally occurring data without any undue disruption to the overall climate within the setting.

The following is an outline of the general characteristics of presentation session where I sought to capture relative insights. Within these sessions, the link between students’ practice and reflection in the development of new thoughts about familiar experiences and tests of particular practices and experiences against general ideas (e.g., Winter 1996) comes to the fore, as does the ethos of communities of practice (e.g., Irwin et al., 2008). “In cooperative settings involving groups of students who are often “as important to one another as the “coach” … learning new habits of action” (Schön, 1987, p. 38). The preservice teachers engaged in “conversational partnerships” (Rubin & Rubin 2005, p. 79) about the culmination of their coursework. This includes the actual artwork/s created, and their choice of media and presentation format, the ways in which they did or did nor aim for a creative synthesis of traditional and ICT media, and the associated evolving critical reflection process within a supportive peer-group environment.

As the students undertake art-based inquiry through a diverse range of media, this forum allows them to not only gain critical peer feedback on their work, but also gather new information, stimulate higher levels of inquiry on a whole group basis where the notion of reciprocity and reactivity in the classroom is at the heart of the inquiry processes (e.g., Creswell, 1998). In following Bell’s (1999) advice on the importance of being explicit about what is being observed, I note that I was able to recognise the vast differences in students’ responses to the provision of ICT in the visual arts education context. In particular, as students’ facial expressions, body
language and in particular, paralanguage such, as pauses, silences, hesitancies, tones and pitch offered critical signals (e.g., Wichroski, 1996) I found cues for determining not only a sense of their achievement about using either traditional or digital media, but also numerous instances of frustration that piqued my attention.

2.12.4 One-one interviews
Following the observations, the data generation and collection progressed to a series of one to one interviews with students whereby, in response to the questionnaire item Q. 24, 20 respondents agreed to be interviewed, and gave written permission for extracts of their visual journals to be included in the relative data unit. However, due to severe time constraints at that end point in the semester, only ten participants actually engaged in the interview process. While interviews are rarely used as the primary source of data in that to understand what people do requires being able to observe their activities (e.g., Travers, 2001), they provide access to the context of people’s behaviour and a way for researchers to understand the meaning of that behaviour” (Seidman, 1998, p. 4). Interviews also encourage people to reflect on their experiences more so than questionnaires as, "In depth interviewing encourages people to reconstruct their experience actively within the context of their lives” (p. 8) within an environment where participants may speak more freely. Other advantages of one-to-one in-depth interviews include their ability to allow the researcher and participant to interpret the present, reconstruct the past, and predict the future and to engage in purposeful conversation (e.g., Lincoln et al., 1985).

Patton (1990) advises researchers to establish a “framework within which people can respond in a way that represents accurately and thoroughly their points of view regarding “that part of the world about which they are talking” (p. 24), and to uncover those things we cannot directly observe. The purpose of interviewing is to allow entry “into the other person’s perspective” (p. 196). Merriam (1998) regards the most common interview as the semi-structured mode, with a set of questions and issues with neither the precise wording and order of question predetermined. This includes more open-ended questions to aid elaboration on topics and issues that might be significant as the interview process develops (e.g., Yin, 1994). It has also been noted that the lower the level of interview structure, the more likely the researcher can assess the interviewee’s responses and their trustworthiness (e.g., Nandhakumar & Jones, 1997). The interview construct was broadly guided by four interrelated, open-ended questions:

1. Did any specific factors influence participants’ decision to either include or not include ICT in any aspect of their coursework?
2. Were there any particular advantages or disadvantages encountered in using ICT in the course?
3. Did the participants use or observe ICT in art related lessons in schools?
4. How do the participants perceive the value of learning ICT skills in visual arts education courses?

My approach did not rigidly focus on a prepared interview guide in that when the interviewees began to convey relevant information I encouraged them to explicitly reflect on their own experience. Similarly, while the interview often prompted narrative inquiry where the interviewees conveyed a story of certain matters from a personal perspective, I aimed for a balance between consistency and discovery (e.g., Strauss & Corbin, 1998). As Lincoln et al. (1985) suggest the use of hand written notes in preference to tape recordings, during the interview I wrote as accurately as possible the participants’ responses in my own form of abbreviated script. While I felt more comfortable in hand writing these notes in situ than using a tape recorder, it was a slow, but worthwhile process. Although I had anticipated that each discussion would take around 30 minutes, the first one ran over 40 minutes. Therefore, in being sensitive to contextual matters, change and emergent conditions (e.g., Burns, 2000), I allowed more time for subsequent interviews, which ranged from 35-50 minutes. These were conducted either my office or the art studio, which are familiar surrounds for the interviewees and generally seem to evoke the sense of the trust needed for access to the life-world (e.g., van Manen, 1990).

As the intention of open-ended interviewing is to access to peoples’ perspectives of the world, and that the information gained is largely dependent on the researcher (e.g., Patton, 1990) I took a conversational interview approach, particularly as the questions differed among interviewees. The questions were invariably steered by the participants’ voices (e.g., Marcus & Fischer, 1986), yet they centered on a particular topic (e.g., Merton, Fiske & Kendall, 1990) and allowed free elaboration on the perspectives they projected in either their written questionnaire responses or during the observed presentation sessions. I endeavored to elevate the interviewees’ thoughts and opinions to new heights by encouraging them to discuss their opinions on a range of phenomena, including their perceptions of ICT associated advantages and challenges. As I was a novice in the situation where the interviewee is the expert (e.g., Patton, 1990), I put aside my own perceptions or what I thought I knew about the topic and what I thought they might say. By means of flexible questioning (e.g., Scott & Usher, 1999), and the interviewees’ generous responses, I enriched my understanding of the various
organisational, philosophical and pedagogical considerations associated with their experiences in integrating art and technology, and added a layer to the insights gained through my observations and the questionnaire data.

Apart from seeking insights into what, why and how, and to what extent, if at all ICT was infused in their coursework I aimed to tease out the participants’ philosophical stance on the use of ICT in visual arts education. At the same time, I understood that as their perspectives at that time were grounded in their life experiences thus far, their views may well differ in the future (e.g., Cohen-Evron, 2002). At the end of each interview I asked the interviewees if I might access to their visual journals and/or images of their artwork as these could add depth to the interview data and enrich the required thick description (e.g., Eisner, 1966). I also asked them to check my hand written notes for any errors, or any sense of being miss-quoted. While none of the ten interviewees reported any errors, four of the ten later sent emails regarding interesting art and ICT experiences that they had encountered since we last met. Judging by the spontaneous nature of these emails, and the tone of excitement they conveyed, I sensed some development in their thinking about the positive and critical aspects of ICT use in visual arts education both within an art specialist or generalist primary classroom setting.
2.14.5 Visual journals

The inherent practice of students maintaining visual journals within the visual arts education courses facilitates their own intrinsic space for writing as an important part of the artistic meaning-making process (e.g., Sullivan, 2004). It also provides a learning environment that promotes a democratic process and shows visual thinking in a variety of forms, including drawing, sketches, collages, photographs and graphics, words and reflections” (Grauer & Naths, 1998, p. 14). Within this space, individuals can engage with the ethos of a/r/tography that places emphasis on inquiry through an ongoing process of art making and writing, not as separate entities that are illustrative of each other, but as being intertwined for enhanced meanings (e.g., Springgay, 2008). This concept encompasses the use of visual journals to preserve what is thought, felt, discovered and learned throughout the artistic process, to scrutinize one’s progress, and to chart the oscillation of one’s feelings, excitements, and frustrations throughout the process of artistic practice (e.g., Rice & McNeil, 1990). For the majority of participants in this study, the journal exemplified a space for rich descriptive narratives about their choice of art practice media and techniques, their sources of inspiration, their conceptual and technical skill development, as well as the creative-risk taking involved in venturing beyond familiar zones of practice, such as using graphics software to create visual compositions, often in aiming for a creative synthesis of traditional and ICT media. Invariably, the narratives described not only the challenges encountered, but also how peer support contributed to the successful negotiation of particular difficulties, or why and how they reformulated their initial ideas in the light of new discoveries or to more realistically manage the constraints of time, initial skill base and/or availability of resources (e.g., Eisner, 2002).

As such, the participants’ journal entries, variously comprising written reflections, reference to artists’ work, diagrams and sketches of embryonic ideas were particularly valuable in gaining rich insights into how they identified specific areas of inspiration and frustration, gauged their progress and linked their experiences to a larger contexts of art practice, and theories of learning and teaching. Above all, the visual journals provided some firm understanding of the ways that students “organized their world, their thoughts about what is happening, their experiences and their basic perceptions … in a way that represents accurately and thoroughly their points of view regarding … that part of the world about which they are talking” (Patton, 1990, p. 24). The visual journals, art practice artefacts and lesson ideas, were collected after the interview process for analysis as an interesting and authentic and record of activities.
In summary, the visual journals and artefacts unit comprises the documents and artefacts collected from a total of twenty participants. These include the twenty who gave research specific access to their visual journal entries, and visual media in a variety of forms, such as hard copy prints of teaching resource materials encompassing booklets on computer use for art rich illustration, individual computer aided art works, lesson ideas, studies of particular art periods or genres, art rich story booklets, and range of studies on similar topics presented in PowerPoint format, as film clips on compact disks, or at times, sent as emailed attachments. However, as previously indicated (see Chapters 1.8 & 2.12.4) only ten of these participants were involved in the one to one interview process. Given the need to perceive and appreciate the important qualities of educational artefacts and to disclose them through evocative use of expressive language (Eisner, 1985), I looked for a range of approaches to ICT integration within the participants’ coursework. Thereby, the artefacts specific to this data unit, which are included in the discussion of the findings, were not selected on the basis of exemplary practice, or from either extreme ends of the spectrum of what I might have perceived as having high aesthetic value. While the discussion on the outcomes of my data analysis is presented in chapter 7, below is an outline of the data collation and analysis processes:

2.13 Data collation

The initial sense of being far too overwhelmed by the prospect of having to efficiently collate a large volume of data was somewhat eased through advice against becoming weighed down by “information overload”, meaning that I needed to be selective and interpretative rather than “spongelike” in soaking up data (Burns, 2000, p. 413). Likewise, that “a hundred separate pieces of interesting information will mean nothing unless they have been placed into categories” (Bell, 1999, p. 173), and that an orderly process of entering the data is helpful for “sorting out data types and positioning the search for analytic categories at the forefront of the research process” (Hughes, 1994, p. 39). Above all, I noted that constructivist research requires simplification, synthesis and selection of data in that “data reduction is necessary for the description and interpretation of the phenomenon under study” (Wiersma, 2000, p. 204).

Each collected data unit called for a preliminary sorting process whereby certain aspects were culled before I explored various techniques to identify patterns or repetitions, likenesses and variations whilst locating key words as a means for identifying a broad range of themes (e.g., Merriman, 1998). I searched for intricate fragments of knowledge like in a kaleidoscope where we get changing patterns of knowledge. The associated system of colour coding themes to highlight certain features of beliefs and practice before searching for broadly defined structures and patterned regularities implicit in the data, allowed the making of inferences based on the
meanings shaped in the context of my exchange with the research participants (e.g., Silverman, 2006).

In all, the data was read repeatedly and labelled to identify specific features, and positioned into categories that linked directly the overarching research question and the sub questions. This intricate process assisted in discriminating patterns and themes as a basis for developing a more concise statement for interpretive presentation. Eventually, through an evolving framework akin to an iterative process of re-examination of emerging categories during data analysis that maximises the opportunity to accept new knowledge, I discerned which themes were not as valuable as I first thought in terms of which were the most significant and their interconnection with the research questions (e.g., Ryan & Bernard, 2003).

2.14 Process of analysis
The data analysis process assumed a reflective, phenomenological attitude towards the data akin to what has been defined as bridling (e.g., Dahlberg, Drew & Nyström, 2001) and characterised by the active waiting for the phenomenon and its meanings to reveal themselves. Allied to this was consideration not only that within the qualitative research framework, “it is more useful to describe and interpret events than to control them (as in quantitative research) to establish cause and effect” (Higgs & Cherry, 2009, p. 6), but also the importance of making sense of the interpretations of experience in order to produce thick description so that readers can understand the given data and form “their own interpretations” (Denzin, 1989, p. 375).

The data analysis was based predominantly on an interpretative/inductive strategy as an “explanation building” process (Yin, 2003, p. 12) with links to elements of critical visual methodology (e.g., Emmison, 2004) to provide insights into the participants’ lived experiences of learning within a preservice teacher education community. At the same time I recognised that the critical aspect of multi-methods data is the opportunity for the crystallisation needed for enriching the data narratives (e.g., Richardson, 1997). I was equally aware of the tendency for generalisations from stories to be precarious (e.g., Carter, 1993). Yet, I hoped that the narratives drawn from this data analysis would generate questions and stimulate discussion enmeshed in the issues, challenges and dilemmas experienced ‘through the living moments of inquiry’ (e.g., Irwin et al., 2008). I also found that throughout data analysis different questions were posed “to generate new meaning and insights from the collected research data” (Whiteford, Wilding & Curtin, 2009, p. 21).
As the study encompassed a constructionist epistemology, the summation of the findings at the end of the thesis is based on my interpretations of experiences along the way, rather than statements of a conclusive position. Inquiry is essentially a perspective on people, things or events, meaning we cannot provide an absolute answer to a question or only one rule for action, especially as: “individuals, are seldom able to give full explanations of their actions or intentions; all they can offer are accounts or stories about what they did and why” (Denzin & Lincoln, 2000, p. 19). While, my emphasis was on revealing trends and patterns that emerged through the analysis rather than focussing on any of the participants’ individual experiences, I include participants’ direct quotes as a valid means to support inferences drawn from the data (e.g., Wiersma, 2000), and to privilege their voices (e.g., Emery, 1996).

More specifically, the purposeful use of direct quotations (e.g., Arskey & Knight, 1999) is a method of maintaining rigor by strengthening and validating findings. Similarly, the measure of credibility and authenticity of the data was subject to my ability to present a balanced view, to be aware of my own biasness, and to justly present the participants’ views. To ensure rigour and credibility in the research I considered a number of criteria for testing interpretations, including the concept that interpretation should illuminate as much as possible rather than just a portion of the contemplated data (e.g., Dahlberg et al., 2001), and the need for attention to the temporal context in which a phenomenon occurs. As I also acknowledged the value of not only developing a significant amount of material/data during the fieldwork, but also the need for evidence of this involvement in any article produced” (Myers, 2009, p. 12), I include specific reference to numerous articles published during the research journey in the introductory chapter, and cite some of these within the thesis. My approach to presenting the findings of the study acknowledges that the validity of the data is contingent on the researcher’s ability “to extend the findings of a particular study beyond the specific individuals and setting in which the study occurred (Mertens, 1998, p. 254). Similarly, that from the constructivist epistemology and interpretive stance, the validity relies on the ability of the researcher to present the distinctive experiences of individuals as a general experience.

2.15 Ethical considerations

Having fully considered the ethical implications of my position as a teacher-researcher within my own learning and teaching context prior to receiving the formal permission from the RMIT University Human Ethics Research Committee I resolved that my research activity would not impinge in on my regular approach to establishing a firm professional rapport in my working relationships with all students. In essence, I acknowledged that, “ethics has to do with the application of moral principles to prevent harming or wronging others, to promote good, to be
respectful and to be fair” (Sieber, 1993, p. 14). Likewise, that research questions need to be sensitive and ethical and suit the purpose of the inquiry (e.g., Higgs & Cherry, 2009). Thus, I ensured that the data collection processes did not seek any information that could be misconstrued as being of a personally sensitive nature.

Importantly, the participants were made aware of the ethical protocols that applied, that participation was strictly voluntary, and that they could withdraw their participation at any time. While I had explained to the students, during the active course time that I would be seeking their participation, the questionnaire, together with the Plain Language Statement was made available for collection from my office after the all course work had been assessed. All participants were assured that rather than identifying them in any way, pseudonyms would be used (e.g., Berg, 2004). At the stage when students gave consent for aspects of their work to be included in the collective data, they were asked to sign the appropriate Consent Form, which was duly stored along with all collected data as stipulated by ethics guidelines. As a means of maintaining anonymity, participants’ names were entered in code form, which also distinguished the data according to the relative course (e.g., Glesne, 2006). Three more points follow:

1. As some of the data provided by the participants includes general comments about their experiences in their professional practice schools, I resolved that the schools, or teachers, would not be identified at any time or in any way.

2. At times, the participants included photographs of themselves or their peers in their visual journals, hence, I purposefully excluded use of these in the thesis even though they were often interesting representations of digitally manipulated imagery and almost beyond recognition.

3. In selecting pieces of the participants’ artwork as part of the data collection, I focused on collecting a cross section of approaches to ICT integration rather than extremes of what I might have perceived as being favourable or otherwise.

In addition to the above, I did not anticipate any sense of compromising the integrity of the data collection process on the following basis:

1. While the study was concerned with gaining insights into the various ways students respond to opportunities to use ICT and the factors which influence their responses, their actual attitudes were totally irrelevant to the assessment processes of the visual arts courses at the time of the research.

2. As noted before, the visual arts courses within this research period were the first to offer students opportunities for ICT integration, and thereby of particular relevance to the
research. But, the students’ choice of traditional or digital media, or combination of both, was optional.

3. The overall assessment requirements of the course did not include a specific ICT component. Thus again, I expected that students would freely choose either traditional or digital media or a combination of both, for their art project purposes, and their presentation sessions.

4. Apart from the introduction of ICT related learning opportunities, the philosophy and general structure of the courses during the research period was consistent with all preceding semester courses that centred on the traditional practice where students are encouraged to self-select media, techniques and learning approaches within a collaborative learning environment.

With respect to the observation unit of the data collection, during the presentation sessions I acknowledge that this did require communication between the participants and myself and that my presence would have effected the overall class interactions to some degree. However, I considered myself as a non-participant observer in this instance as my purpose was to absorb the stream of the events in an unobtrusive manner (e.g., Burns, 2000). Within these sessions, collaboration involves groups sharing what each student knows and constructing new knowledge in the process. This leads to a networked learning community where learning together accelerates the whole community’s learning through inquiry rather than that of the individual. The concern with reciprocity and reactivity is at the centre of the inquiry as the students share their observations, reflections, responses, and questions, and engage in an ongoing reflexivity to highlight “biases, values, and experiences” (Creswell, 1998, p. 248).

2.16 Conclusion
This chapter has explored the basic reasoning, assumptions, and considerations involved in determining the most appropriate research method. It includes a discussion of the selected paradigm and the theoretical position that underpinned the study. The groundwork to the research, as outlined in the introductory chapter, served as the starting point for establishing the methodological approach to meeting the research goal and the questions. The considerations relative to devising the most appropriate data generation and collection methods were discussed. The latter sections of the chapter explained the rationale for selecting the particular study context, the basic characteristics of the context. Allied to this was an account of each of the data collection units, as was an overview of the various facets of the data collation and analysis. Issues in relation to researcher subjectivity and bias, as well as the ethics considerations have also been presented. In all, the chapter has shown that the combination of
paradigm, methodology, method and perspective choices constituting this study design exemplify the arts-based inquiry characteristics set to “expand, possibilities, enabling educators to see more of the things that need to be seen … to improve educational policy and practice” (Barone & Eisner, 1997, p. 116).
Chapter 3

The impact of computer technology advancements on education

3.1 Introduction
The premise of this chapter is the long-standing view within the national and international discourse of visual arts education, that the discipline does not exist in a vacuum, separate from the current cultural epoch emanating from the overwhelming impact of the rapid advancements in ICT on society and the broad sphere of education, including preservice teacher education. Accordingly, it provides an overview of the increasing focus on computer technology in education as it emerged during the 1980s and grew exponentially from that time. Allied to this are some references to new learning concepts, elements of the Australian state and federal governments funding priorities for school computers and the associated media reinforcement, namely from the 1990s to 2008. A summary of successive curriculum perspectives on ICT integration particularly in the field of visual arts education and an outline of the more recent curriculum move towards a first-time national curriculum follow. The close of the chapter touches on the relatively recent calls for more concerted approaches to ICT inclusive pedagogy in relation to the ‘digital native’ characteristics of the current student population (e.g., Betcher & Lee, 2009; Facer, 2011).

3.2 Influence of early computer technology developments
The rapid advancements in information communication technology since the 1970s, when computer hardware, software and interface, then associated with microcomputers, became commercially available in the mainstream, are well acknowledged as having such a powerful influence on all areas and levels of education. As Yelland (1992) notes, numerous educational ICT commentators have likened the advent of computers in society, and in the context of education, to the introduction of the printing press and the impact of television on society. In the terms of Alvin Toffler’s (1980) commentary on the digital revolution, the far-reaching cultural shift from the industrial mode of performing a broad range of tasks stems from the technological development of the silicon microchip during the 1970s.

The perception that the influence of this innovation will continue to escalate in accordance with the rapid pace of advancements in technology and manifest in immeasurable ways is widely accepted. For instance, Lyotard (1984) viewed the computer as the icon of the present historical and cultural epoch, and Lankshear et al. (1997) claim that: “The current constellation of languages, ideas, theories, knowledges, and practices that social theorists refer to as Postmodernism has evolved out of and paralleled the development of computerised
technologies” (p. 127). In Barry Jones’ (1995) view: “computerisation” is seen as the lead technology of the post industrial revolution that “will help create a society marked by unprecedented change in the nature of work, society, communication and personal experience” (p. 98). More to do with the computerisation of education, Yelland’s (1992) detailed account of successive educational policy documents stemming from the United States, Britain and Australia during the 1980s illustrates that they all embed stated aims for computer education, and recommendations for the use of computers in schools. Yelland (2001) reveals that by the 1980s, it was frequently contemplated that in line with the impact of computer technology on work places and business transactions, by the close of the century most of children’s education would take place via computers.

Resonating here is the rarely mentioned early vision of Patrick Suppes (1966), a Stanford University researcher. Suppes’ research revealed that computer mediated instruction produced profound effects on learning, and recognized changes in students’ understandings ranging from simple to complex. While he used computers essentially as a tool, his research-based acknowledgement of the potential for wider applications of computers in education is credited as having “led to the foundation ground work for computer assisted learning” (Kidd, 2010, p. 47). Suppes (1966) explains his realisation of the educational value that could stem from individualised instruction:

One can predict that in a few more years millions of school children will have access to what Philip of Macedon’s son Alexander enjoyed as a royal prerogative: the personal services of a tutor as well-informed and responsive as Aristotle. (p. 207)

In the following decade, Alfred Bork (1979), a professor of physics at the University of California, also a pioneer in computer-orientated education, declared:

We are at the onset of a major revolution in education a revolution unparalleled since the invention of the printing press. The computer will be the instrument of this revolution…. By the year 2000, the major way to learning at all levels and in most all subject areas will be through the interactive use of computers. (p. 32)

Soon after, in the introduction to Mindstorms: Children, computers and powerful ideas, Seymour Papert (1980), one of the early pioneers of artificial intelligence at MIT, renowned for his work on the Logo-based software for learning and teaching, similarly asserts: “We are at a time in the history of education when radical change is possible, and the possibility for that change expressly relates to the impact of the computer” (p. 24). The inference drawn from the work of the aforementioned Suppes, Bork and Papert is that they believed that whilst not all students have the same backgrounds and not all students learn in the same way, many conventional approaches to education use a lock-step procedure for all students and do not
take these differences into account. Essentially, the computer was perceived as an “intellectual tool” (Bork, 1981, p. 24) that can be used to expand the students’ cognitive capabilities and promote different learning approaches. A key stated advantage of the computer is that with good material, instruction can be individualized to allow students much more self-pacing with every student playing an active role in the learning process. In contrast to the passive role characteristic of many existing class-based formats, Borke perceived that: “the student in such a situation is no longer a spectator, but is an active participant” (Bork, 1981, p. 24). Thus, from Bork’s instructional perspective:

> The main interest will be the effects on courses and curricula … the greatest change will probably be in the quality of the courses. As courses are rethought, with the possibility of using an interactive and individualized learning medium, we can produce curriculum materials far superior to those currently in use. (p. 30)

Within the same decade that Papert and Borke’s assertions emerged, the United States Office of Educational Research and Improvement advised the Secretary of Education to promote the need for students to be educated about and with these technologies so that they may understand and control them, for their own purposes and for the benefit of society (e.g., Yelland, 1992). Similarly, in 1981, Kenneth Baker, then Minister for Information Technology in the United Kingdom, stated: “the reason why we’ve pushed ahead with computers in schools. I want youngsters, boys and girls leaving school … to actually be able to operate a computer” (Wellington, 1990, p. 57). Plomp, Kontogiannopoulou-Polydorides and Anderson (1996) convey the rapid and far-reaching influence of this line of thought in their introduction to the *Cross national policies and practices on computers in education*, an account of a two-part survey conducted in nineteen countries during 1989 and 1992:

> In the history of education, the 1980s will stand out as the decade during which many countries throughout the world introduced computers in education on a large scale, the first stage of a technological innovation which is unprecedented in its scope. (p. 1)

### 3.3 Early computer education government initiatives in Australia

Although the above survey did not include Australia, Bigum’s (1987) report on computing in Australian schools, *Coming to Terms with Computers*, which covered case studies of school use of computer applications in three states, indicates a similar response here:

> Developments in computing are not merely changing the technology of education … they are also creating opportunities for changing education itself…. The new technologies are perceived as part of a broader ‘information revolution in society; for the ‘new’ society, new forms of education are needed. Education must change, it is argued, because society itself has changed. (p. 272)
The computer technological advances during the 1970s brought about profound changes in Australia, as elsewhere. These included not only the efficiency and level of production but also the type of jobs required and the amount of time that people needed to work (e.g., Anderson, 1984). Since that time, the wide use of computer technology in the global community is known to have instigated unprecedented efforts by Australian government agencies to ensure students are well prepared for the challenges of work in the contemporary computer world (e.g., Anderson, 1984; Carr, 1990). Although in 1976 Wearing, Carss and Fitzgerald produced one of the earliest reports on computers in Australian education to enthuse dialogue among computer users (e.g., Anderson, 1984), the proliferation of computer education administrative bodies did not emerge appreciably until the Commonwealth Schools Commission (CSC) (1983) stimulated the notion of computer education being of fundamental importance to Australia’s future. According to Anderson (1984), the CSC initiated numerous reports, reviews and policy statements on computer education that were published in the early 1980s.

Among the early CSC schemes was the National Computer Education Program, which was allocated 20 million dollars of federal funding from 1984 to 1986 to be administered by state level coordinating committees within the Commission’s guidelines (e.g., Ingvarson & McKenzie, 1988). Based on the need for students to have an understanding of the uses of new technologies and their environmental, industrial and economic effects “school policy in all states and territories came to embed the computer technology imperative” (Meredyth et al., 1999, p. 247). From that time, due to the rapidly developing sphere of computer technology, and the iterative nature of the policy forming process, policy statements become outdated by the time they were released. Thus, most state education systems followed a series of guidelines based on the dominant discourse on equipping schools with computers in order to prepare students for the future (e.g., Tinkler, Lepani & Mitchell, 1996).

3.4 The genesis of the ‘computer literacy’ concept
Fundamentally, the aforementioned National Computer Education Program was devised to support “a significant shift in Australian education – the shift towards creating a more ‘computer literate’ society” (Bigum, 1987, p. 289). This emphasis on computer literacy mirrors the concerns expressed in the United States soon after the introduction of the microcomputer in the late 1970s, over what was perceived as a national computer literacy crisis (e.g., Molnar, 1978). Although Weber (1997) suggests that ‘computer literacy’ is a relatively new term encompassing a broad range of understandings and skills, which are now regarded as being integral to education in the 21st century, according to Aspray (1991), the origin of the term ‘computer literacy’, which linked computers with literacy, and with learning in schools, was conceived in
1972 by Andrew Molnar, a pioneer in computer-assisted education of the USA National Science Foundation. Evidently, from 1978, when Molnar declared that “the computer literacy crisis would be the next great crisis in American education” (p. 38), and convened important national computer literacy conferences, the concept took on a life of its own by the early 1980s. The important components of the National (USA) Computer Literacy Goals for 1985, as articulated by Deringer and Molnar (1982), include the ability of people to use computers and to appreciate that computing is becoming as vital as the facility to understand and manage the written word. In Molnar’s (1978) own terms, a computer-literate population was as essential to an information society “as raw materials and energy are to an industrial society” (p. 37). Howard and van Duren’s (1993) analysis of the relevant United States 1980’s literature indicates that, as computer literacy was accorded at least some of the status applied to language, it was not unusual for higher education institutions to require a computer language as part of their entrance requirements. Importantly, it was thought that the computer literacy notion might only be the beginning of a broader more general technological literacy associated with the growing perception that a technological society will have to be competent in both the use and language of technology.

In Australia, the ‘computer literacy’ concept was reinforced through the Smith Report, Technologies for Enhanced Learning: Current and Future Use of Technologies in School Education (Smith, 1994), written by the Victorian Government Working Party on the Use of Technology as an Education and Communication Facility in Schools (e.g., Lankshear, Bigum, Durrant, Green, Honan, Morgan, Murrany, Snyder & Wild, 1997). The key notion of the report is that technology is now able to enhance learning, help students to build sound concepts, construct a picture of the world that has relevance and meaning, and give emphasis to the contribution teachers can make as facilitators of learning. The report also notes that in order to maximise such opportunities, teachers may need to rethink their own theories of learning and the way they teach:

Support for such a rethink on the part of educators comes from many directions…. The United Nations, the OECD, UNICEF and UNESCO. The UNESCO Symposium Round Table held in Beijing late in 1989 declared the need for: a new view of knowledge; a greater integration of knowledge; a renewed commitment to lifelong learning; an education system with shifts of emphases from conformity to creativity and innovativeness, from competition to cooperativeness, from private benefits of learning to public benefits, from instruction to learning how to learn, to nourishing the higher-order skills, to positive aspects of personal development. (Smith, 1994, p. 40)

The Smith Report is said to have provided de facto policy guidelines for information technology in education in Victoria, and added considerably to popularised talk of learning technologies
and the concept of enhanced learning through the use of new technologies (e.g., Lankshear et al., 1997; Snyder, 1999; Tinkler, Lepani, & Mitchell, 1996;). In Snyder’s (1999) words, “learning is a prominently featured keyword in the report, and attention is drawn to associated concepts of ‘choice’, ‘flexibility’ and ‘life-long learning’ in association with ICT integration” (p. 8). Allied to this, as outlined in due course, the Smith Report stimulated numerous government funded computer education schemes.

Among the subsequent reports is *Education and technology convergence: Commissioned Report No. 43* (Tinkler et al., 1996). In view of the expansion of global communication networks, this stresses the need to “look beyond "computer literacy", to the importance of "information literacy" relative to “the development of higher-order skills in processing information” (p. x). Consonant with notions encompassed in commentaries, like Drucker’s (1993), *Post-capitalist society*, Tinkler et al. (1996) see the potential of convergent technologies to promote a change in emphasis from teaching to learning, and to do new things rather than to do old things better. Likewise, ICT offer all education sectors “a new opportunity to become involved in the production and dissemination of knowledge” (p. 156).

### 3.5 Influence of the Internet boom on educational thinking

Clearly, with the commercial construct of the World Wide Web lead to the Internet technology boom in the late 1990s, the usual term ‘information technology’ was generally extended within Australia to ‘information communication technology’ (ICT). While the term ICT is often used in the United Kingdom and other countries, the term ‘informatics’ has been widely used in the European context for some time (Plomp et al., p. 7). The emphasis on computer technology in education came to include the communicative as well as the technical capabilities of the technology. Consequently, the “globalised electronic cultures” were seen as being potentially revolutionary because they alter social practices, and the relative political and social power not only of individuals, but of whole sectors of the populace” (Luke & Rowe, 1993, p. 115). Along with the resultant escalation of ideas of radical changes in education came the plethora of manuals, guides, and handbooks on exploring and exploiting the educational benefits of cyberspace. These provide tangible evidence of the myriad calls for schools to provide state-of-the-art computerised technologies, and to “‘have a ‘presence’ in the virtual world through the creation of their home pages on the Internet” (Lankshear et al., 1997, p. 120).

### 3.6 High status of ICT

In all, ICT became regarded as a high educational priority in Australia and internationally (e.g., Jamieson-Proctor, Burnett, Finger & Watson, 2006; UNESCO, 2005). In this respect, UNESCO (2005) viewed that the impact of the Internet, and that current public education systems
worldwide were shaped on the economic model of industrialism, which is changing irrevocably. Likewise Ken Robinson (2000), an international advisor on education in the arts to government, warns that as we no longer live essentially in an industrial economy: “The workforce now needs a new pattern. We cannot fulfil our current economic objective by just doing better what we used to do; we have to educate differently” (p. 5).

The spirit of this tenor also became quite palpable within the United Kingdom during the late 1990s. For instance, the National Grid for Learning was launched by the Department of Education and Employment (DfEE, 1997) with respect to ‘connecting the learning society’. The Introduction of this document encompasses, the then UK Prime Minister Anthony Blair’s, view that children cannot be effective:

In tomorrow’s world if they are trained in yesterday’s skills…. The National Grid for Learning will also send a clear message … here and internationally, that the UK intends to be among the world leaders to harness new technologies to raise educational standards. (p. 1)

William Clinton, the then President of the USA, projected a consonant tone within his First State of the Union speech. In particular, Clinton’s vision of the Internet as a “bridge to the future” was articulated in the context of his Call to action for American education:

The new promise of the global economy, the Information Age, unimagined new network, life enhancing technology – all these are ours to seize…. We must bring the power of the Information Age into all our schools…. We’ve only begun to spread the benefits of a technology revolution…. As the Internet becomes our town square … a teacher of all subjects, a connection to all cultures. This will no longer be a dream, but a necessity. Over the next decade, that must be our goal. (Transcript: President Clinton's 5th State of the Union Address, (Washington Post, 1997 p. 1)

The above statements evoke Lyotard’s (1984) words:

It is conceivable that the nation-states will one day fight for control of information, just as they battled in the past for control over territory, and afterwards for control of access to and exploitation of raw materials and cheap labor (p. 5)…. Machines will come to play an important role in regulatory and reproductive processes, and the power to make decisions will increasingly be determined by questions of access to information. (p.14)

Australian educational researchers, also describe ICT systems as being central to a “knowledge society” for educating students for work, and community involvement:

Students who are denied new information spaces will be socially, culturally as well as economically disadvantaged…. Notwithstanding the limitations of learning objectives, the digital technologies in their most recent phase, do afford some exciting opportunities in developing transformative curriculum. (Kalantzis & Cope, 2004, p. 41)
3.7 The lifelong learning concept
The allied view holds that curriculum that both promotes and is supported by ICT must simultaneously promote students’ computer literacy and their understanding of how and why they learn, what they need to support their learning and how to work with what they find: “These are the most important transferable skills they will acquire if they are to become lifelong learners, active participants and workers in the knowledge economy” (Meredyth et al., 1999, p. 250). Thus, in order to keep abreast of increasingly faster technology driven societal and workplace changes, students need to use computers and acquire “a core series of appropriate skills and knowledges providing a lasting baseline of abilities – lifelong skills – that can be enhanced with further learning” (p. 264). The same notion applies to the sphere of preservice teacher education where, it is argued that computer education must be about, ‘learning to learn’ because the ensuing changes to students’ learning: “lie in their awareness of the criticality of lifelong learning in the area of ICT…. “For future teachers, such insights are essential” (Phelps, Hase & Ellis, 2005, p. 12).

The notion of ‘life-long learning’, is as Watson (2003) notes, on the policy agenda of UNESCO, OECD, and numerous developed and developing countries, including Australia. Indeed, since the OECD’s declared a commitment to lifelong learning in 1996 (OECD, 1997), the concept of lifelong learning has appeared in various national educational policy statements. For instance, the belief that it is essential for both economic prosperity and social solidity, is firmly encompassed in the Adelaide Declaration on the National Goals for Schooling in the Twenty-First Century (MEETYA, 1999). While, a precise definition of the concept is quite elusive because it is used differently in varying contexts, within the contest of education, it is taken as denoting: “No longer front-end school learning but continuous across the life cycle to facilitate flexible career paths and enhance personal development” (Tinkler et al., 1996, p. 80).

3.8 Visions of reconceptualising education
Apart from the economic imperative of preparing a future-oriented workforce, the utopian visions associated with the computer technology advocacy in Australia are said to rest on the assumption that computer technology will promote individualised learning and teaching, enthuse hesitant students, aid those with special needs (e.g., Bigum, 1987). Similarly, the National sample study of the information technology skills of Australian schools students (Meredyth et al., 1999) concludes that under specific circumstances ICT can support what might be seen as universally valued educational concepts. These include motivation and stimulation of learning, and “a reduction in the risk of failure; development of analytical and
divergent thinking; adaptation to students with different learning styles or special needs; and enhanced communication and collaboration with others” (p. 12). The constructive use of ICT was associated with “fundamental reform in every day classroom practice” and the promotion of “competent citizens” (p. 266) for the information age.

Importantly, computer technology became increasingly regarded not only as an instrument of economic interests and for supporting existing learning and teaching practices, but also, as a means for wider educational reforms. Papert (1980) for instance, sought to transform education by promoting a generation of children who had a love for learning and whose education was both effective and highly motivational. In particular, he envisaged learning environments where children could generate their own problem solving tasks and resolve these at their own level by learning from their mistakes, or by finding ways to modifying their approach to learning. At the heart of this idea was the belief that: “Many children are held back in their learning because they have a model of learning in which you have either got it or got it wrong” (p. 23). Papert (1997) later reiterates his ideal: “I saw the social penetration of computers as eventually providing individuals or communities with the instruments to develop and to implement new educational ideas” (p. 426). His radical reconceptualisation of educational environments through ICT is stated in terms of: “Different content, different style of learning, different epistemology, and a different medium all matched to one another and to a form of school structured without curriculum or age segregation” (p. 426). The traditional model of teacher dominated learning environments has also been contested by other prominent ICT proponents, particularly against paradigms of using ICT to simultaneously promote autonomous and collaborative educational environments and students’ ICT skills, (e.g., Yelland, 1999). These visions are indicative of the often-stated belief that ICT undoubtedly offers opportunities for self-paced student-centred learning “as opposed to one size fits all learning” (Tapscott, 1998, p. 101).

The notion of utilising ICT to support new pedagogical repertoires, represents a major paradigm shift from the teacher transmitting information and pre-set learning outcomes model to a learner focused philosophy. More specifically, students’ active construction of knowledge is facilitated through ICT supported problem-solving and open-ended tasks linked to their interests, values purposes and life worlds (e.g., Negroponte, 1994). This conceptual change is consistent with the philosophy articulated in New Learning: The charter for Australian Education (ACDE, 2001). Advanced here, as indicated in chapter 1, is the notion of new learning for new times where ICT can assist in facilitating students’ authentic engagement in challenging, multidisciplinary tasks, and a shift in the traditional culture of the teacher centred to a student centred class-based learning environment. Combined notions include: “The key to self directed learning is to …
foster learners who will be designers of their own learning experiences, in collaboration with others as well as by themselves” (ACDE, 2001, p. 86). This paradigm shift complements both Bork (1981) and Papert’s (1980) belief in transformative potential of computer technology and their vision of learning environments marked by students’ autonomy, and development of higher order thinking skills.

3.9 Notions of constructive learning
Consistent with this shift, are publications that centre on how a technology-integrated curriculum can, at the epistemological level, acknowledge and build upon a variety of ways of knowing, whether these are conceptualised, in terms of different learning styles or Gardner’s (1993) multiple intelligence theory, or constructivist educational ideals (e.g., Carpenter & Taylor, 2003; Jonassen, Peck & Wilson, 1999). It seems that the general perspective derives from Bruner’s (1973) perspective that teachers need to cultivate learning environments from which learning experiences are generated, clarified, and extended through the students’ active rather than passive involvement in the learning process. In much the same way, Papert’s (1980) notion of teaching inherently encompasses epistemological features centred on “teaching in such a way as to produce the most learning for the least teaching” (p. 139).

With respect to the emphasis on constructivism within the Australian educational context, Tinkler et al. (1996) explain that the gradual move to constructivism became a definite shift, and that: “constructivism’ was the theory accepted by Working Party on the Use of Technology as an Education and Communications Facility in Schools” (p. 84), which pertained to the aforementioned 1994 Smith Report. Thereby, as Lankshear et al. (1997) suggest, almost all who advocate major reforms of schooling, especially through the use of computers, aver that learning needs to be more informed by constructivism in order for students to develop higher order thinking skills. In the following decade, Newhouse (2002) concurs that the most commonly held “set of beliefs about learning, well supported by research, are those aligned with constructivism” (p. 6), and that many educators have argued that students’ appropriate ICT use can assist teachers in providing for the prior knowledge and individual learning styles of students. Likewise, that ICT can assist students in engaging cognitively to a greater depth with knowledge domains when they are “supported in employing the full range of thinking skills within authentic contexts” (p. 8).

3.10 ICT advocacy in early childhood education
While the preceding discussion relates broadly to ICT use in school classrooms, there is also substantial early childhood education literature that advocates its use to promote innovative,
engaging and substantive learning opportunities for young children. Marsh (2002) for instance, posits that to separate new technology from the early childhood educational setting is to ignore: “the fact that childhood is a historically mediated concept, located in specific sociocultural and economic contexts which frame its meaning” (p. 133). Other researchers similarly urge early childhood educators to implement computer use, especially for children who have no such access at home because ICT learning opportunities at preschool provide a way of ensuring that the children are better prepared for their subsequent school experiences (e.g., Elliott, 2003).

Zevenbergen and Logan’s (2008) literature review reveals that some early childhood education researchers maintain that the learning value of the excitement that is promoted when young children use digital cameras and produce quality visuals is significant, as is the development of children’s social skills. More specific to curriculum, it also cites studies indicating that children working on computer in pairs engage more than when sitting on the floor to work on puzzles. In addition, developmentally appropriate, open-ended software has been found to assist young children’s understanding of key mathematical concepts (e.g., Clements, 2002), development of fine motor skills, alphabet recognition, self-esteem, and school-readiness skills (e.g., McDonald & Howell, 2011). With respect to the meaning of ‘developmentally appropriate’, Clements (2002) suggests that while it continues to be refined, it can be regarded as meaning: “challenging but attainable for most children of a given age, flexible enough to respond to inevitable individual variation, and most important, consistent with children’s way of thinking and learning” (p. 116). The concept of developmentally appropriate software as described by Haugland and Shade (1990) is addressed in more detail in chapter 5.

Additional advantages of computers in early educational settings are said to include the potential for combining visual displays with animated graphics and speech, and the facility to provide feedback, keep a variety of records and foster individualised learning (e.g., Clements, 2002). Similarly, though not with specific reference to early childhood education, it is thought that the capacity of computers to integrate text and visual representations signifies their firm potential for promoting students’ formulation of concepts and relationships, and thus more effective learning environments (e.g., Lemke, 1996). For Musker (2000), ICT is particularly appropriate for catering to differences in students’ learning styles due to the variety of media suited to fostering diverse ways of learning. Thus, students “should not only be taught how to use ICT, they should be using ICT to learn” (p. 4).
3.11 ICT orientated funding priorities in education and media reinforcement

The following section focuses mainly on the Australian context through a series of snap shots rather than an exhaustive account of the discourse on the multilayered efforts by government agencies, either during or after the 1990s, to support, what Whelan (1991) terms as the overriding belief that the ready availability of computer technology will, among other benefits, “extend our access to information, to each other, and to ours and others’ cultures and learning” (p. vi). With respect to the references made to government announcements of support for educational ICT, these are put just as they appear in certain articles, as distinct from any probing as to whether or not all published promises where fully honoured.

At the state level in Victoria, the computer technology focus became particularly accentuated by Kennett government’s Schools of the Future program which was developed in response to the aforementioned 1994 Smith Report, and is said to have dominated the policy environment of the time (e.g., Snyder, 1999). Two of the recommendations of the report pertain to the need for teachers’ professional development that is “appropriate in these times of rapid economic, social and technological change” (Lankshear et al., 1997, p. 63). As a result of the Smith Report, the Victorian Government allocated $56 million over four years for computer education related professional development for teachers. Among other schemes, the funding was directed in part towards the Navigator Schools Program involving seven schools in Victoria. Essentially, these schools were to model exemplary use of ICT and to provide leadership for Victorian government schools with respect to integration of ICT across the school curriculum (e.g., Lankshear et al., 1997; Snyder, 1999). Aside from this, all schools were encouraged to incorporate in their school charters the need for their staff to be conversant with computers and make provision in their budgets for the following:

- the training of all staff to a level of competency in personal computer use;
- training of staff directly involved in delivery of computer-mediated learning programs specific to the school;
- supplementary training for individuals selected to act as technical resource persons for other members of staff where no person on staff can provide adequate technical support. (Smith, 1994, p. 62)

Indicative of the keen media interest in this Navigator Schools Program (NSP), The Age published a comprehensive article Navigator schools at the forefront. This illustrates, what Tinkler et al. (1996) regard as the intense Australian media attention accorded to the impact of
the ‘information superhighway’ on education that is driven by the ever-increasing policy initiatives taken by both Federal and State governments in response to ongoing advancements in ICT. Within this article, which appears six years after the start of the NSP, numerous school leaders and educators are cited as extolling its virtues. Among these, Peter Cuttance, reported saying: “In terms of school systems in Australia. It was one of the significant initiatives anywhere in the world”. Similarly, Glen Waverly School Principle Daryl Fraser is reported as having approached the topic “with an almost evangelical fervor” (Cant, 2001, p. 7).

An additional glimpse of the media attention associated with one of the numerous other pertinent Government ICT funding priories in Australia, appears in the Queensland Courier Mail by Sid Maher (1996) whose article $300m for computers in schools, reported that at the launch of the 1996 re-election campaign, the then Prime Minister “Mr Keating, said that $240 million would be provided over four years to buy 15,000 computers for schools”. A further $60 million was promised for “teachers’ professional development” because: “A Labor government will not support a school system divided between the information rich and the information poor” (p. 13). Soon after, Bracks, the Premier of Victoria, who had succeeded Kennett, is quoted as stating, in relation to government funding for educational information technology, this is a: “real Labor way of operating” (Hannan, 2000, p. 1).

The importance of ICT in education in Australia is again crystallized in terms of the Australian community becoming a ‘knowledge society’, within the Howard Government’s 1997 Plan for Australian Industry. Specifically, the plan notes that as we merge into the twenty first century our economic, political and social processes will become ever more knowledge and information based, and will require increased accent on ‘information literacy’. As information and communication technologies, and access to them will be vital for Australia’s future, schools need to adequately equip students to “participate in the information society … to use information technology effectively and to … manage the ever increasing quantity of information which is available” (Commonwealth of Australia, 1997, p. 71)

In Victoria, the ever-increasing implications of the ICT literacy drive or the transition towards the ‘knowledge society’ for teachers in government schools is highlighted in The Age article: ‘State schools set to reach cutting edge technology: The blue print for Victorian schools’. This relates to the state government’s undertaking to link all schools to the Internet, and the release of the Learning technologies in Victorian schools 1998-2000, when the Victorian Minister for Education, Phillip Gude reportedly announced that Victoria was now at the front position of global innovation in education. Elements of the blue print are noted as: ‘Principals’ …
commitment to the use of new technologies is considered in selection for appointments…. Schools to carry out technology audits…. E-mail to be introduced to all schools by June 1998” (Jones, 1998, p. 3). In this context, Gude is quoted as explicitly stating the expectation that teachers in Victoria meet fixed computer skill standards in accordance with a newly launched three-year learning technology scheme:

   Schools are to detail in their charter how technology enhances learning…. In order to successfully compete in a technology-rich and ever changing environment our students must be confident, well skilled and flexible in the use of information technology. Teachers’ promotional opportunities will be tied to the new standards … aimed at raising the technological proficiency of school staff and students and creating a state-wide school techno-culture. (p. 3)

A later report in *The Age*, which details the Victorian State Government’s plan to speed up its online strategy by providing laptop computers to all state school teachers and principals by the end of the year, states: “Education Minister Mary Delahunty (in Victoria from 1999 to 2002) yesterday announced that the government would complete the scheme introduced by the Kennett government in 1999, two years ahead of schedule”. In the same context, Delahunty is quoted as saying: “The laptop initiative will significantly increase the skills of Victorian teachers and put them at the front of a rapidly changing profession” (Jones, 2001, p. 2). A later article reports that Delahunty, confirmed that the state budget would reflect high investment in IT infrastructure for schools, and stated, “We want to give students the skills to compete in a modern economy” (Hannan, 2001, p. 1).

The above noted ‘laptop’ scheme pertains to the initiative introduced by the Victorian Department of Education and Training in 1998. As described by Blackmore et al. (2003), notebook computers were leased to each of the 37,000 government teachers in Victoria, over a three-year period, to enable principals and teachers to integrate ICT in classroom and administrative practices. Likewise, to improve teachers’ skills in using ICT in the delivery of curriculum, to increase teacher productivity, and advance the professional status of teachers. In effect, schools were expected to implement a Learning Technologies Plan by 2001. This was meant to ensure principals, staff and students have access to computers, a range of applications and curriculum products and the use on-line information and communications as a regular part of the school’s educational and operational program.

The continuing key agency for the Australian federal government's digital revolution through major funding programs is evidenced through numerous successive Ministerial Media Releases, including the one published by DEEWR (June 3 2008) when the Rudd Labor government’s Minister for Education, Julia Gillard reportedly committed $650,000 to initiate and
fund teachers’ ICT professional development activities over the next twelve months. Apart from an additional $11.25 million to be directed to ICT, through States and Territory Governments, Gillard (2008) announced the Government’s commitment of $32.6 million over two years for online curriculum tools and resources for Australian classrooms of the 21st century:

ICT is now indispensable in today’s teaching and learning, and this investment will be crucial for the successful implementation of the Digital Education Revolution. To be able to compete globally, Australia needs a world-class education system that connects our students, teachers and schools to the global digital economy, and helps prepare them for the future.

(Gillard as cited by Department of Education, Employment and Work Place Relations – DEEWAR, 2008, p. 1)

3.12 Changing landscape of higher education

Australian universities’ common focus in striving to promote students’ ICT capabilities are well established. That is, university educators, particularly those in preservice teacher education, are increasingly expected to change learning and teaching environments and to “provide leadership in articulating and modelling these new didactics in their own instructional practice” (Collis, 1998, p. 373). The expectation relates to not only to calls for new modes of learning and teaching, but also greater course flexibility, including distance education (e.g., Franklin & Peat, 2001; Gillard, 2009). Encompassed here is the view that ICT provides academics with opportunities to promote rich learning environments, enhanced by the abundant Internet-based information and resources, as wells as a wide range of multi-media constructs (e.g., Birch & Sankey, 2008). In view of the high cost of ICT and investments of time means that effective ICT implementation by academics is particularly critical.

Snapshots of the general technology driven climate in the Australian higher education sector, within which Schools of Teacher Education are positioned, and thereby of significance to the current study, come from numerous prominent university personnel, including Carmel McNaught (2001) whose article, A model for staff development for using ICT in teaching and learning: The RMIT experience, acknowledges that universities have reassessed their fundamental business and the way they go about it. Given the view of ICT as an important factor in streamlining their operations, technical support staff, educational designers and graphical designers are now essential throughout the university as is expensive high-end media and multimedia production: “We are trying to combine the benefits of both the integrated and distributed approach in developing new roles and skills” (p. 3).

The Australian Learning and Teaching Council (ALTC) (2010) acknowledges that ICT has been an important factor in the streamlining of university operations in that over time many universities have endeavoured to stimulate innovation through sizeable strategic institutional
funding for projects for advancing teaching and learning within disciplines across all faculties, and for the whole organisation. A large percentage of this financial support has been absorbed by projects pertaining to the use of technology in teaching and learning, an area of progressing importance. Enabling the adoption of educationally effective use of technology requires reliable and effective ICT infrastructure: “This is a key to the acceptance of technology in teaching and learning by both staff and students (p. 43). A more recent facet of the Australian Government’s digital revolution - Digital Economy Goal also relates specifically to the higher education sector:

By 2020, Australian schools, tafes, universities and higher education institutions will have the connectivity to develop and collaborate on innovative and flexible educational services and resources to extend online learning resources to the home and workplace; and the facilities to offer students and learners, who cannot access courses via traditional means, the opportunity for online virtual learning. (Department of Broadband, Communications & the Digital Economy, 2011, p. 1)

3.13 Extending the computer literacy concept

While ICT literacy has been defined in various ways in recent years, in ACARA’s (2011) brief terms, it signifies: “The ability of individuals to use ICT appropriately to access, manage and evaluate information, develop new understandings, and communicate with others in order to effectively participate in society” (p. 1). However, just as Resnyansky (2002) notes that in today’s world, terms like information and communication and countless others have taken on new meanings as part of the common terminology used to describe computer use, Robin (2008) points out that many educators now refer to 21st Century Literacy as Digital Age Literacies, or 21st Century Skills. Yet regardless of the particular term being used, these skills represent the combination of:

- Digital literacy – the ability to communicate with an ever-expanding community to discuss issues, gather information, and seek help;
- Global literacy – the capacity to read, interpret, respond, and contextualize messages from a global perspective;
- Technology literacy – the ability to use computers and other technology to improve learning, productivity, and performance;
- Visual literacy – the ability to understand, produce, and communicate through visual images;
- Information literacy – the ability to find, evaluate, and synthesize information. (p. 224)

In other words, while literacy is a basic way of communicating within the medium of one’s culture (e.g., Wagner, 1995), for Robin (2008), the push for 21st century literacy skills encompasses that view ICT can assist students to gain enhanced communication skills as they learn to conduct research on a topic, ask questions, organize their ideas, express opinions, and construct meaningful narratives. In certain curriculum areas, ICT integration might also benefit students in
“learning to critique their own work, as well as the work of others, facilitating social learning and emotional intelligence” (p. 224).

3.14 Retaining professional credibility
Symptomatic of the ongoing push for teachers’ ICT inclusive pedagogy is the Australian Education Union 1999 policy statement: “Students should be able to spend up to 20% of instructional time using modern computers” (Fluck, 2003, p. 145). In a similar way, the Year Book Australia 2000 Report is cited as stating: “If schools are to compensate for social and economic differences and provide common competencies across the population, it is important to improve teachers’ advanced IT skills” (Mitchell, 2000, p. 37). Marsh (2002) also notes an increasingly common expectation of teachers: “Effective teachers are now using the computer in a wide array of situations. They have no choice because students, parents and the community expect nothing less” (p. 27). At the same time, as Blackmore et al. (2003) note, were the “increased expectations that good schools are hi-tech” (p. 180). By the mid 1990s, this focus extended to include domestic settings in that: “A major part of parents’ motivation in acquiring a home computer is to give their children a “head start”, particularly with school and university assignments” (The Apple Report, 1996, p. 1). More recent studies on the implementation of computer technology in a range of national and international early childhood education settings also report that parents support and expect the use of ICT which they perceive as being important in providing a better starting point in terms of future advantages for their children (e.g., Leung, 2003).

The associated view is that since many of the teachers who, for the foreseeable future, will have to negotiate classroom applications of new technologies that are already in service, ongoing professional development provision assumes great strategic importance (e.g., Lankshear et al., 1997). Otherwise, teachers are “in danger of losing credibility as professionals in the information age” (Yelland & Lloyd, 2001, p. 177), and education systems that disregard ICT as an aide to constructive learning experiences are at risk of being regarded as: “Neolithic by those who experience them and this should be a grave source of concern to those who are responsible for educating the next generation for the information age” (p. 175). Groundwater-Smith, Cusworth, and Dobbins (1998) also stress that in the face of increasing use of and reliance on technology in society, teachers cannot justify perpetuating traditional practices on the basis of nostalgic considerations. Hargreaves (1994), goes further to concede that: “The involvement of teachers in educational change is vital to its success, especially if the change is complex and is to affect many settings over long periods of time” (p. 11). Meredyth et al. (1999) agree that there is an vital need for educators to come to terms with ICT, in that those who think
through concepts such as the ‘knowledge economy’, ‘cultural globalization’, ‘media age’, ‘digital revolution’ are well positioned to confront the future, and can be regarded as “able to change and respond flexibly and proactively, learning from changes that are already taking place” (p. 246). In this light, Whelan (1991) recalls Stranks’ (1983) long standing advice:

The most essential thing which education should provide with regard to rapidly changing society is the base for understanding change, a willingness to understand future change and a confidence in being able to direct it – to actively participate in the process – and not merely be subject to it. (Whelan, 1991, p. vii)

Consequently, Australian researchers of ICT in education observe, teachers are being consistently challenged to use ICT appropriately in order to help prepare students to participate independently, competently and critically in post-school contexts (e.g., Lankshear, Snyder & Green, 2000). For Nicholas Negroponte (1992), renowned for his work as the founder and the director of the MIT innovative Media Laboratory, this means teachers are obliged to participate wholeheartedly in the process of preparing students for a future in which “each generation will become more digital than the preceding one” (p. 2). For others, this also entails teachers inculcating students with the view that ICT literacy is a fundamental aspect of life in the 21st century (e.g., Cope & Kalantzis, 2003).

3.15 Implications for teachers and education faculties

The universal reach of this view was conveyed by James Pellegrino (1999), professor of cognitive studies at Vanderbilt University, USA:

Many educators and prominent ICT advocates world-wide maintain … schools of the 21st century should function quite differently to those of today because of the unprecedented availability of ICT to support learning and teaching in new ways…. The future reality demands a teaching force well prepared to utilise the advances in information technologies to support their own teaching and their students’ learning. (p. 21)

The impact of this argument on Australia preservice teacher education is well illustrated through Blackmore, Hardcastle, Bamblett and Owens (2003) reference to MCEETYA’s (2000) Joint Statement on Education and Training in the Information Economy, which states that graduate teachers are expected to enter the teaching workforce as competent and creative users of learning technologies. Thus, pre-service teacher education programs should:

1. Ensure that the education sector is providing all learners with opportunities to develop their ability to use technology confidently and creatively, and to develop the specialist skills needed to service the needs of the information economy;
2. Support education and training workers, especially teachers, to acquire and maintain the skills needed to take full advantage of the potential of ICT to transform learning; and
3. Share leading practice and research on ICT issues. (p. 143)
Among the plethora of successive national documents concerned with ICT skills as an educational imperative is that of the federal Department of Education, Science and Training (DEST, 2004), which states:

Teachers need to be technology aware and alive to the opportunities that technology presents for learning and innovation. Advanced information and communication technology should be ubiquitous in schools … an educational tool part of the professional repertoire of all teachers…. All teacher education programs prepare prospective teachers for the digital age where ICT is an important tool in information and knowledge management and integral to student learning. (p. 35)

Illustrative of the growing international view of the need “to better exploit the teaching and learning potential of ICT” (DEST, 2005, p. 3) are reports such as the OECD Directorate for Education working paper No. 61: ICT and initial teacher education national policies (Rizza, 2011). This emanates from a review, under the auspices of the New Millennium Learners project, of the survey responses received from Austria, Australia, Belgium (Flanders), Chile, Denmark, Finland, Poland, Slovakia, Spain, and the United Kingdom. The following is just a small excerpt of the recognition given to the relative efforts made in Australia:

In December 2008, through the Ministerial Council on Education, Employment, Training and Youth Affairs [MCEETYA], education ministers agreed to develop a system for the national accreditation of teacher education courses. This system will build on existing course accreditation processes operating in some states by establishing common accreditation processes and national graduate standards, and by specifying the knowledge and skills that graduates need, including ICT knowledge skills as well as other technology in teaching. (p. 11)

Preceding the above publication, MCEETYA (2005) provided a broad vision for improving education outcomes for all Australians through the ever-present use of ICT. The emphasis on the need for all students to achieve their potential is intertwined with the view that ICT promotes teaching and learning that is targeted to individual needs, and facilitates individualised pathways through education that match students’ interests, potential, and life stage. Added to this, MCEETYA claims that as students find it is “stimulating to work in a digital environment with improved access to quality educational resources, educators should take advantage of this increased motivation to achieve more equitable educational outcomes for all” (p.1).

The associated National Assessment Program: ICT Literacy Years 6 and 10 Report (MCEETYA, 2005) substantiates the above claim with reference to Australian community expectation that school leavers are confident and productive users of ICT who understand its impact on society. The conception of overall student ICT progress, MCEETYA (2005) is formulated in three strands: “working with information; creating and sharing information; and
using ICT responsibly” (p. vii). In addition, MCEETYA (2005) insists that, as ICT developments continually change the way people share, use, develop and process information and technology, even the schools that routinely utilise educational technologies must ensure that their effectiveness continues to expand over the next decade. The culminating key emphasis in the goals for young Australians is seen in the Melbourne Declaration on Educational Goals for Young Australians (MCEETYA, 2008), which sets the direction for Australian schooling for the next 10 years. For instance, Goal 2 states that successful learners need “the essential skills in literacy and numeracy and are creative and productive users of technology, especially ICT, as a foundation for success in all learning areas” (p. 8).

3.16 Curriculum perspectives

The influence of the ICT agenda on national policy such as the Creative Nation: Commonwealth Cultural Policy is quite clear. In highlighting the significance of the national culture flourishing especially due to the global consciousness shaped by electronic media, it states: “We must address the information revolution and the new media not with fear and loathing, but with imagination and wit” (Commonwealth of Australia, 1994, p. 7). In keeping with this goal, the Statement on Technology for Australian Schools emphasises the need for people to understand technology, to use a wide range of technological applications and processes confidently and to critically appreciate the consequences of technological innovations: “Technology contributes to cultural, social and economic changes.... At primary level, schools could integrate technology across the curriculum” (Curriculum Corporation, 1994a, p. 11).

With specific reference to arts education, advocacy for new technology in the curriculum have been generating for quite sometime as evidenced through numerous documents. These include: The National Arts in Australian Schools Project: The arts and technology (Curriculum Corporation, 1991), The National Arts in Australian Schools Project: The arts and the year 2000 (Department of Education Queensland, 1991), The Arts: A statement for Australian Schools (Curriculum Corporation, 1994b). For example, the latter document notes:

> Advancements in technology challenge the arts to continue to explore new combinations of content and forms as options.... Arts programs need to take the opportunities technology provides for artistic exploration, experimentation and design, and for taking over low level tasks, freeing students to concentrate on other skills. (pp. 9-10)

Comparable notions are conveyed within the Victorian, Curriculum Standards Framework II (Board of Studies, 2000). This is part of a larger document providing a strong focus for curriculum and clear statements of what students are expected to achieve in the key learning areas (KLAs): English, mathematics, science, technology, languages other than English, health
and physical education, studies in society and environment, and the arts. The emphases is on integrating information technology to support all learning areas. The link between information technology and the achievement of desired learning outcomes relates to the work-place skills and knowledge students now require for a range of vocational opportunities in “an increasingly information-rich world” (p. iii). Within the Arts KLA, ICT is expected to support students’ visual arts learning through the use of various technological innovations (BoS, 2000).

The Arts Domains of the next curriculum framework, the *Victorian Essential Learning Standards* (VELS) (VCAA, 2005), similarly proposes that students’ imagination, experimentation, and planning can be enhanced through art practices that incorporate ICT. This view is later extended within the VELS (VCAA, 2009) *Introduction to the Arts*:

The Arts provide an arena where Information and Communications Technology (ICT) can be creatively used, explored and integrated into the curriculum, for visualising thinking, creating and communicating. Students’ analysis, interpretation, construction and deconstruction of new media, visual, and performed forms of ICT can enhance the complexity, sophistication, effectiveness and accessibility of their own work…. The Arts provide opportunities for students to develop new operational skills in ICT, critical understandings of how ICT operates in the world through critiquing their experiences as both consumers and producers, and opportunities for students to develop their understanding of how ICT is impacting upon culture through investigations of evolving digital art forms. Convergence of art forms and the development of new art forms through ICT raise particular challenges for the Arts in terms of how art and artistic practices are changing and being changed by ICT. (p. 1)

Respectively, VCAA (2008) underlines the need for students to experiment, select, and use appropriate skills, techniques, processes, media, materials, equipment and technologies across a range of art forms and styles. Students are expected to:

Combine and manipulate arts elements, principles and/or conventions to represent and communicate ideas and develop imaginative solutions to set tasks, research, observe and reflect on their explorations, develop, discuss, express and support opinions about their own and others’ use of arts elements, principles and/or conventions, skills, techniques processes, media, materials, equipment and technologies. (VCAA, 2008, p. 21)

In turn, all learning programs in the arts disciplines at all levels, are expected “provide opportunities for students to experience a range of traditional, contemporary and new media/multi-disciplinary forms and genres” (VCAA, 2009, Para. 5). *The First We See: National Review of Visual Education* (Davis, 2008), underpinned by two phases of data gathering strategies, including case studies, surveys and a synthesis of the findings and a review of existing literature, considers ICT in relation to concerns around Australian students’ opportunities to acquire appropriate visual skills or “visuacy”: “The ability to create, process and
critique visual phenomena” (Davis, 2008, p. xi). Although the review recognises that arts teachers who had little preservice experience in ICT inclusive art education, are struggling to align policy directives, curriculum statements, and individual school agendas, all teachers, irrespective of their teaching experience are urged to understand that:

While twenty-first century students are ‘info-age’ savvy in ways that older generations can only envy, they need more than, say, the capacity to click around screens. They need to be able to use the broad array of media at their disposal to communicate their messages; they need knowledge of and practical command of aesthetics to be able to realise their artistic vision/s effectively. (p. 4)

In this context, effective ICT integration on the part of the teacher is seen to allow students to use new and emerging digital hardware and software in creating and investigating artworks. This includes using technology to enhance established conventions, as well as creating new and innovative works both physical and virtual: “Generating ideas and products is a standard component of contemporary live artistic performance, especially in multi-art form presentations (p. 22). In support of the this perspective, within The arts and Australian education: Realising potential: Australian Education Review No. 58, Ewing (2010) refers to the digital age where students design Web sites for projects and integrate video, graphics, and animation into their presentations. “Where art is fast becoming the new literacy for our times” (p. 1). In view of the multimedia environment of the Web, and what is experienced through computers, that require students to think and communicate as designers and artists, Ewing avers:

The age of art has arrived, leaving behind the text-centric world that has guided us for so long. The language of art has become the next literacy—or the fourth R. We need not linger any longer over whether art should have a permanent and central place in our school curriculum. It should, and we need to move quickly to prepare students to be literate in the world that they are inheriting and rapidly shaping. In the digital age, art skills provide access to what Elliot Eisner (1988) refers to as “access to cultural capital”. (p. 1)

3.17 Recent curriculum developments

A more recent commitment to ICT inclusive arts education is reflected by ACARA, the statutory body charged with the development of the very first national curriculum: The Shape of the Australian Curriculum. With respect to Arts education, ACARA expected to provide direction for Arts throughout Years K-12 for both generalist classroom and arts specialist teachers (ACARA, 2010). In light of current evidence collected by ACARA, namely research and data from school administrators, teachers and students, ACARA holds that: “The curriculum stalwarts of literacy and numeracy are no longer sufficient to equip students with the basics they need to operate in the innovation oriented, digitally wired twenty first century” (p. 10). As such, ICT in arts education – dance, drama, media, music, and visual arts, within the projected National Curriculum, is considered as an important component in each discipline. The Draft Shape of the
Australian Curriculum: The Arts refers to ICT as enabling "students to use new and emerging digital hardware and software in order to create and investigate artworks ... To enhance established conventions, as well as to create new and innovative works" (ACARA, 2010, p. 22).

3.18 Rise of the digital native concept

In parallel with consistent calls for advancing ICT in education, is the promotion of ICT as a key to achieving deeper engagement for students (Gillard, 2008) with reference to the current student population as ‘digital natives’. This inclination reflects two interrelated views cited by Lankshear et al. (1997, p. 121). The first relates to Bigum and Green’s (1990) view: "What will eventually drag schools into the twenty-first century, is the force from within, viz., the postmodern lifeworlds and identities of present-day students". The second is Rushkoff’s (1996) oft cited perspective of the the contemporary student as a 'screenager' who is the product of a global culture mediated largely by computer and television screens”. Likewise, with respect to students born after the advent of technology in education – ‘Net generation’, Tapscott (1998) argues that, “the traditional approach to teaching is ill-suited to the intellectual, social, motivational, and emotional needs of the new generation” (p. 131). In due course, Prensky (2001) refers to students born before 1980 as ‘digital immigrants’ suggesting that this applies to most teachers who lack the technological fluency of the digital natives, and that it is more fitting to design learning opportunities that capitalize on how current students prefer to learn.

Some other commentators seem to follow Papert’s (1980) seminal notion of the computer as the children's machine, and his respective concept of children’s proverbial fearlessness of and affinity with technologies (Papert, 1993). Owston (1997) for instance, states:

Students now play, are entertained and learn with the computer and tend to be more visual learners than the previous generations because their world is rich in visual stimuli and they thrive on interacting with the device. The introduction of such technology into the classroom has also the potential to extend and amplify the number and kinds of learning experiences provided to students as well as to motivate students. (p. 10)

Other authors who see the students, born broadly within the 1980-1994 timeframe as ‘digital natives’ as they have experienced ICT as an integral part of their everyday lives, claim that they engage with ICT in ways that differ from previous generations of students and teachers (e.g., Betcher & Lee, 2009; Facer, 2011). In other words: “Most present-day teachers are products of modernity, reared in “real”, as opposed to virtual, worlds” (Lankshear et al., 1997, p. 129). This marked difference between the pre and the post digital generations accentuates calls for educational approaches to change in accord with the skills and interests of these digital natives (e.g., 2010; Facer, 2011; Prensky, 2001). The gap between the students’ technological acumen and educators’ technological expertise is thought to cause students’ a sense of frustration (e.g.,
Prensky, 2005) or estrangement (e.g., Bigum & Green, 1993). Howe and Strauss (2003), who refer to current students as the ‘millennials’, claim that because of their fluency in, and reliance on ICT, learning experiences need to be commensurate with the learning interests of the innate citizens of the digital world. Just as Prensky (2001) holds that: “Today’s students are no longer the people our educational system was designed to teach” (p. 1), Facer (2011) echoes the need for reconceptualising education, and posits that consideration of how children play, learn and live with digital technologies would help adults devise appropriate teaching practice. Allied to this, Lankshear et al. (1997) advise that teachers who ignore the interests, knowledge, and subcultures of students, and who regard “their computer junkie and cybernerd charges pathologically, that is, as deficient instead of as different, do so at great cost to themselves and to society” (p. 121).

3.18 Summary
Collectively the literature outlined thus far indicates that the ever-increasing computer education advocacy evokes the concepts of computer literacy, lifelong learning and constructivist pedagogy as being integral components of 21st century education. Similarly, the advocacy, as others have determined (e.g., Cerych, 1985; Cuban, 1993; Lloyd, 2003) incorporates three inextricably interwoven agencies in the computer inclusive education construct, namely the economical, sociological and pedagogical. Concisely put, the economic driver is due to the urgency of ensuring students are well prepared for the ever-changing nature of the workplace environment. The sociological agency requires schools and teachers to implement ICT in accord with government school policy directives, parental aspirations for their children’s future, and the general community expectations regarding students’ equitable access to effective ICT encompassing education. The pedagogical push is underpinned by the perceived potential of ICT to enthuse students towards deeper levels of learning on both an individual and collaborative basis.

This chapter has described how the developments of ICT have lead to the ever-increasing advocacy for ICT inclusive curriculum and pedagogy in the broad context of education by drawing on national and international literature perspectives and curriculum statements. In doing so it simply focused on the promotion of ICT integration in education as distinct from the more critical discourse on the topic. Therefore, as my own approach to facilitating ICT inclusive visual arts programs at preservice teacher level, is informed as much by the cautionary perspectives of ICT in education as it is by policy directives, the following chapter focuses on describing these, as inferred from both the past and ever-increasing national and international conversations.
Chapter 4
Cautionary perspectives on the ICT agenda in education

Our inventions are wont to be pretty toys, which distract our attention from serious things. They are but improved means to an unimproved end.
(Henry David Thoreau, 1854, p. 46)

4.1 Introduction
The broad-spectrum of calls for ICT integration in education, especially those that relate to both art and preservice teacher education, as outlined in the previous chapter, clearly contributed to the perceived need for the current research. Of equal importance to the study is an understanding of the ongoing discourse around the complex philosophical, practical and ethical issues associated with the ICT phenomena. Specifically, for precluding any naïve assumptions of its advantages, least of all for visual arts education, where well intended, but impulsive ICT implementation might simply be a means to an unimproved end. This chapter begins with an overview of a wide range of cautionary opinions that align philosophically with the current study in that they do not oppose ICT per se, but “against sleepwalking attitudes that distract from important things – against making a god of it” (Postman, 1996, p. 207). It then outlines comparable views that illustrate why the implementation of ICT inclusive curricular within the visual arts education field is not as straightforward as it might intuitively appear. Although the sections that apply to the general context of education and those that are more specific to art education are presented separately, given the highly context dependent nature of arts education, the themes are tightly interwoven and sometimes overlap.

4.2 Countering the euphoria: Questioning ICT rhetoric
The accumulative effect of the increasing prominence of computer technology in education since the 1980s has been described as “an educational revolution that has spawned many debates” (Shade, 1999, p. 1). The diverse nature of these debates continues to engage national and international educational researchers and ICT commentators alike. While the particular technologies and policies that inform their educational use vary from country to country, the overall issues raised with regard to the challenges that educators encounter across year levels and disciplines, are seen as being relatively similar (e.g., Rowan & Bigum, 2010).

With respect to the early concerns, an Australian researcher of computers in education notes that although it is asserted that computers will enable individualized teaching, enhance learning skills, enthuse hesitant students and so on, many people raise questions such as, “is it a tool ushering in new modes of learning … or is it a fleeting enthusiasm, in time to be relegated to the shelf?” (Anderson, 1984, p. 2). In light of the mounting new technology zeal, Bigum (1987)
questions the growing fascination on social grounds, and suggests that technology might constrain students’ creativity and expression and the issue of people being “controlled” by technology.

In due course, Bigum and Green (1995) contend that technologies are seen as “our salvation and solace in a time of crisis and change” (p. 5). In Hargraves’ (1994) view, this position is indicative of “goal displacement resulting from extreme fascination with the means of achieving our goals, and allowing the means to override the actual goals” (p. 23). For Barry Jones (1995) this situation, as described in his Sleepers, wake!: Technology and the future of work, denotes:

The increasingly fatalistic conviction that the answer to every complex problem is to be found in a ‘technological fix’ – and the more complex the fix, the more likely it is to be accepted without debate … irrespective of any adverse social consequences. (pp. 214-215)

4.3 Conflicting priorities in education

While the emphasis on ICT by policy makers is consistent with a discourse linking computers in education with technological progress, students’ enhanced learning and employment prospects, cautious, if not sceptical perspectives abound. Among these is the view that, apart from diverting resources from other facets of the curriculum, the escalating installation of computers in schools accords ICT an educational legitimacy that it otherwise lacks. Specifically, irrespective of how they are used in classrooms, “computers are now firmly entrenched in public perceptions of modern educational practice and their growing use in the home appears to be linked to a now general acceptance of their educational worth” (Bigum & Kenway, 1998, Para. 4). This implicit sense of technological determinism evokes the concepts introduced by McLuhan (1964) in understanding media: the extensions of man, where he highlights the paradigm shifts in thinking that accompanied the early adoption of technologies into society.

An allied view is that ICT initiatives in education privilege certain ways of doing things and exclude others (e.g., Fox, 2001). In highlighting the pertinence of this point with respect to the fiscal priorities accorded to computer installations, and the choice between losing specialist teachers and programs or raising class sizes in Australian schools, the Victorian education union’s president, Mary Bluett is reported in the age as claiming: “if the teachers and principals had a choice, they would have preferred to wait and have extra money spent on more teachers” (Jones, 2001, p. 2). In another Age article, Bluett is reported as asserting: “teachers need a ray of hope that they could offer a decent variety of programs in classes of appropriate class size and you need more teachers to do that … we’ve got money for buildings and more bloody money for computers” (Robinson, 2001, p. 4).
Likewise, Amanda Gome argues: “the first priority of any government in a knowledge nation must be small class sizes at every level and at every school … I feel alarmed, angry and ashamed about excessive class sizes at the school” (Robinson, 2001, p. 4). Other school based issues cited in the print media include: “in some of our most underprivileged schools … children sometimes don’t have a pencil, let alone a state of the art computer” (Hilton, 2000, p. 26), and: “thanks to the Kennett (ICT) revolution … only 13% of Victorian primary-schools school libraries are run by trained librarians” (Haigh, 2006, p. 30). Delacruz (2004) reports similar responses within her United States study of art teachers’ attitudes to ICT integration. In particular, some teachers: “resented what they saw as a draining of school resources for technology” (p. 8). As their schools came online, were outfitted with computing labs, and employed technical staff, resources for other educational priorities diminished.

Of equal pertinence is Beale’s (2009) observation, which is based on her experiences as a teacher, and her analysis of computer policy frameworks in Australia during the last decade. She concludes that the push for ICT integration within a particular teaching environment, and policy frameworks marginalise the teachers’ voice, therefore: “teachers will continue to come under pressure to employ computers “in ways that are determined outside their profession” (p. vi). Clandinin and Connelly (1995) suggest that the embedding of prescriptions for teachers within vision and policy statements may in fact be at odds with teachers’ practical working knowledge and value systems. Delacruz (2004) similarly notes adverse tensions stemming from situations where some teachers, with a strong commitment to technology, are at the forefront of change while others view such change as an imposition exacerbated through insufficient support within their school context.

For Jones (1995) conflating technology concerns can only be ameliorated through using technology “to extend and diversify human capacity and not to substitute for it” (p. 86). Respectively, in defining technology as the “great siren song of education,” Kearsley (1998, p. 1) avers that technology has become primarily, “if not paradoxically, a grand scale distraction from what matters most – effective learning and good teaching” (p. 47). Cuban (2001) draws on his USA study of educational computer use to argue for a broader vision of the social and civic role of schools in a democratic society. Otherwise, the extreme focus on technology use in schools is in danger of trivializing a nation's core ideals. In similar light, Davis (1998) calls for technologies to be seen: “not as slaves or simple extensions of ourselves, but as unknown constructs with whom we make creative alliances and wary pacts” (p. 335). The concept of pacts and alliances is applied by Lloyd (2003) to the purchase of classroom computers,
suggesting that the associated assumptions amount to myths around the educational advantages, and that in most cases the placement of computers in classrooms is an enactment of these myths. Further, “myth may be disinformation, but it is not, ipso facto, misinformation. The myths we now adopt may dissipate over time when experience and observation convert them to clear instances of fact or fiction” (p. 7).

4.4 Inequitable access to ICT

As shown in the previous chapter, Australian educational researchers generally advocate the need for schools to effectively align their teaching and learning programs with the requirements of an ever-increasing information economy, and highlight the importance of students developing lifelong learning skills. Importantly, the value placed on ICT in education is not seen as an issue separate from educational reform efforts, but rather as being inextricably intertwined. ICT implementation is regarded as an important factor in meeting the universal goals of equitable access to quality improvements in the education of all students (e.g., Toomey, 2001). Yet, a consistent concern identified in numerous studies, is that ICT integration is uneven both within and across classrooms, schools and systems, as is the quality of the related pedagogy. Implicit here is that the actual rather than mythical advantages of ICT implementation in education are dependent not only upon the installation of computers in schools, but also teachers’ equitable access to technical support, and their capacity to cultivate appropriate learning environments.

As inferred from a comprehensive review of international and Australian studies of ICT use in education (e.g., Tolani-Brown, McCormac & Zimmerman, 2009), successful ICT integration depends on effective and integrated leadership in schools at regional and national levels. Elliott (2001) underscores the significance of this point during an ABC radio interview: “our recent research shows while governments have spent literally millions of dollars on computers, they are actually not being widely used in classrooms”. Allied to this, a local teacher is cited as stating: “outside it classes, computers sit idle, especially the teacher allocated laptops, because teachers receive no training (Bell, 2001, p. 17). In light of similar claims, Yelland (1999) asserts: “anyone interested in education should be demanding not just the placement of computers in classroom, but also that the machines are used to their full potential” (p. 40).

In this regard, Wang’s (2011) contention that ICT enthusiasts’ commitment to the ideal benefits of new technology in education continually distracts from the practical aspects of implementation such as institutional matters of time, funding and provision of technical support for teachers echoes familiar concerns that computer technology determinism may either increase educational equity or inequity depending on context specific circumstances (e.g.,
Anderson, 1984). For instance, with respect to the early Australian advocacy for computers in education, Anderson (1984) notes that people ask: “will the presence of computers tend to widen divisions in the educational community?” (p. 2). Jones (1995) is in no doubt that, “there are real victims … computer illiteracy will widen the gap between the skilled and unskilled leading to the ‘information poor’ becoming a new lumpenproletariat – ‘ragged workers’ in Marx’ coinage” (p. 106).

Over more recent years Australian researchers attest that the issue of access to technology is a major equity concern. For instance, with respect to all areas of education, the national survey of technological infrastructure in education (e.g., Tinkler, Lepani & Mitchell, 1996) identified the lack of technical support available, particularly in the school sector. The inequity in terms of teachers’ pedagogical practice in implementing ICT for optimum learning is also noted. While some schools establish essential support services either by innovative organisational restructuring or community funding, and certain independent schools and larger secondary colleges manage to incorporate the cost of ICT support as an integral part of the budgeting process, many others remain under resourced. Subsequent Australian researchers, including Lankshear and Bigum (1998), confirm the continuing inequities in access to educational ICR resources, as did the National study of the information technology skills of Australian school students (Meredyth et al., 1999). This found a clear divide between: “the information technology 'haves' and 'have-nots’” (p. xxxiii), especially in areas of indigenous Australians and rural and isolated young people. With regard to school organization of ICT resources within a wide range of educational institutions both in Australia and internationally, Meredyth et al. cite Russell’s (1997) study which shows that computers are typically placed in maths and science classes before those of English and Art. There is also a tendency to provide ICT professional development first to maths and science teachers. Toomey’s (2001) review of successive national and international research reports, also concluded that, despite some areas of highly successful ICT integration, inequitable access to appropriate resource and learning experiences in all educational sectors causes ongoing concern both in Australia and internationally.

With respect to the United States, Heath (2001) highlights institutional gaps that cause a range of negative effects for the student population. Unlike youth of the past, who did not have any access to multimedia technologies, there are those who are now subjected to precarious institutional promises, failed efforts, and inequities of access and support. The concept of the ‘digital divide’ is also well documented in the early childhood literature by Elliott (2003) a prominent Australian researcher who calls for specific processes and steps to promote equity in
access and use of digital technologies. Specifically to ensure appropriate integration in learning, especially for children who may otherwise not have opportunities for engagement with current information and communications technologies.

According to media reports in Victoria, local teachers also draw attention to inequities, not only between schools that have enough computers and those who have none or insufficient (Hilton, 2000), but also inequity of access within schools (Bell, 2001). In keeping with such reports, Snyder (1999) notes that state government funding initiatives in Victoria “to technologise education” (p. 2) actually increase inequities. These are exemplified by the increasing gulf between technologically endowed and technologically disadvantaged schools, which have to some extent, been initiated and then institutionalised by government policies:

Since the late 1980s, certain schools have been selected for special treatment in regard to technology. In Victoria, for example, `science and technology centres', `magnet schools' and the `navigator schools' project all have received special funding. (p. 12)

Notably, Snyder (1999) claims that there is insufficient capitol for the range of resources required to realise the vision of a future-oriented, technologised state system of education. Hence, as technology increasingly becomes an important means in which public and private schools market themselves, there is the unbridgeable gap between the two systems: “in terms of digital media and telecommunication resources, professional development opportunities and support services, become poignantly patent” (p. 2). More specifically, in an era in which government education expenditure is declining and the promotion of ICT continues apace, the acquisition of contemporary technology will be an increasingly fiscal challenge for schools (e.g., Kenway, Bigum & Fitzclaren, 1995).

4.5 Consideration of teachers’ attitudes to ICT integration

Coupled with the issue of inequitable access to ICT resources, is the urgency of education systems raising computer competency levels. While it cannot be assumed that any single factor influences outcomes independently of the others, teachers’ attitudes are invariably seen as being critical (e.g., Anderson, 1984; Lankshear et al., 2000; Tinkler et al., 1996; Toomey, 2001). For instance, Anderson (1984) who in the early stages of computer education in Australian schools had considered a range of possible impediments to the progress of computer education, concluded that teachers’ attitudes to computers would be the most important factor as they would be “enmeshed with how these are used, which in turn, relates to the cognitive and affective outcomes of students” (p. 93).
With respect to the implications of this view for Australian teachers, Tinkler et al. (1996) argue that in part, this means that a large number of teachers, many of whom are over 40 years of age, need to understand, in a very short time, how to integrate ICT with educational practice, and to optimise the new opportunities offered through access to the national and global networks. For others, it also means that “rather than myopically teaching how to use specific types of technology” (Kearsley, 1998, p. 1), teachers should ensure that the classroom culture prompts students “to understand and explore their own investigative, creative problem-solving and communication activities when using ICT” (Meredyth et al., 1999, p. xxxiv). In effect, the classroom culture in terms of student interactions and teachers’ attitudes to ICT integration “holds critical equity implications” (p. 19). Allied to this, Blackmore, Hardcastle, Bamblett and Owen’s (2003) review of Australian and international literature, which discusses how teachers’ attitudes become embedded in their classroom use of ICT, concludes that the more innovative teachers regard ICT not as a replacement for traditional teaching approaches, but as part of a repertoire of constructivist teaching strategies.

The Cross-national study of ICT in schools (Fluck, 2003) identified concerns from the teachers’ perspective in that ‘ill prepared’ teachers, who might be described as ‘laggards’, often resist ICT for various reasons: “such as unreliability, lack of training, or inappropriateness for the subject” (p. 2). Another impediment relates to the need for teachers to acquire technological pedagogical acumen, which includes among other things, the skill of software evaluation, “especially if the software is to be used for self-paced learning” (Newhouse, 2002, p. 31). But, as this takes time and expertise in both education and computer use, teachers invariably rely on promotional material and software reviews that may be biased, inaccurate or inappropriate for certain educational purposes. Tinkler et al. (1996) concur that new technology devices in general demand a great deal of learning if they are to be used to the best educational effect: “one piece of hardware such as a pc is very different from another such as a Macintosh, and each type of software is likely to demand a different procedure” (p. xii). Lankshear et al. (2000) add that teachers working with ICT need sustained energy, diligence and persistence, frequently in the “face of considerable odds … in overcoming many barriers to “make things work” (p. 110). Implicit here is the need for caution in prejudging teachers’ attitudes until they are well supported in making professional judgements about the appropriateness of particular ICT and the needs of their students (e.g., Blackmore et al., 2003). The support needs to include technical assistance in overcoming technical hitches and customising local solutions, “enabling continuous upgrading and support for ubiquitous networking” (Tinkler et al., 1996, p. xii).
4.6 ICT concerns within higher education

In terms of advancing ICT implementation within higher education, university educators are urged to become more technologically literate, more skilled in the use of convergent systems and “less inclined to be content with established educational practices” (Tinkler et al., p. xvi). Yet questions are raised among academics about any implied or explicit assumptions that ICT implementation will yield more effective learning and teaching practices (e.g., Burbles et al., 2000; Nora et al., 2009). It has also been mooted that many of the claims about its value in enhancing pedagogy are as yet, untested (e.g., Schuck, 2002). Nora et al. (2009) suggest that some long standing claims of the influence of technology on student achievement might be viewed more accurately as assumptions as the rigor and conceptual dependability “of some studies is highly questionable” (p. 9). In much the same way, Becker (1994) had long called for systematic evidence that the teaching practices that promoted discovery-based learning and problem solving were best supported by computer-use. Likewise, with respect to the United Kingdom, Selwyn (2002) posits that although it is commonplace to link ICT with enhanced learning, there is a need for more research concentration on how technology is changing the nature of teaching and learning in qualitative ways. According to Hodge (1991), there are also educators who accept the importance of computer literacy for students, yet question the assumption that this literacy will ensure employment opportunities.

Lankshear et al. (1997) are concerned that overtly optimistic assumptions signify applied technocratic rationality that places technology as a self-contained entity where its potential is merely subject to learning certain basic skills. Fox (2001), asserts that the pressure for universities to “computerise” place technology as a “neutral tool” (p. 1) in terms of what it supposedly provides, and seldom with regard to the changes in work practices and extended work time that are brought about, in part, or in whole by the prevailing ICT agenda. Allied here are a number of local media articles (e.g., Armitage, 2001; Jones, 2000) that cite academics as highlighting the disparity between the expectations within higher education sectors and the provided resources. Funding cuts and lack of resources such as, “computer hardware and software were identified by academics as barriers to carrying out their role in the standard they believed appropriate” (Jones, 2000, p. 9). Nichols (2007) concurs: “workload issues, time-commitment … lack of effective staff development, and drawn-out implementation are some general barriers” (p. 6). Another concern is the assumption that using ICT to support learning requires change for all teachers. Yet there is no doubt that there are those who have generated appropriate learning environments for years without ICT (e.g., Newhouse, 2002). Accordingly,
Schuck (2002) notes that educators who routinely observe the principles of good practice as encompassed within the higher education literature, question the imperative of ICT inclusion to improve their pedagogy.

4.7 Concerns in preservice teacher education

Following Kearsley’s (1998) lament: “one of the saddest aspects of educational technology is how ill prepared most teachers are to use it” (p. 1), Meredyth et al. (1999) highlight barriers to ICT teaching practices within national schools of education. Essentially, they contend that while undergraduate teacher education courses are expected to play a critical role in preparing graduates for teaching practices that are commensurate with the demands of the information age, they have inadequate provision for promoting ICT integration experiences and role modelling of related teaching practice. A decade later, Black, Smith and Lamshed (2009) identified fundamental systemic flaws in the national quest to promote student teachers’ competencies in education courses and practicum settings where the actual use of ICT can be either low or confined to the use of ICT for productivity purposes. For example, while educators generally agree that integrating ICT into teaching and learning is important, the actual use of ICT can be either low or confined to the use of ICT for productivity purposes. For some lecturers, the central impediments to the modelling and embedding of “ICT is the deficit in terms of available resources such as computer labs, lack of time, and poorly set up or antiquated versions of the software in the university” (p. 19).

A compounding factor is that many student teachers enter university as ICT novices who can be challenged by simple tasks such as transferring “images/movies/sounds from their mobile phones and into the computers they were using to create simple ‘learning objects/resources’” (p. 29). Some had not even used PowerPoint to create non-linear, interactive resources that incorporated video, and most had not created or posted user generated content of any form. Hence, the obvious challenge to advance them to a stage where they can use learning materials effectively within the course time available.

This factor supports the view that student teachers are not all characteristic of the ‘net generation’ who challenge teachers to think differently and are adept at multitasking, technologically fluent, do not need instructions, and are active self-directed learners who welcome change (e.g., Prensky, 2001). In fact, Sheely (2008) warns that the digital native concept lacks a critical edge in that it overestimates the link between students’ use of ICT for recreational purposes and their actual ability to apply this to learning at school. This observation aligns with the findings of Kvavic’s (2005) study, which encompassed thirteen tertiary
institutions in five states within the USA. Specifically, while it was expected “that net generation students would demand greater use of technology in teaching and learning in the classroom. They did not. What we found was a moderate preference for technology” (p. 17).

4.8 Mismatch between university and practicum-based experiences.
Within the aforementioned Black et al. (2009) study, educators referred to frequent issues student teachers encountered in aiming to exercise their ICT knowledge in practicum-based lessons. For example, school computers not working, limited ICT knowledge by host teachers, poor access to computers for lesson times, and “host teachers who were not modelling ICT integration in any way” (p. 21). As student teachers' ICT competency is not typically covered in their practicum report, any reference in the reports to a student teacher's ICT capability in the classroom invariably depends on the host teacher’s own level of “ICT savvy” (p. 18). Likewise, a Learning Federation report on ICT use in Australian preservice tertiary institutions (Curriculum Corporation, 2009) notes that despite the increase in uptake by institutions that are preparing the next generation of teachers for work in 21st century schools, there are challenges to resolve before access and use of the digital curriculum resources becomes routine. Among these are the situations where student teachers “report that, even when they prepare to include digital content during practicum, access to computers, digital content and support at the school level often is not readily available” (p. 4). McKinnon and Hemming (2010), of Acadia University – the first Canadian institution to implement a full cross-curricular laptop program in 1996, identified comparable factors in their longitudinal study of teacher interns’ use of technology as they entered the teaching profession. Therefore, they advise that even when teacher education faculties explicitly provide “cutting-edge” experiences in technology integration, the inherent infrastructure in school settings can characterize a distinct mismatch with the reality of school classrooms.

4.9 Overall disappointment
With respect to the multiple gaps in curriculum design in general, and lack lustre promotion of preservice teachers’ ICT competencies, it has been argued that these amplify the inadequacy of current organisational and curricular frameworks to support ICT orientated initiatives in our educational systems. Rather than being the anticipated agent for change, new technologies have been mainly mapped on to old curriculum, that were conceptualized in different times (e.g., Papert, 1996). That is, “in the sense that the knowledge and understandings deemed to be important in schools have changed little since the introduction of computers” (Rowan & Bigum, 2010, p. 33). Consequently, Papert (1996), who as previously noted, shared the same vision as
Bork in the early 1980s regarding the potential of computer technology to transform educational practices, states:

Cyberostriches who make school policy are determined to use computers, but can only imagine using them in a framework of the school system as they know it … this is quite perverse: new technology being used to strengthen a poor method of education that was invented only because there were no computers when schools were designed. (p. 25)

In all, the meagre impact that new technologies have had on the practices and familiar patterns of Australian schooling are well noted not only by educational researchers, but also at national government level. As Penesis, Chin, Ranmuthugala and Fluck (2011) note, Gillard (2008) issued the following statement which encapsulates the government’s concern about lethargic ICT based transformation in education: “While ICT has fundamentally reshaped whole industries, revolutionised production processes and generated massive improvements in productivity in our workplaces, our education systems have been slower in adapting” (p. 331).

4.10 ICT implications for art education: Contextual constraints

When computers first gained acceptance in the field of visual arts education in the 1980s educators who were enthused by their seemingly extra ordinary capabilities, anticipated that radical changes would follow (e.g., Hubbard, 1985; Freedman, 1989; Greh, 1990; Grabar, 1994). In Australia for instance, in 1985, the government funded, experimental art foundation (EAF) in Adelaide initiated a national research program to examine the existing link between the arts and technology (e.g., Duffy, 1995). The subsequent indications of the benefits of computer technology implied that major changes would follow in visual arts education. Ongoing conversations within the field of arts and design education suggest agreement among art educators, albeit not unequivocal, that rather than being a transient fad, the technology agenda has an explicit role in contributing to the overall learning needs of students in the 21st century. Thereby, the cliché that the computer focus is merely “a passing phase, an adventure, temporarily impressing the neighbours” (Goldstein, 1994, p. 42) is defied.

Despite observations of the increasingly elevated status of digital media within the creative disciplines (e.g., Bowden, 2005; Newcombe, 2010; Penny, 1995), numerous challenges were acknowledged within the national and international discourse as being particularly poignant in art education. Among these is that, notwithstanding cases of successful ICT integration in art education, the reported advantages of ICT advancements are not well reflected in art classrooms, especially as the majority of art teachers are either not using ICT optimally, if at all (e.g., Brown, 2004; Delacruz, 2004; Hurwitz & Day, 2001; Phelps & Maddison, 2008). As Phelps et al. (2008) observe in relation to visual arts education in Australian secondary schools:
"while some teachers have embraced new technologies, many continue to use ICT in a limited manner" (p. 1). Importantly, the more recently graduated teachers are not necessarily integrating ICT frequently or creatively. Another Australian art educator/researcher (Aland, 2004), found that neither the art teachers or students had any knowledge of the work of those artists, either national or international, that have been using computers in their artistic practice over the past forty years.

The associated view in Australia (e.g., Meredyth et al., 1999) as elsewhere (e.g., Delacruz, 2004) is that art classrooms are usually the last to receive computers or to have access to computer labs. Although, Australian researcher on ICT use in schools (Elliot, 2001) denies that computer funding has a negative impact on specialist subjects, a local teacher states: “as a teacher of information technology, I know that many school computer labs are time tabled for IT classes to the extent that other subjects have little access to the resources” (Bell, 2001, p. 17).

This position simultaneously supports Dunn’s (1996) claim: “when computers are purchased for a school, the art specialist teacher is often the last teacher to receive a machine rather than the first” (p. 8), and Greh’s (1986) long-stated observation that whether for political, economic or personal reasons, computers do not find their way into most art classrooms. It follows then that the in which art teachers engage with ICT is partly contingent on their access to appropriate resources and support. With respect to art teachers in Victoria, given the current autonomous nature of school organization, this will depend on, “how each school works out the best way to organise its own teaching and learning program taking into account government policies, the school community’s priorities, resources and expertise” (Board of Studies, 2000, p. 1).

Thereby, Duffy’s (1995) argument, that the assumption that art teachers can compliantly embrace policy directives to integrate art education and new technologies is inappropriate, still rings true. As Australian art educator and researcher Bamford (2002) notes, “teachers are faced with the dilemma of reconciling curriculum decision making with the realities of contextual factors such as lack of time, space and resources” (p. 27). In this light, art teachers may simply apply the “practicality ethic” in contesting the mythologizing language of technology advocacy when faced with top-down reform efforts that are not feasible “within the particulars of the teachings situation” (Delacruz, 2004, p. 6). Essentially, art teachers’ low level response to the pro ICT curricular recommendations does not necessarily signify technophobia on their part as distinct from practical considerations, and/or possibly their sincere and principled concerns about the pedagogical value of ICT in their particular setting.
The associated contention is the minimal discussion of what time and resources are required for effective computer education will mean for the time and funding available for teaching other fields (e.g., Eisner, 2002). For instance, Tania Tickyj (2001) argued that the computer technology initiatives in some Victorian state schools are at the expense of other valued resources in education, particularly art education. Tickyj’s view takes into account the high cost of installing and upgrading ICT and that of employing art specialist teachers and resourcing art room facilities. “It concerns me that governments of both persuasions believe it is sufficient to put money into capitol equipment … without devoting any real spending on some much needed art specialist teacher education” (p. 3). A consenting view comes from American journalist, Todd Oppenheimer (1997) who writes from a long history in the arts and education:

There is no good evidence that most uses of computers significantly improve teaching and learning, yet school districts are cutting programs – music, art, physical education - that enrich children's lives to make room for this dubious nostrum, and the Clinton administration has embraced the goal of "computers in every classroom" with credulous and costly enthusiasm. (p. 45)

A key AEA member sees that the ICT curricular policy approach to education is “based upon the belief that … children must be provided with technology wizardry often at the expense of their creative subjects” (Flood, 1997, p. 1). According to Davis’ (2008) research, art educators have observed disquieting trends in Australian primary schools regarding diminished schedules for children’s arts-based learning experiences. Just as the view that the arts are increasingly seen as dispensable luxuries that must provide their worth in the impersonal mass market (e.g., Csikszentmihalyi, 1997) resonates here, so to does the long-standing call from a prominent Australian music educator: “we must challenge those who would change the arts experiences for children through computer technology regardless of whether it has pedagogical or artist relevance” (Comte, 1993, p. 163). Years later, another Australian art educator wonders if any research has been conducted into the way children integrate art and technology, and whether anything is known about artists’ methods of implementing technology (Aland, 2001).

Allied to this, Australian art educator, Adam Newcombe (2010) who works at the forefront of digital art practice, whilst maintaining a passion for traditional studio practice is among those educators who might be described as Delacruz (2004) states, “not buying into what has been termed the mythologizing language that often accompanies technology advocacy” (p. 8). Specifically, he regards the promotion of computer-dominated learning environments within the national universities as being detrimental to studio-based learning in several ways. First, the creative studio time is limited and seldom accessed by students outside the creative arts disciplines. Second, university students live predominantly within the matrix of computers where “the voice telling of the importance of studio-based, multi-intelligence creativity is being lost
because studios live outside of the machine” (p. 8). Yet, it is abundantly clear that “students need infinitely more nourishment than sitting at a lineal machine using limited sight and their fingertips to repetitively press buttons” (p. 8).

While Newcombe’s view relates to higher education, it somewhat evokes early interrelated early childhood education perspectives. First, computer use should not preclude children’s creative interaction with their environment: “Children should paint with real paint brushes, dance real dances, and collect real flowers rather than just doing these things on a computer screen” (Adams, 1985, p. 35). Second, irrespective of the quality of software programs, they are an abstract entity as distinct from the important physical interaction facilitated by manipulation of concrete media (e.g., Bobrow, 1985).

According to UNESCO (2005), such philosophical and practical challenges are equally prevalent within the international community where there are great difficulties in finding space for arts education in the already overloaded curriculum: “This is possibly due to the diminishment of the arts in education as a result of the growing emphasis on technology squeezing the arts out of the school curriculum” (p. 7). Evidently, in the developing regions, many schools lack resources for basic arts education programs, let alone those that use digital media. There is also concern in the sphere of teacher education regarding the need to meet the new requirements and demands in arts education: “for example the emergence of new aesthetic sensibilities that come from visual and audiovisual culture” (UNESCO, 2003, p. 16).

### 4.11 Ideological qualms

Newcombe’s aforementioned stance also resurfaces Jones’ (1995) instinct that as the arts are important in providing relief and balance in a rapidly changing environment, they should be immune to the pressures of emerging technology orientated conventions. An additional thought is that we should not be overly impressed by glittering new scientific techniques, assuming that they automatically constitute art simply because they overwhelm inexpert artistic eyes (Mueller, 1983). As Reade and Johnston (1991) aver, “technology has become more automatic, more impersonal, more objective”, whilst in reaction, thinking about “art has become emotional and specifically human” (p. 21). Other views regarding the incompatibility of art concepts with those of technology include: “computer art is limited by the very nature of the tool itself” (Farrell, 1990, p. 32), and automated machines compromise creativity by overtaking imagination and cause excessive reliance on technology for stimulus (Eisner, 1972).
McFee and Degge (1977) explain the long-standing division between science and art is one of attitude: “we learn to identify with one more than the other... and are often distrustful of the other” (p. 323). For Reade et al. (1991) this ‘distrust’ reflects the belief that new technology will unavoidably “undermine the artistic process, mechanise action and produce a new and powerful elite, indifferent to the creative issues of the arts” (p. 21). According to Sherry Turkle (1997) of MIT, comparable views even arise in her faculty where some educators see computers as being useful insofar as they compensate for lack of hand drawing skills. For others, computer drawings have lower aesthetic value in that any novel solutions generated through digital technology are regarded as being sterile. Additional concerns are that students “get lost in the multitude of options” (p. 80) in computer software, and computer simulation “not only encourages detachment from one’s work, but detachment from real life” (p. 80). Within the architecture faculty at MIT, most agree that drawing software assists in generating more precise images, but express: “a loss of attachment to their work” (p. 80). One educator put it this way:

I can lose this bit of paper in the street and if [a day later] I walk on the street and see it, I’ll know that I drew it. With a drawing that I do on the computer … I might not even know it is mine. (Parenthesis in original, p. 80)

Busby, Parrott and Olsen (2000) found similar responses in their USA study on the use of computers in basic fine art design classes. Although there were instances of high enthusiasm among some of the professors, other professors simply conceded that they did not know the computer well enough to teach their students how to use it in art courses. A particular source of concern for some fine arts professors was that computers can do too much of the work, and that students will not need traditional art classes such as composition and drawing. Likewise, that the one-of-a-kind quality of art would be diminished if an endless number of duplicates of the same piece of artwork can be printed.

Again the implication is that philosophically, computer technology and traditional arts practice part rather than coalesce because many practitioners are not able to ideologically and systematically broach the ‘technology gap’. Of interest here with respect to art teachers’ attitudes to ICT is the observation of Phelps et al. (2008) that, regardless of recent curriculum changes, less than half of the teachers interviewed during their research considered ICT as fundamental to visual arts curriculum. Many of the teachers were concerned that ICT use would undermine, rather than supplement, traditional approaches to the subject. The prevalence of this attitude within, certain preservice teacher education courses is illustrated by another Australian art educator, with reference to students who generally have not had extensive computer experience for creative activity and are disdainful of non-traditional studio practice.
For instance, one student stated: “painting a canvas is an ‘extension of my hand’ while, working with a computer is more like ‘having to work with my brain to tell the computer how to paint’” (Litchman, 1996, p. 46). As such, the issues in art education are not just the challenges of accessing and learning to use hardware and software, but also in countering the perceptions of limiting creative activity (e.g., Hicks, 1993).

This tendency for people to accept in principle, the importance of technology in education, yet question its appropriateness in art education is also well noted by others (e.g., Mcleod, 1991; Boughton, 1993). Again, this position reminisces the age old humanistic versus mechanical ideology and the perceived threat of technology removing creativity and aesthetic considerations as noted in the art and technology literature (e.g., Cuban, 1986; Jackson, 1968; Kaufman, 1970; Mumford; 1952). Concisely put, new technologies are more difficult to assimilate both theoretically and practically than those of the past (e.g., Reade et al., 1991). In emphasising this point with regard to the United States context, Henry Clauser (1998) draws on the words of art critic Grace Glueck (1983) as published in the New York Times: “We’re accustomed to looking at art that addresses us in a more or less known grammar … that can be placed … in a critical - historical context” (p. 116).

In all, it seems that art and technology are often seen as mutually exclusive concepts as long observed by the computer art theorist, Jonathan Benthall (1972): “computers are to a large extent the servants of large administrative, commercial and military institutions; this fact has greatly influenced our image of them” (p. 48). In due course, Herbert Franke (1985), a prominent proponent of early computer art, comments on the continuing power of this influence on public response to the early-time artists’ use of emerging computer technology:

> Even today’s applications have caused remarkable unrest in practice and theory in the contemporary art scene. The question of the possibilities of new machine-dependent techniques, of evaluating the creative elements of expression and beauty are being raised anew. (p. 167)

According to the digital artist/educator and new media theorist, Simon Penny (1995), the increasing emphasis on computers in creative disciplines reflects misguided acceptance of: the “argument bandied about in certain circles that art practice that uses emerging technology is of value because it is future orientated by virtue of its tools, it is “progressive” (p. 53). Implicit here is that the prevailing focus on computer technology in education is seen to undermine the inherent value of promoting learning through concrete forms of studio practice.
Consequently, the associated uncertainty regarding the technology trend has a concomitant impact upon university programs where “familiar materials and methods are juxtaposed uneasily against the image-making potential of new technologies” (Boughton, 1993, p. 22). Thus, despite the apparent allure of new technology within art education, numerous issues around its liabilities need to be explored before agreement can be achieved. In this respect, Maxine Greene’s (1995) advice rings true: “We cannot assume that there is a consensus about what is valuable and useful and what ought to be taught, despite all of the official definitions of necessary outcomes and desired goals” (p. 3).

It follows then that art educators need to develop and trust their own informed judgments about how, when and why they use digital media. This includes assuming a sense of scepticism about the unrealistic euphoria surrounding computer technology, and a spirit of open-mindedness to see beyond its liabilities and to identify its attributes for visual arts education (e.g., Walters, Hodges & Simmons, 1989). Ideally, although technology related challenges for artists and educators are great art educators will be in the position to aim for a crucial synthesis between traditional and digital art practices (e.g., Hicks, 1993).

4.12 Paradox within higher education

Of interest here is the paradox of the current climate within the higher education sector. The notions of constructivist pedagogy and creativity are highly valued as critical aspects of contemporary pedagogy (e.g., Biggs & Tang, 2007; Ramsden, 2003) as are educators’ efforts to use ICT for promoting new learning and teaching paradigms within all disciplines. However, although art educators are seemingly well positioned philosophically to uphold such ideals, in reality impediments prevail. For instance, with regard to the Australian context of preservice teachers’ art education, Paterson (2010) observes that the expectation that student teachers engage with new media ironically comes at a time when our educational system is unable to cater for the ever more pressing need for the studio time. That is, time to allow students to engage with the complexity and non-linear nature of the creative process and to absorb new ideas, and to develop understandings that relate to both traditional art practice and digital media applications (e.g., Eisner, 2002). As Schrum (1999) observes, numerous researchers warn that learning with and about technology is a “non trivial and life changing event, and it is qualitatively different to learning other new skills ... brief exposure does not provide sufficient training or practice to incorporate technology into a classroom” (p. 85).

Consistent with Paterson’s (2010) view are the previously noted research findings (e.g., Black et al., 2009; Meredyth et al, 1999) on the inadequate provision for ICT in preservice teacher...
education. Equally relevant is the thrust of Moseley’s (1995) *Managing and leading the university of the 21st century: Megatrends and strategies*, which highlights the influence of megatrends on higher education, where less money, more accountability and increased use of new technology are notable trends. Clarke and Budge’s (2010) argument, which without any specific reference to ICT issues or preservice teacher education, also holds that the current climate of viability driven change occurring in tertiary institutions within Australia and other OECD countries creates pressure for art and design educators to “do more with less and to perform well, despite the changing conditions” (p. 153).

### 4.13 Techno fatigue

An associated, but infrequently voiced issue specific to art educators engaged with new technology, is raised by Wong (1991) in the context of her computer art education initiative at the Hong Kong Arts Centre. The notion of ‘doing more’ pertains to the high commitment educators need in acquiring the necessary functioning knowledge in terms of conceptual frameworks and technical skills associated with successful ICT implementation. Her program evolved not only from the inspiration gained through her initial sighting of computer art, but also through the subsequent sustained consultations with computer artists, and countless hours invested in learning to use computer graphics software and peripherals. This included exploration of the elements and principles of design that are integral to the aesthetic sensitivities associated with in depth rather than ad hoc arts practice. Of relevance here is suggestion that knowledge of the principles of design such as unity, harmony, focal point – dominance and emphasis, balance, and colour, is integral to the aesthetic qualities of visual work regardless of the media used. Successful compositions are achieved through the artists’ skilled use of design elements such as line, shape, form, colour texture, space, scale-proportion, and rhythm to express creative ideas (e.g., Kanuka & Szabo, 1999).

Associated with the notion of educators doing more, is Mishra and Koehler’s (2006) perspective that the broad educational context has established technology in ways that could not have been previously imagined. There is now a vastly different conceptualization of teacher knowledge compared to the times where old technologies were quite uniform, and their pedagogical implementation within specific disciplines remained comparatively static over time. In contrast, a critical aspect of overall teacher knowledge now extends to technological pedagogical acumen that comes from sustained learning of the current tools, and then advancing to new techniques and skills as these become obsolete. Succinctly put: “Effective use of ICT is a matter of “becoming proficient with a range of interlocking, complementary procedures, knowledge, understandings and dexterities” (Lankshear, et al., 2000, p. 122).
4.14 The market force of technologising education

Another concern that pertains as much to art educators as it does others is the overt market orientation to the process of technologising education. For instance, Snyder (1999) points out the growing commercialisation of schooling is “exemplified in the deals made with computer companies to provide products and facilities at bargain rates, and also in the very appearance of the glossy documents that embody policy initiatives” (p. 2). Likewise, Selwyn (2003) discusses a range of advertising images to explain how the notion of every child as computer user is advanced to a large degree merely as “means of persuasion and promotion on the part of the key commercial and political guiding interests of the information age” (p. 374).

In more explicit terms, it has been argued that teachers are targeted as consumers of ready-made notions of technology defined by cultural mediators, including journalists, ICT industry personnel, ICT enthusiasts and governments focussed on assisting people “to understand, appreciate and consume” (Kenway, 1995, p. 36). Over all, education systems have been so convinced of the importance of classroom computers that they have made major and ongoing expenditure on computer resources: “so much so that today, the major consideration is not whether to buy but what to buy…. Schools are clearly caught in an increasingly expensive pattern of consumption of high technology products” (Bigum & Kenway, 1998, Para. 2). Educators in higher education also lament being evermore subjected to the culture of the marketplace where keeping pace with ICT developments is central to the global spread of the culture of consumerism (e.g., Unwin, 2007). Rowan and Bigum (2010) explain this situation arises as, paradoxically; the failure of a prior technology to live up to its promises is translated as a sound reason to acquire the next generation in which all the problems of the previous model are remedied. Therefore, “now, upgrades are a requirement to stay in the game” (p. 34).

Ironically, while Bigum et al. (1998) regard ICT ‘boosters” as having “few if any doubts about the educational merits of their vision for change” (p. 3), the prominent pioneer of the personal computer revolution, Steve jobs, who might be conceptualised as a ‘booster’, conceded:

I used to think that technology could help education…. But I’ve had to come to the inevitable conclusion that the problem is not one that technology can hope to solve. What's wrong with education cannot be fixed with technology. No amount of technology will make a dent. (Wolf, 1996, p. 105)

The sense of inevitable consumerism is also well reflected in the field of art and design education. Bowden’s (2005) art/design educator’s lens illuminates an image of ICT introduction as being not only the first major technological advance in practice for many years, but also the largest capitol investment. The same view is infused in Penny’s (1995) term “ techno fatigue”,
that evokes the common concern about the phenomenal growth in new technology that stretches the experts’ ability in keeping abreast with advancements, let alone lay people (e.g., Stevens, 1991). In Penny’s view the relentless introduction of new digital devices and updates represents specific fiscal costs, and pressure for artists/educators to continually learn the new applications often without appropriate recognition or support. Encompassed here is the thought that the technology resources, including hardware, software and computer system capacity required for artistic practice, are infinitely more complex and expensive than that required for standard computer processing. Also, even though related updates are not always necessary for aesthetic development, artists/educators are often caught in a cycle of ICT corporatization or “unrequited technological consumption” (p. 51) driven by the corporatisation of technology. Technological ‘progress’ is fuelled not necessarily by a cultural or societal need, but by corporate need for profit. Thereby, artists who engage these technologies engage consumer commodity economics, scarcely learn the new technology before it is superseded: “Imagine if every two years the tools of a painter went out of date and the painter had to retrain” (p. 51). His only solution lies in pedagogical strategies that promote students’ conceptual skills that may be transferred from one digital platform to another rather than perpetuate “fetishization of products that will probably become obsolete before they graduate” (p. 56).

4.15 Aesthetic obsolescence
An added dimension to the above is the duel facet of “aesthetic obsolescence” (Penny, 1995, p. 50) that relates to several interdependent factors. First, when artists feel compelled to continually upgrade inline with technological advancements, there is little time left for the real task of art making, including the in depth creative development and analysis of work created with a particular technology. Second, the pace of technological change can render whole genres of digital work obsolete, or at least dilute their aesthetic value. Third, the contradictory climate challenges art educators to keep abreast of changing technology whose agenda is of its-self philosophically retrogressive. Interestingly, the current pace of technological advancement places acute emphasis on Kandinsky’s (1911) reflection on the changing landscape of art practice in his era: “What was odd or inconceivable yesterday is commonplace today; what is avant garde today, and understood only by the few is standard tomorrow” (p. 1). For Penny (1995) within the current climate, “this is a burden that the pace of technological change … forces upon us” (p. 51).

4.16 Dilemmas of a globalised Internet culture
The controversy around the escalating trend of students accessing a seemingly unlimited range of information through the Internet has gained momentum since the time when Jones (1995)
noted, that there were 35 million Internet users by 1995, and that, “it was estimated that the figure would double annually” (p.183). Subsequent views enthusiastically hold that, an exhilarating and rewarding aspect of the Internet is that it brings people together in a place where they can learn and communicate with each other (e.g., Eisenstadt & Vincent, 2000). This social role includes proving students with opportunities to connect with other people and ideas. In addition is the efficiency of bringing information to students and teachers, which provides an economic rationale in that internet-based information might offer the most cost effective solution to information needs (e.g., Newhouse, 2002).

By contrast, a cautious lens senses that the Internet “diminishes one’s sense of reality and of the meaning in one’s life” (Dreyfus, 2001, p. 102), and more to do with education: “One of the greatest analytical challenges facing students of globalisation is to make sense of the way in which political and cultural boundaries are being simultaneously permeated, and re-established” (Holton, 1998, p. 187). Allied opinions relate to students’ ever-increasing reliance on, and misuse of internet-based information are well detailed in Gideon Haigh’s (2006) How Google is making us stupid. Possibly the most consistent concern is that as children now have access to an uncontrollable influx of socially undesirable material, there is an acute need to promote their critical awareness abilities rather than having them subjected to any negative influences (e.g., Yelland & Lloyd, 2001). In Jones’ (1995) terms: “internationally, the little red school house has less influence in shaping values” (p.182).

4.17 Digital ethics: Appropriation of artists’ work

For artists the allure of the Internet relates to the unprecedented potential for new interactive art forms, coupled with new forms of relationship between the artist and audience. Apart from facilitating greater audience participation in both traditional art and computer art forms (e.g., Candy & Edmonds 2002), Internet access accommodates artists who challenge the notion that art galleries should dominate exhibition spaces. “Many postmodern artists think that art should be exhibited in the community and be freely available to anyone who wants to view it” (Bamford, 2004, p. 7). However, for numerous commentators the implications of the new technology driven trends lie not only in complexities associated with art educators’ need to harness specific advantages of ICT, but also in the management of digital ethics matters (e.g., Mercedes, 1996; Roland, 1996; Throsby, 1999). This factor adds another facet to the calls by art educators for a critical stance in facilitating ICT inclusive art education. Their contention rests on the explosive global use of digital media in the arts that challenges the very nature of being an artist, and blurs the boundaries between the producers and consumers of creative material in somewhat problematic ways. Throsby (1999) for instance, avers that although digital
artistic genres are just another stage of conceptual and technical progression in the arts, the associated threats to the integrity of art practice and education cannot be ignored. Thus, he asks in a world where any one can think that they can be artists: “Do critical standards crumble, does the good work become swamped by the mediocre, is the truly talented artist likely to be overwhelmed by the newly-empowered nerds?” (p. 33).

4.18 Challenges to traditional notions of originality

Above all, the widespread use of the World Wide Web, coupled with the increasingly wide appeal of illustration and photographic-manipulation software programs is thought to create unparalleled ethical dilemmas for art educators regarding the indiscriminate manipulation, alteration, and appropriation of images. As the original creative work can be downloaded and transformed without the creator’s knowledge, the original artist’s rights and integrity of the work is readily violated (e.g., Roland, 1996). Even though the Internet provides access to the work of wide-ranging artists and ‘great thinkers’, the real potential of this global network will be seriously compromised if original works are “pirated away with the push of a button and appropriated into the work of others” (Roland, 1996, p. 3). Consonantly, Mercedes (1996) posits that previously unquestioned concepts regarding artists’ “ownership” need to be redefined in today’s electronic age. The proliferation of ‘intellectual property’ coupled with new electronic distributing systems “is changing and reconstructing our cultural values. We, as artists and educators, need to consciously move digital technology forward in a beneficial direction” (p. 49). In emphasizing the issue, she quotes Roberts’ (1993) summation of the appropriation of imagery via scanning and digitally altering the images of others and the passing of these along the electronic superhighway has become common practice: “the ‘borrowed’ image is now one of the popular themes in art” (p. 49).

Evidently, copyright not withstanding, revising, manipulating, and appropriating images saves time and money, and is now fashionable in certain circles, as is the notion that digital media itself encourages such exploitation, especially as specific scanning facilities can be readily applied for this purpose. Similarly, that distorting appropriated images to an unrecognizable extent, constitutes a new art piece and, is therefore often seen as being perfectly acceptable (e.g., Mercedes, 1996). Herein lies another complex side of current art pedagogy. The traditional notion of promoting students’ capacity for creative art activity is compromised when artists adapt each other’s images, and art teachers and students see this as a legitimate approach to their own art practice, particularly when class time constraints preclude optimal development of students’ conceptual skills.
The persistence of this disquiet is conveyed in Alter’s (2010) literature survey, which reveals that less value is now accorded to the originality of art practice as evidenced, “with many art educators encouraging students to borrow ideas from other artists and appropriate images, ideas and compositions from diverse cultural sources” (p. 5). Alter acknowledges that this is a characteristic trend of postmodernist art that regularly appropriates visual ideas, and juxtapositions culturally diverse art objects and images. Hence, “creativity is more closely associated with the process of production, the synthesis and transformation of existing ideas and imagery with one’s own, than it is with originality of style or form” (p. 5). Thus, Wang (2011) suggests that if the argument for ICT implementation within a discipline is that it fosters creativity as its principle focus, but actually facilitates mere productivity more than genuine creativity, this argument needs closer examination.

The intricacies surrounding questions around creativity, originality and ethics in visual arts education are also reflected in computer artist Lillian Schwartz’s (1996) publication of her own and other artists’ digital images. These works are appropriated and manipulated versions of renowned artists’ compositions, which in her terms, were altered within the bounds of ethical practice as the original artists’ work is duly cited and used with ‘due reason’ as a source, “to create new visual imagery or to study great works of art with the purpose of understanding the artists’ intent” (p. 43). In addition to providing cues for various ways of appropriating artists’ ideas, compositions and palettes as sources for one’s own new imagery, Schwartz (1996) qualifies the practice by drawing on the art scholar Norbert Lynton’s (1992) comment that artists have always used ideas from other artists: “it is of course the use to which such borrowings are put to that justifies them” (p. 43). Considering that art educators may be vexed by the prospect of justifying the ‘due reason’ element with respect to their students’ artwork, Mercedes (1996) offers useful discussion points for ICT inclusive art education courses:

What constitutes a manipulated image? Is it fitting to use such an image? If so, when and how? Is it proper to appropriate images, removing them from their original context? All of an image? A portion? Who owns the final “new” image? (p. 44)

Ideally then, art educators will have the scope to structure course work time to allow for such discussion in order for students to understand that the appropriation of other peoples’ images is contrary to the art education ideal of students generating their own conceptual and technical skills. Specifically, through students’ sustained exploration in art practice, and thereby their authentic sense of creative ownership of their work (e.g., Culpan, 2008; Culpan & Hoffert, 2009; Robinson, 1982).
4.19 Legal implications for teachers: Breaching software licence agreement.
An added concern for art educators as underlined by Roland (1996) regards the alarming degree of inappropriate copying of computer software in schools. Apparently, many teachers either do this in the face of severe fiscal constraints associated with purchasing software licenses for whole class use, or simply regard this as being legitimate practice when done for educational purposes. The breach is exacerbated when teachers make multiple copies of visual material for class use without permission from the relevant authorities. While copyright laws are fairly clear there is confusion about the ‘fair use’ doctrine regarding use of artistic material for non-commercial purposes in education and research (e.g., Mercedes, 1996).

Roland (1996) accepts that although teachers generally acknowledge the work of renowned artists as ‘intellectual property’, uncertainty often surfaces about the distribution of the same image accessed via the Internet, or in using downloaded sound clips and such in multimedia productions. Therefore, it is imperative that educators take responsibility for educating themselves and their students on such issues “in order to ensure a future generation capable of making ethical decisions regarding intellectual property” (Roland, p. 3). Concisely put:

These rapidly changing times challenge educators to find areas of work that are hard in the right way: they must connect with the kids and also with the areas of knowledge, skills and (don't let us forget) ethics adults will need for the future world (Parenthesis in original – Papert, 2002, p. 1).

Even though the issues of plagiarism, intellectual property and copyright are undoubtedly covered in university course documents, the principle of explicitly engaging students in dialogue about what they can do within the confines of digital copyright law and software license agreements must be addressed through class based discussions. Again, there is the issue of inequality in terms of “access and participation of the haves and have-nots” (Throsby, 1999, p. 33) due to insufficient funding in some schools for appropriate software, especially in visual arts education (e.g., Freedman, 2003; Roland, 1996). This means that for some art educators and students, presuming they have the appropriate hardware capacity, the only alternative, albeit far from ideal, is to become accustomed to locating and downloading appropriate shareware that is in the public domain, and often free of charge.

4.20 Moving art education beyond the ICT rhetoric into a creative reality
Irrespective of the bountiful calls regarding the multi-faceted rewards associated with ICT in education, including visual arts education, the continual stream of cautionary perspectives show no definitive solutions to the lingering concerns for art educators other than considering four interrelated viewpoints. First, “almost everyone in educated circles agrees that technology has
cultural, social and political meanings that need to be both understood and, if possible, brought under some kind of responsible control” (Wang, 2011, p. 195). Second, “very few educators and educational commentators would advocate no investment in computers, even if only using a computer literacy rationale” (Newhouse, 2002, p. 5). Third, blind embracement of new technologies is detrimental to art education, “awareness is, of course, an important first step, and more discussion is certainly needed. Education, while not a solution by itself, is an equally important consideration” (Mercedes, 1996, p. 49). Finally, art educators have a particular responsibility to contribute to how cultural life is seen and valued; they cannot avoid the impact of technology and globalisation.

4.21 Summary
This chapter has shown that while there are many multi layered cautionary perspectives on the advocacy for ICT inclusive education in general, art education is in a particularly vulnerable position. Collectively, the concerns align with Way and Webb’s (2007) research findings, that ICT integration into all aspects of school curricula, including visual arts education, still presents a challenge for Australian educators as they aim to side with policy directives, curricular statements, and individual institutional agendas. However, it is important to note, that the philosophical stance of current study resonates with the view “it is best to consciously engage as none of us can enjoy the luxury of opting out of the transformations now in play” (Duncum, 2000, p. 171). Encompassed here is the view that “teachers cannot align themselves up as either technology enthusiasts or technology demonisers; as either technophiles or technophobes” (Snyder, 1999, p. 45). Extreme positions are untenable as they neglect technology's material bases and the intensifying global economic dependence on technology. At the very least, the need to take account of the cultural and educational forces of communication and information technologies is clear.

Ultimately, in order for student teachers to achieve a nuanced understanding of the intricate relationships between pedagogy, discipline specific content, technology and the prevailing contextual circumstance, art educators need to be conversant with worldwide patterns and directions of change in order to maintain some form of objectivity and distance from policy persuasions and focus on educational objectives (e.g., Hickman, 2004). In keeping with this view, the next chapter shows how visual arts educators have either envisaged numerous advantages of ICT use in the discipline, or have actually identified certain advantages through their own teaching practice or research.
Chapter 5
Constructive perspectives on computer technology in visual arts education

Criticism for which art lovers used to find support for their judgements, has become so contradictory that if we exclude from the realm of art all that critics of various schools deny the right of belonging to art, almost no art would be left.
(Tolstoy, 1889, p. 8)

5.1 Introduction
In keeping with Tolstoy’s sentiment this chapter considers a range of perspectives held by art educators and ICT commentators who acknowledge the prevalent criticism regarding the use of computer technology in education, but nonetheless see ICT as a constructive force in extending the traditional boundaries of art education. The authors cited in this chapter do not offer any specific solutions to the issues discussed in the previous chapter. Yet by articulating the range of pedagogical and artistic benefits of ICT integration within the discipline along with acknowledgement of the inherent complexities, they add support to my perceived need for the current research. Within the context of this discourse the perspectives that particularly pique my interest are those where the impetus to embrace ICT in visual arts education does not simply stem from policy directives, but the chance to promote a seamless interplay of traditional and digital media. The chapter begins with an overview of the reassuring comments on the art and new technology nexus together with those about art education being on the lower run of the hierarchical scale of education. An outline of the perceived pedagogical and artistic advantages of ICT implementation in terms of the interrelated concepts of visual literacy, problem solving, aesthetic sensitivity and creativity follows. The close of the chapter includes a series of guidelines relative to teachers’ appropriate use of ICT, and an outline of the arguments around the importance of educators’ technological-pedagogical acumen as well as a note of the implications for art educators in the context of preservice teacher education.

5.2 Reducing concerns around ICT in visual arts education
Notwithstanding the range of cautionary facets of ICT integration in arts education such as those noted in the previous chapter, many national and international art educators hold fast to one of the central notions dominating discourse on ICT in schools – to be an effective teacher in the modern world, one must make effective use of technology. For example, Stevens (1991) trusts that contemporary attitudes will ensure the emergence of new art forms as a result of new technology, and that rather than the dehumanizing the arts as many feared, technology can be regarded as a highly constructive and creative force:

Despite what will undoubtedly be quite drastic changes in the forms of creative artistic expression, traditional means and mediums will persist and flourish as
they have in past periods of technological change. The path forward will be
one of construction of the future rather than destruction of the past. (p. 13)

Evident here is that the interest in linking ICT and art education does not in any way suggest
that the value of studio-based learning through traditional mediums and processes should be
compromised. Similarly, that the learning of “mainstream art history should not be discarded but
take its place as one story among many” (Efland, Freedman & Stuhr, 1996, p. 96). In
Eggleston’s (1992) view, as technology design actually responds to the political, economic and
social world, the role of both technology and education is to inform and benefit society.
Moreover, technology can strengthen traditional links and inform the practice of artists and art
educators in a context where new technology permeates all contemporary life. In this light, Grey
who, applies a similar ideological lens, avers: “These advances (in technology) reflect the
innate desire of man to create outlets for creative expression, to use technology and
imagination to gain empowerment and freedom of ideas” (p. 5, Parenthesis added).

Art historian Jeremy Kingston (1980) said: “Technological innovations have led to new art
industries which produced their own kind of artists, new instruments and processes and
provided a new range and purpose for the field of visual arts” (p. 24). According to Stephen
Wilson (2002), artist and Head of the Conceptual Information Arts Program at San Francisco
State University: “We are at an interesting place in history, in which it is sometimes difficult to
distinguish between techno-scientific research and art – a sign that broader integrated views of
art and research are developing” (p. 4). The current generation of artists engage with science
and technology, not just by adopting the terminology and gadgets, but also by exploring and
commenting on the content, agendas, and future possibilities of new technologies. While
Wilson acknowledges the general anxiety, scepticism, and cynicism permeating twentieth and
twenty-first century thinking on technology, he sees that the role of the artists and educators is
not only to interpret and to spread scientific knowledge, but also to actively participate in
determining the direction of research. In recognising dissonant perspectives on art and
technology, Hicks (1993) cites Winslow (1989): “There are two views … of technology…. One
can assume technology is a catastrophe … or that it is an ever growing pile of discrete and
wonderful events moving society toward some sort of utopia” (p. 43). Importantly, it is widely
accepted within the art education community that technological development has long been an
important aspect of visual arts practice and that traditionally arts education have embraced and
assimilated new technologies to enhance and develop specific art forms, and revolutionise
issues of aesthetics (e.g., Grushka, 1996; Hodge, 1991).
Reade et al. (1991) regard new technology as a new medium and a device for expression as it can extend existing art processes and create new ones, and:

Find the balance between all the visual arts by providing an avenue, to link the chain that was once divided. It gives us the option to pursue a new tool, to portray it as another medium or to use it as another resource. (15)

In the terms of the writer, artist and teacher Carol Gigliotti (1998), the bridging of arts, education and computer technology seems ideal. Her extensive writing on the importance of collaborative activity across disciplines is based on the belief that artists and art educators have a responsibility to contribute ideas on the integration of computer technology. This responsibility is central to the ongoing evolution of an emerging aesthetic interactivity that links “aesthetic goals with ethical goals” (p. 90). This aesthetic standpoint encourages participants to take responsibility for their actions and their world, and in very real terms, provide students with the means to become involved in the use of interactive technologies, which offer: “a possibility of a way to affect one of the major tools of power: communication media (p. 19). With respect to the teacher’s role, she states:

If one is to teach well, one must teach toward the future—but education cannot be only about the teacher. The central value of education is to give the student the possibility to change, correct or build upon what we have done. (p. 24)

According to Reade et al. (1991) realisation of this type of goal requires understanding that education should essentially provide the basis for accepting and participating in future change, rather than being subject to it. This includes overcoming apprehension or technology resistance among teachers, and: “re-establish[ing] their balance by supporting them to master new machines instead of allowing them to become passive victims” (parenthesis added, p. 17). In this regard Comte (1993) advocates the need “to document exemplars” (p. 162) of technology aided work to enable all educators to draw their own conclusions regarding the way computers may be used in arts education. Aland (2000) adds that the support for teachers needs to include more information on how they can use computer technologies in visual art classrooms and how multi media technologies enhance the ways that students perceive art forms.

Of equal resonance is Kaufman’s (1970) age-old advice that simultaneously acknowledges that a cultural context does not remain static over time and the challenges confronted by art educators will be acute:

The coming flood of mechanical devices and objectivity regularized procedures in education is appalling to think of ... No matter how much we value art, we cannot believe that it will exist in isolation from other factors of culture. Conversely, there can be little of a shared happiness and of personal
satisfaction in a technological social machine devoid of the creative mystery of genuine art. The two opposing qualities, the objectivity of technics as against the subjectivity of art, can only achieve a synthesis if there is a mutual sense of respect and understanding; a harmony of contraries and it is an art teacher’s great vocation to achieve exactly that. (p. 296)

5.3.1 Retaining professional credibility and the status of art education

As previously indicated, many Australian and international art educators hold that irrespective of any philosophical reservations we may have about the value of ICT to visual arts education, there is an urgent need to break free on the conventional approaches to the subject and to support the technology agenda in education. Among the reasons for advocating ICT use in art education is the culture dependent nature of the discipline in that its security and relevance in the school curriculum is contingent on art educators and teachers retaining professional credibility in a changing global environment (e.g., Dunn, 1996; Freedman, 1997). In this respect Reade et al. (1991) argue that technology gives status to a subject, as it is associated with: “intelligence, progression, innovation”. Therefore, implementation of technology in arts classrooms explicitly “demonstrates its relevance and meaning as it directly relates to the technological advances of the real world…. This is the discovery period of the technological age” (p. 22). It has even been noted that technologically adroit art teachers might assume leadership positions within their schools (e.g., Dunn, 1996). Another concept is that art teachers’ involvement with ICT can lead to increased interaction with peers in other curricular areas, professional development, and greater job satisfaction. Thus, the possibilities for professional growth are “tremendous for a computer-active art educator” (Matthews, 1997, p. 2). In addition: “Art educators, as … artists and researchers, have an opportunity to utilize this new landscape of digital technology to develop the artist-researchers of tomorrow” (Mayo, 2007, p. 50).

Consonant here are the oft-cited words of Brand (1987): "Once the new technology rolls over you, if you're not part of the steamroller, you're part of the road" (Chia & Duthie, 1992, p. 209). Decades later an Australian art educator similarly underlines the need to accept the drive for reform and embrace the new order of change: “Art education has nibbled at the edges or just placed its toes in the water without really taking the plunge” (Brown, 2002, p. 63). Given the profound impact of ICT on the nature of learning and teaching, teachers can no longer attest to being the sole gatekeeper of knowledge. Further, as students require a new skills set in visual design and literacy for today’s image saturated environment, “electronic imaging can no longer be set apart from the basic constructs of art education” (Madeja, 1993, p. 8). Thus, the need to “examine existing practices and possible changes to art curriculum” (Brown, 2002, p. 63).
These factors align with the consistent theme in the history of art education – that cultural context is a unifying force: Art education does not reside in a vacuum: “its acceptance and rejection are intimately tied to other aspects of society and culture, which provide the central unifying element in developing a unifying framework for curriculum developments in the Arts” (Grenfell, 1991, p. 54). In keeping here is McLeod’s (1991) call for art educators to be empowered to make informed decisions about the appropriateness of new technology resources within their discipline field, especially as:

These continuing changes will mean … being conversant with current debates in art education, and being able to extract the implications these debates have on their area of expertise. They need to be skilled in selecting and redefining debates in ways that support, rather than undermine, the nature of the arts and the way in which students respond to their social and educational setting. (p. 8)

5.3.2 Raising the status of art education
The notion of elevating the status of art education by integrating ICT is indicative of educational researchers concerns regarding the tendency for art education to be devalued in schools (e.g., Bamford, 2001; Chapman, 1982). Chapman (1982) for instance has long contended that the fundamental low status accorded to arts education and unnecessarily perpetuated in education, has a detrimental influence on school art programs. Two decades later, Eisner (2002) laments: “some school climates assign to the arts an inferior status vis-à-vis other subjects” (p. 172), points to the ways in which science and the arts have been constructed as oppositional:

Science and art became estranged. Science was considered dependable; the artistic process was not. Science was cognitive; the arts were emotional. Science was teachable; the arts were matters of preference. Science was useful; the arts were ornamental…. One relied on art when there was no science to provide guidance. Art was a fallback position. (p. 6)

With respect to the same perception in Australian schools, Brown (2002) recalls: “At the 9th annual conference of the curriculum Corporation, Bruce Wilson illustrated that art classes were relegated to last position on the curriculum hierarchy” (p. 62). Similarly, UNESCO’s International Bureau of Education (2006) asserts:

Although aesthetic education has become part of the core curricula today, at the same time visual and performing arts are perceived as threatened and marginalized school subjects. Even with the extensive research focussing on the benefits of aesthetic education for the learner and for society as a whole, and its strong support by international agencies, education of, in, or through the arts is still contested. (p. 10)

In discussing the ICT resistive attitudes of art teachers, Matthews (1997) explains that computers, unlike clay, pigment and charcoal, seem alien, and even the term computers connotes tools of the quantitative realm, pole opposite to the arts. Nonetheless, he advises that
if computers were ever an obstructive idea in art education this no longer needs to be the case. Specifically, once administrators, parents and community find that an art educator is going to teach their children to master the creative possibilities on the computer: “that an art educator may find that his or her relevance and importance have soared” (p. 2). In addition to the intrinsically sound reasons noted for computers in art programs is: “a significant extrinsic reward is the increased support and status that the art program may enjoy” (p. 2).

5.4 Exciting aspects of ICT in art education

Aside from policy directives and the notion of engaging with ICT as a means of retaining professional credibility, the past decades have seen perspectives of traditional genres of art within the school curriculum extended to include learning and teaching through new technologies that signify new opportunities for enhancing learning and improving pedagogy. In fact, as previously noted, the potential advantages of computer technology in art education had long been well acknowledged (e.g., Bangert, 1974; Goodman, 1987; Greh, 1986; Freedman, 1989; Roland, 1990). Goodman (1987) aptly reflects on the emerging view: "Computers are making new and aesthetic experiences possible and are changing the way art is conceived, created and perceived" (p. 86). Based on the information available at the time, these art educators indicated that computers have the potential to enrich learning experiences, especially as the open-ended nature of some graphics programs held promise for promoting aspects of divergent thinking, and the generation and solving of problems.

These factors are seen as being integral to proving exciting new opportunities for artistic practice for students and teachers alike as in ways that would have been practically impossible in the past. For instance, D'Angelo (1988) stated: “Once in a while, a technology advance comes along which is so extraordinary that it demands the attention of … the art educator … it’s the computer (p. 41). Likewise, Walters et al. (1989) who refer to the “intriguing” new software programs state: “it is time for serious consideration of computers in the arts” (p. 99), and for Roland (1990): “The computer can be seen as a viable partner in the art curriculum rather than a diversion” (p. 10). Hurwitz and Day (1995) add: “The computer will become increasingly significant as a tool for generating art images” (p. 242). In the following decade Hurwitz and Day (2001) are among the many art education authors who lament that the considerable pedagogical and artistic advantages of the advancements made in ICT are not particularly apparent in art education settings. They describe the considerable range of visual arts teaching that could be now accomplished with ICT, especially as anything can be done now because higher-level software programs, which allow for all types of editing, special effects, titles, and sound are “Truly mind boggling”, thus: “Teachers should bear in mind if Leonardo da Vinci were
alive today, he certainly would have used any means at his disposal capable of extending his unique vision” (p. 185). The resources they discussed include those suited to creating and manipulating electronic art works, generating ideas for work to be produced in traditional media or for manipulating traditionally produced work as well as electronic formats to support learning of arts concepts and presenting and sharing art works coupled with electronic research and communication mediums.

In Eisner’s (2004) terms, the new technology can be of unparalleled importance in the arts:

The computer has a particularly promising role to play in providing students with opportunities to learn how to think in new ways. Assuming the programs can be developed … operations are performable on the computer that cannot be executed through any other medium. New possibilities for … representation can stimulate our imaginative capacities and can generate forms of experience that would otherwise not exist …. Indeed, the history of art itself is, in large measure, a history studded with the effects of new technologies. This has been at no time more visible than during the 20th century. Artists have learned to think within … materials that make forms possible that Leonardo da Vinci himself could not have conceived of. Each new material offers us new affordances and constraints and in the process develops the ways in which we think. There is a lesson to be learned … for the ways in which we design curricula and the sorts of materials we make it possible for students to work with. (p. 15)

5.5.1 Preparing students for the future

According to Hicks (1993), irrespective of policy directives, as the very nature and interests of students themselves contribute to the changing face of visual arts education: “There must be a clear shift from traditional media if educators are to efficiently prepare students for the future” (p. 42). In addition, he describes how a certain group of ninth-grades students were using high-tech media and traditional processes to create a series of self-portraits integrating pencil drawing, collage, paint, computer graphics, scanning, and digitizing laser disk technology. A typical example of art created on the computer included both traditional and high-tech drawing as well as the study of form and visual perception. In this context, he specifies the need for ‘media arts’ within the curriculum.

This argument for ICT in art education is similar to that of Gigliotti’s (1998) aforementioned view. It highlights the link between aesthetics and culture, specifically, the visual aspects of mass media and their reliance on design concepts and thinking skills associated with visual art instruction and the: “Connectivism and interactivity which pervades all our lives…. The skill of synthesis required to operate within this society is also present in visual design” (p. 42) with a focus on creativity, problem solving and the resultant creation of art forms. Thus, the call for art educators to maintain two positions simultaneously by seamlessly merging the use of traditional
and technology-based practices (e.g., Hubbard & Greh, 1991). This means not only creating with technology but also using it as an educating tool within a range of teaching strategies, while supporting a role for traditional practice materials processes. Importantly this requires an integration of computer technology resources in art teaching space as distinct from working in computer labs. In short, “educators must find a balance between the ‘technology approach’ and the ‘traditional approach’ by moving fluidly between technologies extending students’ experiences in many directions” (Hicks, 1993, p. 42). Matthews (1997) concurs:

We live in the computer age, and vital art necessarily reflects and interacts with contemporary forces. While continuing to embrace traditional media, art teachers should consider the merits of exploring the educational possibilities of the computer. (p. 3)

At this point it is interesting to note that the following image appearing on the large glossy chart on *Information Technology in The Arts* (Board of Studies, 1997) seems to represent the antithesis of the above calls for seamless integration:

![Image removed due to copyright restrictions.](image-url)

*Figure 4: Using IT to help students achieve the learning outcomes in The Arts key learning area (BoS, 1997).*

Support for the aforementioned views come from Aland (2004), who argues that art teachers need knowledge, understanding and appreciation of the ways that technology has, and continues to change artistic practice: “To become informed about the attributes and features which characterise such works, and to reflect these understandings in their approach to teaching visual arts” (p. 7). The she conclusions she drew from her interviews with artists and students about how digital media has changed fundamental art practice in numerous ways:

- altered the Western paradigm of art;
- redefined art, both as a process and production and of consumption;
offered endless possibilities for visual representation, which allow for the dynamic analysis of motion, time, space, and the abstract relations between them;

- created new spaces, new terrains, new virtual worlds, and the new cultural realities of reproduction, representation, simulation and appropriation;

- changed the way we see the world; enabled us to inhabit and experience fabricated visual spaces that are radically different from the mimetic world of film, photography, and television;

- altered the way art itself is viewed;

- opened up opportunities for artists to deal with a whole range of new issues and questions relating to their use;

- changed the actual physical practice of making art … shifted the emphasis from traditional reliance on hand skills providing artists with a much more intense engagement with decision-making and with the creative process itself.

Particularly enthusiastic calls for technology in art education include: “Visual technologies can be used to transform art classrooms into centres for investigating visual culture that expand the boundaries of the field” (Freedman, 1998, p. 2). Among various advantages of ICT in art education, is that as an art medium, the computer encourages all the richness of artistic exploration associated with any other art medium, raises questions concerning aesthetic qualities of the images, and invites a host of considerations of art making typical of the more "traditional" art media (Rogers, 1995, p. 17). As electronic tools comprise far more complex features than those built into a brush, printing press, or a camera, they require students to engage with deeper levels of thinking in generating and solving creative problems through experimentation (e.g., Lovejoy, 1992). Dunn (1996) adds:

The visual and technical problem solving that occurs when students use new technology to create visual images, download work from the “real world of art”, access information about these works, engage in critical analysis … compare and contrast the aesthetics of a wide variety of cultures can prepare them to meet the challenges of the 21st century like no other subject in our schools. (p. 9)

5.5.2 Promoting problem-solving skills

The consistent reference to ICT as an aide to promoting problem solving skills “as a way to teach creative thinking” (Ettinger, 1988, p. 54) within the art education discourse aligns with the many long-term comments in the broader education literature pertaining to the want of the problem-solving ability of students. Yelland (1999) for instance, draws on numerous research studies that show frequent calls for an increased emphasis on teaching problem solving skills in the United Kingdom, the United States, and Australia where for example, Speedy (1989) had long called for: “a literate society, a problem-solving society, one capable of generating viable alternatives to rapid change” (p. 9). In addition, Yelland points out that most of the curriculum documents produced by various State Education Departments in Australia during the 1980s re-
emphasised the need for students to become proficient problem-solvers. Although, these documents invariably refer to the mathematics curriculum, rather than that of art, the art education literature makes abundant reference not only to the need to promote students’ problem-solving skills, but also their capacity to generate their own creative problems to solve.

The potential for art education to promote connections between art and maths concepts through problem solving activities has also long been acknowledged. For instance, Reid (1995) explains that computers can be used in creating patterns for various art practice activities. Straker (1988) also describes children’s application of pixels in creating designs and their ways of manipulating the size, shape, and colour of their images. This includes exploring visual arts maths concepts such as symmetry, repetition, reflection, rotation and tessellation. Over more recent years this combined art and maths concept has been extended by a number of authors. These include Doris Schattschneider (2003), who explains that while at the most practical level, traditional mathematical tools have always been used in the creation of art; digital technology is fast becoming a primary choice medium in art practice and education:

In the hands of an artist, computers can produce art, powered by unseen complex internal mathematical processes that provide their magical abilities. Mathematical transformations provide the means by which an image or form in one surface or space is represented in another. Art is illusion, and transformations are important in creating illusion. (p. 9)

5. 6. ICT as an alternative art practice medium

Art educators’ calls for ICT integrating in visual arts curriculum encompass the view that the advent of new technologies, particularly computer technology, has provided an avenue for non-traditional artists, many of whom would not have worked with conventional mediums and processes (Reade et al., 1991). With respect to ICT use for promoting children’s confidence in art practice, Stokrocki (2001) describes particularly notable situations where children, who were considered as ‘slow learners’, were able to create highly imaginative compositions when she supported their use of the KidPix multimedia program. Hyser and Hengst (2002) add that the practice of guiding children to take risks when working on computers is consistent with Vygotsky’s (1962) theory on of extending children’s learning through assisted participation.

An allied view holds that: “A good reason for bringing computers into the art room is that their presence constitutes an attraction to many students who presently may find little interest or value in the realm of art” (Di Blasin, 1993, p. 46). In other words, ICT can encourage those who might not have the skills or interest related to traditional media to focus more on conveying ideas and less on execution of refined art works. Thereby, they might also enhance their engagement with visual image making processes and their aesthetic sensitivities (e.g., Wang,
That is, mistakes can be readily corrected, resulting in decreased anxiety and promotion of experimentation, which lies at the heart of creative practice (e.g., Hicks, 1993). For Matthews (1997) perhaps, because of students’ overall familiarity with new technologies, many of those who might otherwise never explore the riches of art are attracted by the offer of computer use in art classes. Thus, opportunities for computer use in art education might entice their entry into a world of aesthetic possibility as “we now have the tools for shifting towards “a connoisseurship teaching approach that holds great promise for the vast majority of our students who are not destined to become artists” (Dunn, 1996, p. 9).

Collectively, these concepts signify the value of ICT integration in terms of an inclusive approach to art education that can cater for different learning styles (e.g., Dunn, 1996) in ways that align with the theory of multiple intelligences as first defined in Gardner’s (1993) *Frames of Mind*. Allied here is the view that the theory of multiple intelligences emphasises: “the importance of fostering aesthetic competency in the whole development of each learner” and that “there seems to be increasing evidence that youth who are considered ‘at risk’ benefit the most from aesthetic education” (UNESCO, 2006, p. 10). More specifically, ICT integration in visual art education can been linked with the theory of multiple intelligences through appropriate pedagogy coupled with selective use of ICT to stimulate the use of multiple intelligences, cater for different learning styles, and extend students’ preferred modes of learning. Bates and Leary (2001) explain the importance of this concept in terms of everyone having a learning style which if accommodated can result in improved attitudes towards learning and an increase in academic achievement, and creativity. They define the term ‘learning style’ in Messick’s (1976) words: “A learning style is a composite of characteristic cognitive, affective, and physiological factors that serve as a stable indicator of how a learner perceives, interacts with, and responds to the learning environment” (p. 45).

The importance placed on the opportunity ICT offers for multi-sensory and aesthetic learning accords with Eisner’s (1998) concept of inclusive pedagogy:

> It is important to attend to the array of forms of representation employed in a class because of the different kinds of meanings that each provides and the different kinds of thinking skills each develops, and because educational equity is likely to increase as the diversity of forms grows. (p. 179)

### 5.7 Artistic relevance of ICT

The importance of aesthetic learning that interweaves the acts of making and appraising art is seen as being particularly a pertinent consideration by Judith Burton (1994), Director of the Art and Art Education at Columbia University, New York. Chia and Duthie (1992) relate this factor
to the importance of children’s learning the aesthetics facets of computer art, which includes learning to convert and combine images, and weaving together elements of movement, sound, and audience interaction as the basis of the aesthetic development. The resultant appreciation of the features and effects of computer graphics allows children to become more perceptive and critical consumers. Loveless (2003) concurs that appropriate graphics programs can assist not only in formulating ideas, making connections, and creating, “but also evaluation” (p.12). The process of learning to appraise their own artwork empowers students to make decisions about what they like and dislike, as well as provide an opportunity to consider ways that they could alter or develop their work. Thus, computer art applications are thought to provide possibilities more than any other medium. While undoubtably there are many types of valuable three-dimensional art practice activity that cannot be accomplished through computer applications they do offer unrivalled tools for two-dimensional visual experimentation, communication, perception and appraisal (Matthews, 1997). The words of artist James Faure Walker (1992) apply here:

I enjoy playing around with the new freedom offered by digital painting – merging painting, drawing, and photography. Pictures can be assembled from active components, and that makes for an interesting space to orchestrate (London Group, 2012, Para. 4).

5.8 Risk taking
All told, computers are regarded as holding the potential for heightened experimentation by allowing students to test artistic ideas as original sketches can be saved, then the limitless additional versions of the original can be altered and backed up for future reference. As such, students can view successive variations individually, or display the collection of reduced images simultaneously on the same screen. This facility allows the novice artist to branch out and explore risky possibilities that otherwise would not be dared. This includes making contrasts with various versions of their working ideas adding and deleting images without destroying the original (e.g., Matthews, 1997). Thus, students are more inclined to review and redesign original concepts with computers than with traditional art media (e.g., Walters et al., 1989). This latter point evokes Gardner’s (1980) reference to Picasso’s comment, “It would be very interesting to preserve photographically, not only the stages, but the metamorphosis of a picture” (p. 264). The pedagogical advantage of ICT with respect to the visual and technical problem solving that occurs when students engage in multi media projects is thought to stimulate problem-solving skills, and creative intelligence because ICT often demands interactive involvement, decision-making and experimental learning and “creative risk-taking” (Vaughan, 1996, p. 28). In addition, when students download artists’ work, they can engage with critical analysis of artworks from a
wide range of cultures. This factor: “can prepare them for the challenges of the 21st century like no other subject in our schools” (Dunn, 1996, p. 8).

The frequent reference to the concept of risk taking within the educational ICT discourse, aligns with the position taken by Neisr (2010) of the United Kingdom National Endowment for Science, Technology and the Arts who notes that the value of invention and original thinking is often overlooked by policy makers with respect to preparing young people for the future. Yet, through practice, young people can learn to recognise opportunities and possibilities rather than play safe and tread well-worn paths of enquiry. Risk taking is both a skill and a personal attribute that can be promoted by “giving young people greater freedom to design their own projects and fostering a learning culture that supports independent thinking” (p. 4). In elaborating on this issue she notes that a review in the United Kingdom (OfSTED, 2008) found that primary school teaching has often “led to minimal risk-taking with a heavy reliance on worksheets and on telling pupils what to do rather than encouraging them to make decisions for themselves” (p. 4). Whereas the concept of risk can be advocated in terms of helping students in the broad educational context to make decisions about subject choices and routes and to evaluate alternative courses of action and build confidence. As discussed elsewhere (e.g., Culpan & Macmillan, 2008), the willingness to take risks is perhaps the attribute of creativity most consistently cited in the wealth of literature on the subject.

Further interrelated advantages of ICT include students’ motivation to extend visual art learning through the art elements of movement, light, chance, and audience, which are rarely considered in traditional visual art education, promote of higher levels of enthusiasm through software that inspires the use of more senses to reinforce learning processes (e.g., Duffy, 1995). These elements, which have historical precedents in art, contribute to the aesthetic qualities of computer art, and thus merit further study relative to teaching ICT related aesthetics and criticism (e.g., Freedman, 1989). Likewise, the conventional art education construct needs to be broadened by the inclusion of the history of computer art in the curriculum, and animation and sound to promote aesthetic sensitivities (e.g., Dunn; 1996; Freedman. 2003).

The value of ICT is also thought to reside particularly in the potential to promote students’ independent learning, through software programs that enable them more control over their learning than traditional art methods, and also stimulate their creative intelligence through interactive involvement and decision-making (e.g., Hausman, 1991; Tapscott, 1998). Interactive programs are regarded as offering infinite choices for art practice where the endless freedom of choice is a particularly compelling call for art educators to integrate technology as a “power
tool” in their repertoire of instructional approaches (Dunn, 1996, p. 7). However, Dunn (1996) notes the importance of realising that even in classrooms where there are only very basic ICT resources, limited choice is far more motivating than no choice at all. Wilson (2002) similarly notes that all levels of involvement with technology in the arts are valuable.

5.9.1 Universal pedagogical goals

With respect to promoting universally valued pedagogical concepts, Dunn 1996 asserts that students’ use of computer applications in art encourages their active participation in their own learning as encompassed in Dewey’s (1910) and Bruner’s (1957) learning theories, as “they must encounter the unknown, hypothesise about it, test their theories, and evaluate their results (p. 7). Implicit here is that they also enact Dewey’s (1938) five elements of problem solving. In art classes the development of students’ creative problem solving skills can be advanced through open-ended graphics programs suited to extending teaching objectives such as promoting higher order thinking and discovery based learning (e.g., Matthews, 1997). In other words, the concept of higher order thinking skills as described in Bloom’s (1958) Taxonomy of educational objectives, holds relevance here in that the basic thinking skills are learning facts and recall, while higher order skills include critical thinking, analysis, and problem solving. In Jonassen’s (1996) terms this means that technology-based learning occurs when students use computers as ‘mind tools’ – that extend thinking strategies, knowledge construction and problem solving. This way, they can organize and demonstrate their knowledge effectively. Negroponte (1994) who emphasises that the ongoing technological advancements have increased the potential of computers to extend high order creative problem-solving skills in all areas of learning, suggests a way that ICT can be explored in visual art classes:

Since computer simulation of just about anything is now possible, one need not learn about a frog by dissecting it. Instead children can be asked to design frogs, to build an animal with frog-like behaviour, to modify the behaviour, to simulate muscles, to play with the frog. (Negroponte, 1994, p. 199)

5.9.2 ICT as a stimulus for the social aspects of learning

Among the numerous pedagogical reasons stated for ICT integration is the one relating to the social aspects of learning in that researchers have identified various forms of collaboration among students when engaged in computer-assisted artwork. There is evidence that the most computer literate individuals spontaneously support their peers and that high levels of social interaction occur among children when working with computers. More specifically, according to Freedman (2003), despite numerous concerns that students become anti-social as a result of sitting in front of computers, research has revealed that they may not only work best in collaborative situations when using computers, but can also interact with each other’s work in
ways that are unlike traditional media. In particular, they can change images in response to the constructive critique of their peers or teachers without interfering with the original image.

5.9.3 Visual literacy

The need to promote students' visual literacy adds another dimension to ICT use in visual art education. In broad terms, visual literacy is the multi faceted ability to critically process visual information, thinking, learning and communicating in terms of imagery, rather than just viewing images. The most recently found definition of visual literacy comes from ACARA (2010) who suggest that the contemporary concept of visual literacy falls within the realm of both Information Literacy and ICT Literacy. Implicit here is that students need the ability to evaluate information across a range of media; recognise when information is needed and have the ability to locate, synthesise, and use information effectively with print and electronic media. Selivanov (2004) explains that the arts have more means for manipulating informational entities in order to turn them into communication objects than any other human activity.

We should highlight a phenomenon that many teachers ... are aware of. Children were always especially good at generating descriptive imagery, but nowadays that requires an additional effort and extra attention on teachers’ part, because children are inundated with visual information and frequently begin to retransmit “somebody else's” images, they are captivated by ready-made metaphors and see no need to create anything of their own. In other words, we encounter emotional deafness and imagery muteness that develop against the background of emerging unprecedented means for interpersonal communication. (p. 30)

Although traditionally the promotion of visual literacy resided in visual arts education, it is now considered as being equally important across disciplines because of the changing nature of information and the unprecedented proliferation of visual images since the advent of ICT (e.g., Freedman, 1997; Tapscott, 1998). In this light, Bamford (2001) states: “Youth in Australia are bombarded with images ... the ability to understand these images is a vital literacy” (p. 1). For Burmark (2002), the key literacy of the 21st century will be visual in the form of pictures, graphics and images of every kind: “Thus our students must be able to move gracefully and fluently between text and images, between literal and figurative worlds” (p. 5). As arts literacy and computer literacy are both considered as powerful and valuable languages for stimulating perception they require: “tuition and cultivation” (Christie & Misson, 1998. p. 94), and critical and creative ways of engagement (e.g., Duncum, 1997; O'Toole, 2009).

In this regard, Freedman (1997), who suggests that art educators play a critical in contributing to the wider education goal of promoting student’s visual literacy, calls for both production and viewing of electronic images in art curricular, and for teachers to “pay increased attention to the interpretive and critical analysis of imagery and other information” (p. 8). The consonant view is
that, global culture presents new challenges in visual art education, including the need to acquire the ability to critique images that represent our visual culture – the abundant visual images and artefacts in our lives and the frequency of our interaction with them. In this sense, ‘visual culture’ pertains to all things we encounter visually (e.g., Carpenter, Burton, Manifold, & Wightman, 2003). Mirzoeff (1999) sees visual culture as a concept still in the making rather than a well-defined existing field, and that in the present intensely visual age:

Visual culture is not just a part of everyday life, it is everyday life…. concerned with visual events in which information, meaning, or pleasure is sought by the consumer in an interface with visual technology. By visual technology, I mean any form of apparatus designed either to be looked at or to enhance natural vision, from oil painting to television and the Internet. (Para. 3)

Duncum (2006) similarly explains that visual culture is not something special, but something we all possess and practice all the time. Even literacy educators, who have long focused on words alone, now refer to multiliteracies where language texts are related to audio, behavioural, and visual modes of making meaning (e.g., Cope & Kalantzis, 2000). Consequently, it is argued that if art education has a future in the world of image saturation, it must engage with images that are now characteristically worldwide: "Unless it adopts a defensive stand, it has the opportunity to contribute in an ongoing, constitutive role to the globalisation of culture" (Duncum, 2001, p. 179). Therefore, preservice teacher curriculum must embrace the visual nature of learning, “while recognising the differing styles of learners and the need for visual literacy education to include skills in interpretation and appreciation of images, as well as image creation and manipulation” (Brown, 2003, p. 3). This is because observing the new visibility of culture is not the same as understanding it (e.g., Duncum, 2006), especially as: “The gap between the wealth of visual experience in contemporary culture and the ability to analyse that observation marks both the opportunity and the need for visual culture as a field of study” (Mirzoeff, 1999, Para. 3).

5.10 Promoting creative activity

As indicated in the preceding discussions, ICT is seen as an important aspect of promoting students’ creative thinking and practice in art education in ways that resonate with the thrust of current thoughts on education. UNESCO for instance, who in 1999 appealed for the promotion of arts education and creativity at school as part of the construction of a culture of peace (e.g., UNESCO 2005), highlight Venturelli’s perspective (2001):

Basic literacy skills and imitative learning adequate for following instructions on the assembly line, the workshop, or desktop terminal are simply inadequate to the demand of a creative and innovative society. It is not basic education, but advanced intellectual and creative skills that emphasise interdisciplinary and independent thinking that should be required at earlier
stages of the educational process and extend from preschool to grad school. (UNESCO, 2006, p. 4)

A complementary call is encompassed in the report: *All futures: Creativity, culture and education* in the United Kingdom (National Advisory Committee on Creative and Cultural Education, 1999). In this context, teaching for creativity includes "forms of teaching intended to develop young people's own creative thinking or behaviour" (p. 90). Likewise, the New Learning concepts proposed by the Australian Council of Deans of Education (2001), as previously noted, represent a broad-spectrum call for creative pedagogy:

Creativity is essential in the development of thinkers of the future with a focus on creating a kind of person, with kinds of dispositions and orientations to the world, rather than simply commanding a body of knowledge. These persons will be able to navigate change and diversity, learn-as-they-go, solve problems, collaborate and be flexible and creative. (p. 2)

The above statement implies that the concept of creativity is not restricted to arts education, yet *The National Education and the Arts Statement* explicitly highlights its importance to arts education: “the arts foster imagination, risk taking and curiosity – important aspects of creativity” (MCEETY, 2007, p. 6). While the literature is replete with explanations of creativity mostly related to the arts, the National Advisory Committee on Creative and Cultural Education (NACCCE, 1999) in the United Kingdom draws upon a range of conceptualisations of creativity and presents a definition which is a useful non-arts specific framework for educators in terms of creativity as imaginative activity fashioned so as to produce outcomes that are both original and of value" (NACCCE, 1999, p. 29). In broad terms, ICT use for creative practice entails: "processes of capture, manipulation and transformation of media" (Loveless, 2002, p. 4).

In an extensive review of literature on *Creativity, technology and learning* by Loveless (2002) notes: "A characteristic of creativity with digital technologies would be the recognition of the potential of the features of ICT to be exploited and experimented with to support creative processes” (p. 12). The research literature identified that the following learning and teaching features fostered creativity. The following is a condensed version of the original:

1. an awareness of the ways in which creativity is related to knowledge across the curriculum;
2. opportunities for exploration and play with materials, information, and ideas; to take risks and make mistakes in a nonthreatening atmosphere; for reflection, resourcefulness, and resilience;
3. flexibility in time and space for the different stages of creative activity;
4. sensitivity to the values of education which underpin individual and local interest, commitment, potential, and quality of life;
5. teaching strategies which acknowledge teaching for creativity as well as teaching creativity. (p. 217)
In the context of this review, the following framework was used to identify and describe the range of creative activities supported by digital technologies. While, as Loveless states the following categories are not mutually exclusive, they relate to the way in which ICT can support creativity in the classroom:

- physical and virtual learning environments
- developing ideas
- making connections
- creating and making
- collaboration
- communication and evaluation. (p. 4)

The most comprehensive account found on the way ICT can support creative activity in arts education is that of Selivanov (2004) who addressed the expert meeting with the keynote presentation *Education, Art and ICT* at the Moscow UNESCO Institute for Information Technologies in Education. Specifically, in discussing the potential of ICT for aesthetic development in arts education, he states: “ICT give an opportunity for balanced cognitive development in image thinking, discursive thinking, integrative thinking, projective thinking. Besides, ICT give an opportunity for balanced cognitive development, including all aforementioned components, due to their specifics” (p. 29).

Table 1: *Summary of Selivanov’s perspective of what ICT can facilitate:*

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<tr>
<td>1.</td>
<td>comprehensive impact on user’s perception by means of synthesizing visual, aural and moving images in one communication object;</td>
</tr>
<tr>
<td>2.</td>
<td>imitating any visual means of expression, including illusion of three-dimensionality, allow creating illusion of movement, as well as creating and objectively representing visually the objects that cannot exist in reality, or reconstructing the past and projecting the future (virtual modelling);</td>
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<tr>
<td>3.</td>
<td>turning elements of screen images into interactive objects, i.e., into objects that interact with users. That means that each object can be assigned a function that results in a sequence of events. These functions can be assigned to static objects (turning an image into an interactive map) or dynamic objects, including digitalized video images, animated objects and films;</td>
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<td>4.</td>
<td>creating multilevel informational objects that reveal their contents in the process of spacio-temporal, non-linear interaction between users and interactive elements;</td>
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<tr>
<td>5.</td>
<td>designing models of self-developing informational systems, the simplest of which are an interactive bulletin board, chat and e-forum, which contents develop, thanks to free access, for different users who can post their information;</td>
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<tr>
<td>6.</td>
<td>uses an opportunity to absorb information at his/her own speed, with his/her own motivation and thinking;</td>
</tr>
<tr>
<td>7.</td>
<td>organisational structure of informational digital objects built upon the principal of focusing (multi-step classifiers – from general to more specific, or search engines with advanced search options), which allows intensified processing of information arrays</td>
</tr>
</tbody>
</table>

(Selivanov, 2004, p. 33).
Selivanov also identified that visual representation is enhanced by means of:
- synthesizing in one screen object several different visual images such as
objective images, charts and graphs, symbols, animated visual “comments”,
video and sound indexing of events;
- simultaneous representation of images;
- dynamic screen refreshing;
- direct interactive modification of images and graphical comments – it is possible
to draw and modify images directly on the interactive screens. (p. 33)

5.11 ICT in early childhood visual arts education
As previously suggested, the notion of what constitutes visual art education for young children in
early childhood literature has been extended to include the use of visual media, such as digital
photography, video and computer aided imagery as a means of offering exciting new ways for
children’s art-making process (e.g., Clements, 2002; Vecchi & Guidici, 2004). For instance, Vecchi
et al. (2004) of the Reggio Emilia schools in Italy, commend “the processes involved in the creative
act, such as synthesis, exploratory tension, the intense relationship with things, symbolic invention,
metaphor, evocation and analogy, and cultural courage” (p. 15). They also state that as new
technologies provide new and different elements that represent changes to the environment of art
and artists as well as that of children: “We are dealing with a new landscape of possible mental
images and technical and inventive action” (p. 141).

Clements (2002) supports this stance by recalling that early research into young children’s
computer-based drawing experiences, found that some computer programs allow children to
create more elaborate pictures than those that they can create by hand. Specifically, children
could modify their ideas and use these new ideas in all their artwork. Thus, the view that certain
computer software can assist children to extend their experiences and their creative activities in
learning to draw. As another example, Clements cites Wright (1994) who found that young children
could use a graphics program to combine the three primary colours to create three secondary
colours. While as Clements (2002) notes, such complex combinatorial abilities are often thought to
be beyond the reach of young children, in both these examples, the computer experience led the
children to explorations that increased the boundaries of what they could do. They also used
higher-order and creative thinking in the free exploration activities. Howland, Laffey and Espinosa
(1997) also describe how children can create complex simulations and combine pictures and text
at all age levels. Others add that access to the Internet provides young children with more
opportunities to find information, ideas and examples of artwork that may assist them with their
own art-making and creative thinking. Likewise that digital animation, a form of visual art media
that is often characteristic of children’s television programmes and films provides opportunities for
children to create their own animations and to bring in some cultural references that have particular meaning for them (e.g., Long, 2001).

5.12 ICT as an aide to managing teaching resources

Hubbard (1999) discusses a range of ways that ICT can simplify the management of teaching aides. As a brief example, he notes that the traditional types of instructional images including reproductions, slides, and filmstrips are expensive, bulky, and deteriorate over time. Whereas images captured digitally into a computer memory never change and can be readily and repeatedly retrieved to serve varieties of instructional needs. Moreover, digitized images can be modified without damage to the originals and compared with traditional media, are relatively inexpensive to produce. The addition of sound, whether as voice, recorded music, personal compositions, or special effects extends the boundary of traditional teaching and practice within the field. In particular “text, pictures, and sound may be incorporated within programs, making possible the integration of three primary modes of communication in one product” (p. 45).

Others concur that technology provides teachers and students alike with new tools to access, organise and present information and to enrich lessons through multimedia (e.g., Bridwell & McCoy, 1991). In a similar vein, Busby, Parrott and Olson (2000) identified that the tracking student work was simplified by saving the work on the hard disks or floppy diskettes, and Aland (2004) notes the advantage of ICT for maintaining digital portfolios to document students’ artistic “achievements and progress” (p. 16). The fact that technology facilitates communities of practice in terms of communication between students and teachers, including those from different schools, or cultures, and with practising artists from around the globe is another noted advantage as is the WWW in providing a virtual international gallery for research (e.g., Loveless, 2003; Selivanov, 2004). In this context, Coutts (2004) notes that due to crowded curriculum syndrome and the inherent time and cost constraints in organising class excursions, visits to galleries become complex. Thereby, while there is no comprehensive substitute for viewing artworks in person, ICT offer alternative access to a wide range of artworks.

Of course in more recent years, developments in digital video and software offer art teachers and their students opportunities to create video-based projects and still photographs for teaching and art practice purposes (e.g., Ewing, 2010). Interactive whiteboards (IWBs) are also being increasingly seen as an innovative instructional resource as well as an aide for art practice and other learning activities. In this way they are considered as having the potential to revolutionise traditional computer use in both the teaching and learning situations (e.g., Ewing, 2010). Tazhigulova (2004) draws attention to the more recent advancements in electronic
textbooks as being a valid teaching resource in that they provide opportunities for students to see unique images, museums and theatres, exhibitions from the places of the past ages, including “ceramics, jewellery decorations, dishes, manuscripts, gold, silver, copper coins, which were used by merchants advancing on caravan road Great Silk Way, etc” (p. 54).

5.13 Appropriate use of ICT

Haugland and Shade (1990) present a useful set of criteria for inservice and preservice teachers to consider in assessing the developmental appropriateness of computer software, including the following condensed version, which can be regarded as applicable to all areas of learning and teaching:

1. The concepts taught and methods presented show realistic expectations of young children.
2. The children, as active participants, not the computer, decide the flow and direction of the activity.
3. Verbal or graphic directions are simple and precise. Written instructions are not appropriate for young children.
4. Software use begins with the child’s current skill levels, and a learning sequence emerges where children can build conceptual skills.
5. Children are able to use the computer and software with a minimum amount of adult supervision.
6. The challenging activities that children have in exploring and experimenting with software are what engage children on the computer.
7. Objects used in software are reliable, realistic models of objects in a child’s world. Objects in realistic proportion to each other, portrayed in meaningful settings, provide children with a small model of their world.
8. The short attention span of a preschool child is better held by high-quality software with colourful, uncluttered, and realistic graphics and sound effects. Avoid slow running software that keeps children waiting.
9. Opportunities for creative problem solving and testing alternatives are several ways for children to explore and learn through trial-and-error.
10. Software allows children opportunities to change objects and situations and explore hidden processes. (pp. 6-14)

In a similar vein, NAEYC (1997) includes guidelines for teachers/ECE professionals, which are outlined as follows: First, teachers need to assess the worth of a wide range of ICT media regarding what affect these have on children’s current and future learning. This entails previewing software carefully, as the information on the packages does not usually provide information on ease of use of the package; time delays in waiting for programs to load, save or print; variety of pathways inherent in design; gender and cultural sensitivity and inclusiveness; range of ways that the program can be used; levels of use for children; how supportive the material is for curriculum; quality of graphics, text and sound effects; accuracy of information; whether the topic is relevant to Australian children; and whether a range of offline activities can be stimulated. Second, teachers should involve children in the review process, since what may
appear at first glance as suitable or unsuitable may be utilised quite differently by different children. Observations of children at work on the computer and asking their views is a particularly reliable method of evaluating the worth of a particular piece of software. Above all, open-ended software is seen as providing many more learning opportunities for children than drill and practice software, which is limited and is based on a behaviourist approach to learning. Third, as in most educational programs the development of social skills is an important element; professionals need to ensure that not only do they choose software which encourages group interactions, but that the strategies for the implementation of the technologies focus on children interacting and not working in isolation. Another important factor is adult modelling so that children can also become aware of when and how information technologies should be used. In this regard Viktor Lowenfeld’s (1975) longstanding view holds resonance in that it emphasises that the teacher’s approach rather than the tools and materials used, determine the success children’s artistic progress.

5.14 The importance of visual arts educators’ technological acumen

In light of the above, it is clear that new technologies do not of themselves promote constructive or creative learning environments through a special sprinkle of magic. Importantly art educators’ enthusiasm for ICT does not belie their recognition of the need for technological-pedagogical competence (e.g., Selivanov, 2004; Worrall, 2004). As Peter Worrell (2004) explained in his UNESCO presentation: The Digital Derive and Art Education – ICT developments 1997–2002 in Initial Teacher Training at the Institute of Art and Design, University of Central England in Birmingham, United Kingdom: “The of the role of the teacher as a media expert and manager or gatekeeper of large databases of interactive knowledge and online conceptual digital tools” (p. 58). Chia and Duthie (1993) focus on the importance of teachers’ pedagogical skills in scaffolding children’s progress when working with computers and stress that technology per se is only one aspect of the learning context: “The focus needs to be on students and how they can be supported in using the computer most effectively” (p. 41).

Ettinger (1988) advised that art curriculum planning of computer technology integration should include questions much the same as those to do with the selection of any art medium. For instance, does the student control the medium, or does the medium control the student? Is the medium appropriate for the educational situation at hand? What attitudes, both intended and unintended, does the instruction foster in the student? “Questions must also be asked concerning the unique characteristics and potential of the medium (p. 56). An equally salient feature of the technology discourse in art education is the importance of teachers knowing what is and is not possible to do with computers in art learning. For instance, Walters et al. (1989)
promptly identified not only the most promising art education specific features of the technology available at the time, but also the limitations. Although they expected some ‘awkward’ aspects of using computers for art practice would improve through future developments, they note that: “both the promise and the limitations play a part in the consideration of the integration of computers into an educational program”. Thus, they recommend: “a spirit of open-mindedness and scepticism” (p. 100). The scepticism is to offset unrealistic euphoria surrounding computer technology while open-mindedness is to see beyond its liabilities to identify its attributes relevant to visual arts education.

A related factor is advanced by Bik’s (1991) explanation that the teachers’ enthusiasm is critical to successful ICT integration. Specifically, her first sighting of computer art inspired her instigation of related teaching courses at the Hong Kong School of Visual Arts because: “A world with no boundaries gradually opened up in front of my eyes, a world that could be as wild and unlimited” (p. 441). In this light, Vaughan (1996) suggests that to transcend a mundane level in art practice, teachers need high commitment to using computer technology in relation to their teaching of aesthetics, and to collaborate with technicians with shared artistic interests, especially as the hardware and software govern the limits of what can be achieved. This means, successful composition of art elements requires artistic skills as well as knowledge of the hardware and peripherals, especially system requirements in terms of the capacity specific to generating and storing visual imagery, and the most efficient means of using these.

Included here is the need for teachers to identify the most appropriate software for allowing for students’ control in creating artwork, to encourage exploration of tools and art elements (e.g., Isbell & Raines, 2003), and extend the scope for individual discovery, rather than restrict practices to strict teacher directed or low level cognitive tasks (e.g., Jonassen, 1996). In fact, Papert (1996) readily concedes that software often fails to enable children to retain control of their intellectual processes, to extend their innate ability to ask questions and solve problems. Selivanov (2004) adds, applied educational techniques based on ICT should be the main criteria for evaluating resources:

- overall concept that defines goals, means and methods of using ICT in education;
- projective creative organization of learning process by means of ICT;
- methodology and technology supporting and developing creative personality;
- standards;
- analytical tools.

Levels of using ICT opportunities for creative personality development constitute another set of important criteria:

- interactive opportunities and objects that can be manipulated;
• level of visualization;
• level of multimedia penetration. (p. 35)

The above views are clearly in stark contrast with those that suggest that the use of computers in art is similar to using a pencil or paint, or “plug and play” (Mathews, 1997, Para. 2). Clearly, “this attitude undermines the inherent capabilities of the computer as an artistic medium and the level of intellectual mediation required (Duffy, 1995, p. 17). It has also been argued teachers require little computer knowledge with the “new breed of computers” (D’Angelo, 1988, p. 43). However, views of this type understate the need for careful planning, time and expense of learning to select and use art related hardware and software in order ensure ICT are effectively integrated in visual art teachers’ pedagogy. Indeed, while it is commonly accepted that recent advancements in technology have reduced the cost and complexities of ICT use, ICT are more difficult to assimilate in visual art education both conceptually and practically than traditional media (e.g., Reade et al., 1991). Allied views hold that just as word processing software does not instantly transform students’ writing skills, graphics software does not automatically imbue with artistic talent (e.g., Crowe, 1988; Ettinger, 1998; Roland, 1990).

In other words, although computers have changed the way some artists accomplish visual thinking for artistic production, no matter how sophisticated computers might be: “By themselves they do not make art or turn their users into artists ... art practice involves skills in use of tools, techniques and processes; generating ideas; experimenting with possibilities; and finally creating visual statements in intentional ways” (Preble & Preble, 1994, p. 197). As Bates (2000) states, this is “significantly different from simply clicking a mouse to create a design and then labelling it art” (p. 63). In Gardner’s (1988) sense this means that: “At the heart of any arts education process must be the capacity to handle, to use, to transform different artistic systems – to think in and with materials of the artistic medium” (p. 164).

5.15 Implications for preservice teacher education

As previously indicated the focus on ICT in teacher education, especially at the preservice level, has gained force especially in terms of recognising the intricacies of preparing of graduate teachers for their work in the 21st century (e.g., Galbraith, 1997; Hutchens, 1997). Indeed art educators have noted the importance of teacher education as a channel for change. For instance, while Busby et al. (2000) claim it is no longer a question of whether computers are used in arts education but how they are used, Brown (2001) calls for preservice teacher curriculum to embrace visual learning, recognise individuals’ different learning styles, promote skills in interpretation and appreciation of computer-based images, and to use computers for image creation and manipulation.
5.16 Summary
This chapter has presented a range of constructive perspectives on ICT integration in visual arts education with reference to art educators’ concerns about the low status accorded to the discipline in the school curriculum. Allied to this was an overview of the perceived advantages of ICT in proving exciting opportunities to broaden the traditional boundaries of art education in terms of art practice and pedagogy in terms of promoting valued educational concepts. Art educators’ stance on the importance of technological-pedagogical competence was also outlined, specifically with respect to ensuring discerning use of ICT within the discipline. This feature of the discourse highlights the fact that while ICT integration in this discipline is important, it is by no means a simply undertaking and that the implications for preservice teacher educators are clear.

In keeping with Aland’s (2004) advice that art educators: “need to ensure that they become familiar with the work of these artists to the same degree that they are with our painters, sculptors, or printmakers” (p. 17), the next chapter touches on the history of computer art. Specifically to show how the collaborative work of the early computer scientists and artists contributed manifestly to the advanced graphics technologies currently available to artists and educators alike. Although the genre of computer art has attracted much scepticism if not criticism from its inception due to its association with mechanical devices that creative experimentation in technological science and art practice had long coalesced in a mutually reciprocal way.
Chapter 6
Computer art: An overview of historical perspectives

In the early decades of digital art, artists had somewhat limited modes of expression because of an incomplete understanding of what computer techniques and applications would do for them. Now it seems some artistic production shows a considerable lack of knowledge of what has gone before. (Patric Prince, 2003, p. 1)

6.1 Introduction

In light of the above sentiment and the myriad calls for new ways of perceiving and conceiving visual arts education, art educators need insights into the phases of computer art that preceded the vast, varied and ever-changing genres of contemporary digital art. Beyond being crucial in the evolution of visual arts towards new media arts, computer art through its pioneering practitioners, exponents and critics, set the foundation for the current thriving field of art and technology. In fact, some pioneering artists were the first to institute the innovative degrees and diplomas that provided the model and formula of our new media pedagogy (e.g., Taylor, 2004).

This chapter explores a range of early literature perspectives, ongoing commentaries, and web sites that encompass the evolving nature of computer art. That is, unlike traditional art, there is no single comprehensive text that tells the history of the inventions in computer graphics and computer art. Nonetheless, there is growing international awareness of the impact of computer technology on three distinct arts domains – computer art, computer music and computer animation, which have a divergent history, and that the history of visual computer art appears to be more turbulent and contested than either the music or animation streams (e.g., Taylor, 2004). The chapter notes the significance of the history of computer art for art educators and an outline of the early computer art literature together with some of the more recent sources on information on computer art and offers a tentative definition of computer art. A snapshot follows of the early phases of computer art, including the perspectives of some of the early proponents and practitioners of computer art, and their critics, to illustrate both the optimism and skepticism surrounding the aesthetic validity of the computer art genre. Clearly, an exhaustive analysis of the unrest, the computer art developments, the allied artistic practice, theories, and the labyrinth of technical detail covered in the literature, is beyond the bounds of this study.

The term computer art is often applied to different art forms, including painting, performance and filmmaking; the focus of this study is on the visual arts form. Yet due to the array of computer technology applications associated with visual artistic practice, it is necessary to limit the discussion to the ‘static’ or ‘dynamic-passive’ computer art genres (e.g., Candy et al., 2002).
6.2 Relevance of computer art history to art educators

Traditionally visual arts educators were acculturated into art appreciation, practice, and pedagogy in ways that excluded the sphere of the computer visual arts. In this regard various twentieth century art publications were, and continue to be invaluable for understanding the historical and cultural conditions that influence the way different traditional forms of fine art are conceived, created and perceived. However, the early computer art texts show how the initial computer technological innovations, coupled with artists’ search for a creative synthesis of aesthetics and technology, have fuelled emerging art practices. As such, they not only inspire an extension of conventional notions of art beyond historically validated media, but also show how new technologies have sharpened the challenge of articulating a precise contemporary definition of visual arts (e.g., Kingston, 1980). As Mike King (2002), researcher in the domains of art and science, posits that many inquiries regarding computer art can be clarified through a credible body of computer art literature that presents the case for an art/science collaboration matching the efforts of computer art pioneers in bringing to fruit many promising experiments.

6.3 Early computer art literature

The readily accessible literature on computer art, prior to the 1970s is limited, especially as some is in German, whereas other writings were published in computer science specific journals that were not generally available to people beyond the associated disciplines. Moreover, research on the history of computer art is hindered by the loss of relevant material, particularly as many of the computer art catalogues from as late as the 1980s were misplaced or destroyed (e.g., Taylor, 2004). However, a search of the early literature revealed that it includes theoretical bodies of work, such as: *Aesthetica* by Professor Max Bense (1956) of Stuttgart University, which shows that Bense aimed to formulate a theoretical basis for computer art. Specifically, Bense introduced the term ‘Generative Aesthetics’ to indicate that an aesthetical object can be generated with the help of the computer (e.g., Schwab, 2003), and demonstrated early attempts to link human activities in the realm of “creativity and the realization of those activities with the aid of a cybernetic device” (Reichardt, 1971, p. 89).

Bense was also particularly influential in promoting his students’ interest in computer art, namely two Germans, Frieder Nake and Georg Nees who both become prominent figures in contributing to computer art practice and theory (e.g., Benthall, 1972; Franke, 1985; Reichardt, 1971). Nees for instance, who is the first person to have gained a PhD in computer art in 1968 (e.g., Candy et al., 2002), wrote *Generative Computergraphik* in 1969, which is essentially a
reprint of his PhD dissertation that explores the theory of information aesthetics as developed by Bense during the 1950s and 1960s (e.g., Franke, 1985). As the computer served Nees as an aesthetic laboratory, he described his use of computer programs in great detail, explicitly stated his aesthetic goals and used numerous visual graphics as proofs (e.g., Klütsch, 2007). Also, along with Nake and the German artist Manfred Mohr, whose work has a strong aesthetic-mathematical basis, Nees adopted the use of information aesthetics in the application of computer graphics (e.g., King, 2002).

With respect to other early computer art publications, Leslie Mezei, Professor of Computer Science at the University of Toronto co-authored one of the few found early written surveys of computer art: *The electronic computer as an artist* (Rockman & Mezei, 1964). He also wrote *Computers and automation* in 1964, and other writings that were published in many journals. He is well noted as being one of the first advocates of computer art, promoter of computer art events, and for initiating opportunities for the aforementioned Nake to work in Canada, and establish contacts between American and European computer artists (e.g., Franke, 1985). Interestingly, in reflecting on other authors’ publications, Mezei (1974) commends Herbert Franke’s (1971) *Computer graphics – computer art* in the following way: “Though Franke’s book covers too large an area too superficially, it is the only book in English I can recommend” (p. 1). The same Franke (1985), a Viennese artist/scientist/researcher at the University of Munich where he lectured on computer graphics and computer art, also comments on early computer art publications. For instance, in discussing a 1968 report on computers and animation which states that the United States followed by West Germany and Japan were the key centres of art related computer development, he argues that this and other literature tends to focus heavily on the American experience because the United States held prominence in computer research. In addition, he explains that the scarcity of computer art literature is due to the fact that by the 1980s there had been a phenomenal increase in the activities of this field, coupled with the fact that computer art was practiced in many places well before it attracted international attention.

Even so, interesting insights can be drawn from the writing of commentators, practitioners, exhibition curators and researchers who discuss various aspects of the early computer art activity from a close perspective. The following table presents some publications, which include numerous images of early computer art and discussions on its conceptual roots. It is interesting to note that Cynthia Goodman is the only one of these authors who is a qualified art historian.
Table 3: *Texts on developments in computer art*

<table>
<thead>
<tr>
<th>Date</th>
<th>Author</th>
<th>Title</th>
<th>Publishers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1968</td>
<td>Reichardt, J.</td>
<td><em>Cybernetic serendipity</em></td>
<td>NY: Praeger</td>
</tr>
<tr>
<td>1972</td>
<td>Benthall, J.</td>
<td><em>Science and technology in art today.</em></td>
<td>London: Thames &amp; Hudson</td>
</tr>
<tr>
<td>1974</td>
<td>Nake, F.</td>
<td><em>Ästhetik als Informationsverarbeitung</em></td>
<td>Vienna/New York: Springer Verlag</td>
</tr>
<tr>
<td>1985</td>
<td>Wilson, M.</td>
<td><em>Drawing with computers</em></td>
<td>NY: Putman</td>
</tr>
<tr>
<td>1987</td>
<td>Goodman, C</td>
<td><em>Digital visions</em></td>
<td>NY: Harry Abrams</td>
</tr>
<tr>
<td>1988</td>
<td>Em, D., &amp; Ross, D</td>
<td><em>The art of David Em</em></td>
<td>NY: Harry Abrams</td>
</tr>
<tr>
<td>1992</td>
<td>Schwartz, L., &amp; L</td>
<td><em>The computer artist’s handbook</em></td>
<td>NY: Norton</td>
</tr>
<tr>
<td>1993/97</td>
<td>Popper, F.</td>
<td><em>Art in the electronic age</em></td>
<td>NY: Harry Abrams</td>
</tr>
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</table>

6.4 Current sources of computer art literature and images

Particularly useful information sources on early and current forms of computer art include:

1. The now web-based *Leonardo*, the international peer-reviewed research *Journal of the International Society for the Arts, Sciences and Technology*. As the *Leonardo* information section explains, the journal was founded in 1968 in Paris by kinetic artist and astronautal pioneer Frank Malina who lead the UNESCO’s division of scientific research before pursuing an interest in kinetic art. Malina recognized the need for a journal that would serve as an international channel of communication between artists, with emphasis on the writings of artists who use science and developing technologies in their work. *Leonardo* now seems to be the leading on-line journal that relates to the application of contemporary science and technology to the arts, especially as it comprises English translations of the work of computer artists, theorists and commentators from numerous countries.
2. The *Digital art museum* (DAM) initiated by Wolfgang Lieser in Berlin in 1998 as a joint research project between the London Guildhall University and two independent galleries, one in London, and the other in Wiesbaden Germany with the aim of becoming the world’s leading online resource for the history and practice of digital fine art (Lieser, n.d.). DAM exhibits the work of leading computer artists, mainly those within the 1956-1986 timeframe who are characterised by their engagement with early computer technologies for image production, where the technologies include both analogue and digital circuitries, and may only remotely resemble modern digital computers (e.g., King, 2002). However, as DAM is an on-going research project, at the time of this research it was not possible to ascertain a complete list of computer art pioneers. Yet, DAM provides a wide range of background information including biographies, interviews with relevant practitioners and theorists, and essays by artists and theorists specially selected to place the works in context. In many instances the information is presented through special arrangement with the aforementioned *Leonardo*. There is also a history section that chronologically lists key events and technology developments.

3. The Victoria and Albert Museum (V&A) has an equally notable web site specific to computer art, which includes a comprehensive list of readings, and computer art terminology. The main worth of its curatorial scope resides in its presentation of works on paper, such as plotter drawings, screen prints, inkjet prints, laser prints and photographs by early computer art practitioners who were working in Britain, France, Germany, Spain, the United States, Japan and South America, in ways the belie the view: “The myth of computer art is that it is a visual art” (Youngblood, 1983, p. 94). As Victor Acevedo (2003) posits:

> Where is this art? Where are all these artifacts? I sure would love to go to my local art museum and see a collection of this work on “permanent” display. And I’d like to see these pioneering artists get recognized…. Too few, so far, have gotten enough play, so to speak. (p. 4)

### 6.5 Defining computer art

Computer art is a broad term describing work created with computers as a medium used from around the late 1950s where artists used the computer in a variety of ways without privileging any one particular aesthetic. As artist Ruth Leavitt (1976) argues:

> It is obvious some people have a stereotypical image of computer art, but actually, there is no such thing as ‘computer art’. Different artists use the machine in different ways to produce different types of art. (p. 45)

Others hold that attempts to precisely define computer art causes continuous uncertainty over what computer art is: “Because the computer was a variegated technology, any concept associated with its explication had difficulty sustaining competing articulations … computer art
tends to be an elusive concept that frustrates and defies “the powers of definition” (Taylor, 2004, p. 7). Moreover, right through the history of computer art, the morphology and pace of technological developments, and consequent succession and out dating of art forms, is known to challenge art theorists, artists and educators (Franke, 1985). In short, the computer art medium changed drastically in a short time span compared to traditional art practices that largely maintained their form and purpose for many generations.

Fundamentally, the visual form is seen on a computer screen, and may now usually be printed as hard copy artwork. Alternatively, computer-based images might incorporate elements of movement to be viewed on screen, with the option of printing still images. A range of other images can be scanned via specific programs to be manipulated in various ways on the screen. In the widest sense, computer art is created with the help of a computer. In a narrower sense, the term indicates a more specific style of artwork created by artists, programmers and engineers from the 1950s to through to the mid 1980s (V&A, n.d.). The early computer art literature often uses the term ‘computer graphics’ – coined in the 1960s by William Fetter, an engineer with the Boeing Company in Renton, Washington, (e.g., Reichardt, 1971). In the strict sense this denotes computer use for utilitarian rather than aesthetic purposes. However, the art critic and curator Jaisa Reichardt (1971) notes that although computer-generated art is conceptually linked to computer graphics in the industrial sense, it is often difficult to distinguish whether computer images were produced for utilitarian or aesthetic purposes. Both types focus on solving problems with much the same processes and media, but many of the graphic images created for practical reasons have such high visual appeal that they might be thought to be the product of artistic intent. Similarly, Franke (1985) reveals, the history of computer art and computer graphics is imperceptible. However, computer art theorist Jonathan Benthall (1972) considers the term ‘computer art’ is preferable to ‘computer graphics’ as it avoids confusion between the traditional meaning of ‘graphic arts’ or ‘graphic design’. Therefore, the term ‘computer art’ is used in the following discussion unless referring to a specific author’s focus.

According to Frank Popper (1997), there is a basic distinction between two dominant domains of computer art. Both employ computers to assist with image creation on the screen, but the focus of one is on two-dimensional images, whereas the other involves images based on algorithms for creating three-dimensional effects. Further understanding of the varied modes of computer visual art can be drawn from an analysis of computer art categories by Candy et al. (2002). A full explanation of these categories is not essential within the context of this thesis a basic summary of their page three discussion follows:
1. Static – The art object does not change and is viewed by a person. There is no interaction between the two that can be observed by someone else. The artwork itself does not respond to its context. This is familiar ground in art galleries where consumers look at a painting or prints.

2. Dynamic-Passive – The art object has an internal mechanism that enables it to change or it may be modified by an environmental factor such as temperature, sound or light. The artist specifies the internal mechanism, and any changes are entirely predictable. Sculptures that move according to internal mechanisms and also in response to atmospheric changes in the environment fall into this category. The viewer is a passive observer of this activity performed by the artwork in response to the physical environment.

3. Dynamic-Interactive – All of the conditions of the dynamic passive category apply with the added factor that the human “viewer” has an active role in the changes in the art object. For example, by walking over a mat with sensors attached to lights operating in variable sequences, the viewer becomes a participant that influences the process of the work. Motion and sound capture techniques can incorporate human activity into the way images and sounds are presented. The work might react to human movement by changing a kaleidoscope-like image and making music at the same time in direct response to the viewer’s movements.

4. Dynamic-Interactive (varying) – The conditions for 2 and 3 above apply, with the addition of a modifying agent that changes the original specification of the art object. The agent could be a human or it could be a software program. The performance of the art system is not predictable as it depends on the history of interactions with the work. In this case, the artist from time to time updates the specification of the art object or a software agent and automatically modifies the specification (p. 3).

6.6 Origins of computer art
The first of three phases of computer art is positioned between 1956 and 1986. But, the actual origins of computer art are traced back to 1950 when Ben Laposky, a mathematician/artist in the USA composed Electronic Abstractions by using an analogue computer and a cathode tube oscillograph – an electronic instrument that uses a cathode ray tube to show the wave shape of an electrical signal, and then in 1956, composed a coloured electronic image (e.g., Davis, 1985; Reichardt, 1971). One of the earliest electronic works in the Victoria and Albert Museum collection is Laposky’s ‘Oscillon 40’:
John Whitney, American artist/engineer whose work appeared soon after Laposky’s, comprises a series of intricate circular abstractions denoted as Premulations, is described by the artist, art critic and pioneer of computer art Douglas Davis (1973) as, being aesthetically more pleasing than Laposky’s. Whitney who later became an artist in residence at the Los Angeles IBM establishment in 1966, where he accessed advanced equipment and information (Davis, 1973) is acknowledged as one of the visionary computer art animation pioneers (e.g., Taylor, 2004). Whitney’s work, which was created on a homemade analogue computer built from a surplus anti-aircraft gun detector, was based on artistic rather than practical intentions. From his earliest experiments with computer graphic systems, Whitney balanced cutting edge use of technology with a strong sense of artistic control and integrity, and believed that:

The compositions at best are intended to point a way toward future developments in the arts. Above all, I want to demonstrate that electronic music and electronic color-in-action combine to make an inseparable whole that is much greater than its parts. (Whitney, n.d., p. 1)
6.7 Key phases of computer art

The following is a summary of Leiser’s (n.d.) description of three key computer art phases coupled with insights mainly drawn from the work of King (2002), the afore mentioned Victoria and Albert website, and the writings of Alvy Ray Smith III (1997), an American engineer and pioneer in computer graphics who co-founded the animation studio Pixar with Edwin Catmull and Steve Jobs in the 1970s:

Phase 1: 1956-1986 The Pioneers

During this period it was stated that: “Man is creating in our time new tools and methods at a rate unmatched in the past” (Davis, 1973, p. 16). Indeed many artists were working with mechanical devices and analogue computers in a way that can be seen as a precursor to the work of the early digital pioneers who followed. The pioneers of digital art were not all primarily artists, but their visual explorations were crucial to the emerging medium. The writing of the first aesthetically orientated computer programs, by engineers and artists was central to most of the work during this period. The start date of 1956 of this phase actually marks the beginnings of computer art experiments by a third early pioneer, the aforementioned Herbert Franke, and in some sense also the beginning of a movement. Franke, started generating works of art using computers in the 1950s, was intrigued by the possibilities of machine-supported graphical creation. He made an important scientific contribution to the understanding of the aesthetic mechanisms by concentrating on the aspects of information and reception theory that are relevant in the borderland of art and science. His pioneering electronic abstractions paralleled those of Laposky, leading however to his own distinct and varied computer art oeuvres (e.g., King, 2002).
Three particular features apply to this period:

First, early computer artists, particularly during the 1960s and 1970s, used interactivity, arbitrariness, algorithmic expression, dimensionality, transformations, motion, heuristic techniques and other inventive aspects of computer production in their work. These features of computerised expression conveyed art ideas that were part of their time (e.g., Prince, 2003).

Second, the artwork was created during a time-frame spanning up to 26 years before the Apple II was introduced; 30 years before the first IBM PC; 32 years before the adaptation of TCP/IP protocol for ARPANET; at least 38 years before the development of HTML; 42 years before the first WWW graphical browser (Mosaic, 1993) and 44 years before the DVD emerged as an industry standard (e.g., Acevedo, 2003). Third, with respect to the United Kingdom, the first possibilities for students to study computer programming as a part of their courses in the fine art only occurred in the late 1960s (e.g., Brown, 2003). By the early 1970s many interdisciplinary programs had emerged, including the Slade School of Fine Art at the University College London, which received a bequest from alumni Eileen Gray for: “a Data General Nova 2 minicomputer system for their new Experimental and Computing Department” (Brown, p. 2).

Fourth, Prince (2003), an American art historian, who encourages new digital artists to engage with the history of computer art as a key to understanding relative contemporary research and art practice, explains:

> Program or perish became the call of the digital avant-garde in the 80s, similar to the intellectual battles fought in the 19th century between artists who were Colorists versus the Classicists - Ingres versus Delacroix. (p. 1)

Phase 2: 1986 - 1994 The Paintbox Era

In this period art software became available, albeit slowly at first, attracting artists who could create works without programming. Thus, emphasis moved from computer programming to the use of the emerging principle software ‘paint’ programs, underpinned by affordable computers and devices such as the scanner and film recorder. Hence, the view that: "The future of computer graphics will address aesthetic, social, and cultural issues of computer-generated imagery, a major vehicle of communication in the 21st century" (International Society for the Electronic Arts, 1992, p. 1). King (2002) describes three historical landmarks of this period.

First, BBC TV broadcast a series Paintings with light which followed a group of celebrated modern painters who managed the Quantel Paintbox – a pioneering television graphics paint system. Second, Andy Warhol created works with the Commodore Amiga, including self-portraits and portraits of singer Deborah Harry. Third, 1986 was the year in which Adobe Photoshop was produced, but not yet released on the market. Current software such as Adobe Photoshop, Composer, and Corel Draw are noted as being the ‘heirs’ of the paint programs developed during this time (Smith, 1997). Although Photoshop was released for Macintosh (US)
in 1989, since this time Adobe earnestly sought to make their software products function identically, regardless of which operating system is used.

The end of the era is marked as being the year when WWW became available to artists on a global scale (e.g., King, 2002). The following is an image created during this phase by a notable early computer art practitioner, Paul Brown, now residing in Australia, who studied at the Slade School of Art, University of London from 1977 to 1979. His computer-generated drawings integrate individual elements that evolve or propagate in accordance with a set of simple rules. Brown developed a tile-based image generating system. “Despite using relatively simple forms, it would have taken a long time to write a program to produce a work such as this” (V&A, n.d.).

![Image removed due to copyright restrictions.](image-url)

*Figure 7: Paul Brown 1975 'Untitled computer assisted drawing' (V&A, n.d., Museum no. E.961-2008)*


The multimedia era is characterized by an increase in technology and Internet access allowing the digital media artist interactivity with many art forms. The widespread availability of computers and software allowed digital artists to create distinctive works of art. For instance, by combining and transforming the traditional modes of art practice such as drawing, painting, photography, animation and filmmaking. With the growing availability of technologies of interactivity and Internet access, there is both a democratisation of the medium and new interactive and online art forms (e.g., King, 2002). This phase encompasses artists from 1995 onwards who are defined in terms of new and emerging talent. Although during and beyond this period, the term 'computer art' is used with reference to computer-based art practices in
general, recent literature suggests that term should be understood as being separate from that of digital art. This implies a much freer use of technologies. Aspects such as connectivity or interactivity often play a key part in contemporary digital or new media art, but were less a part of the vocabulary of the early technology (e.g., Rush, 2005; Wands, 2006). The following is a table of early computer art practitioners as indentified from Leiser’s Digital Art Museum, and a search of individual artist’s web sites:

Table 4: Computer art practitioners’ timeline

Image removed due to copyright restrictions.
6.8 Original concepts in computer art

Scientists and mathematicians predominantly fuelled the initial concepts in computer art primarily as they alone had the requisite knowledge to generate programs and access to essential resources. That is, only the scientists at industrial and university scientific research sites gained access to mainframe computers, the only computing resource available at the time. Second, as there was no real interactive software, the need for the scientific programming expertise of the engineers or scientists was clear. Third, as the process of generating computer-based art was essentially algorithmic in nature, and not necessarily in accord with the way traditional artists inherently think, traditional artists were reluctant to regard computer-based compositions as an acceptable art form (e.g., Reichardt, 1971).

Notable cases of engineers’ involvement in computer-based visual work pertain to the 1960s when K. Alslenben in Germany, and the aforementioned Fetter in the USA, created computer graphics. Fetter, one of the earliest exponents of computers for artistic purposes designed a computer program and used a plotter to draw pictures on paper with various pens controlled by digital monitors and generate a series of grey scale drawings (e.g., Franke, 1985, pp. 102-103). These represent people within an aircraft and various airport perspectives seen by a pilot preparing to land. Although these drawings had specific scientific goals, their striking aesthetic features ensured they were seen in the context of computer art. Fetter was inspired to explore his visual communication by the characters punched on IBM cards that have an unprecedented similarity to Babylonian characters (e.g., Reichardt, 1971).

![Image removed due to copyright restrictions.]

Figure 8: William Fetter: 'Boeing computer graphic: Two 50 - percentile pilots in a cockpit 1968' (Reichardt, 1971, p. 16).
Numerous other engineers recognized as computer art pioneers include, K. C Knowlton and M. R. Schroder (e.g., Franke, 1971; Reichardt, 1971) of the USA Bell Telephone Laboratories research team who during the 1960s seemingly came to work with computer art by chance. But collaborations between artists and scientists began, and in many cases flourished. In fact, as seen in the influential cluster of activity at Bell (e.g., Noll, 1993), it was the technology that drove the early computer art experiments as much as the artistic influences of prevailing art movements. Bell in particular, had an open research strategy that encouraged explorations between artists including Lillian Schwartz and engineers, such as Noll who were among the pioneers of digital art that emerged through collaborative ventures.

Although Schwartz was a traditional artist, she held consultancy positions at AT&T Bell Laboratories, IBM's Thomas J. Watson Research Laboratory and Lucent Technologies Bell Labs Innovations. Independently, and with leading scientists, engineers, physicists, and psychologists, she developed techniques for the use of the computer in film and animation (Schwartz & Schwartz, 2001). In addition, Schwartz, whose computer art was the first in this medium to be commissioned by the Museum of Modern Art in 1984 (Preble & Preble, 1994), contributed to scientific research in visual and colour perception, and sound, and became a Fellow in the World Academy of Art & Science and a committee member of the National Research Council Committee on Information Technology and Creativity under the Computer Science and Telecommunications Board of The National Academies (Schwartz et al., 2001).

With respect to Noll, King (2002) explains, that he typifies the computer professional who took an interest in art and produced computer-generated works, rather than the artist who took up the computer. During his time at Bell, Noll programmed a digital computer to generate visual patterns solely for artistic purposes, and simulated paintings by Piet Mondrian and Bridget Riley (e.g., Dietrich, 1986). Noll is also credited as being not only one of the earliest engineers to recognise the artistic potential of computer technology, but also as being one of the most articulate exponents on the topic and one of the few who engaged in computer art from a technological perspective. Noll argued that: “other than sharing his methods, the engineer has no place in the “creative activity generally called art” (Reichardt, 1971, p. 25). Although Reichardt (1971) notes that Noll’s purpose in producing computer art was specifically to alert artists to new possibilities rather than practicing the art himself, Taylor (2004) contends that Noll refers to himself as an artist by means of several of his explorations and in instances of seeking to be copyrighted as an artist-programmer. Several of Noll’s images are shown by both Reichardt (1971) and Davis (1973) who explain that Noll provided artists with examples of the way in which elements of order and randomness could be aesthetically combined in computer
art. The aforementioned German mathematicians Nake and Nees, and several people in the USA created other computer graphics independently, but almost concurrently in 1965 (e.g., Franke, 1985; Popper, 1997; Reichardt, 1971).

Importantly, in the early 1960s computers were still in their embryonic stage, cumbersome and extremely expensive hence for practical reasons, the prime centres of the computer art movement were not art departments or schools of art, but research departments within industries, universities and computer companies. Although several art departments of large universities accessed the university’s computer, technical personnel, and computer peripherals acquired specifically for their use, this was an exceptional rather than common situation (e.g., Reichardt, 1972). As the first generation software lacked a user interface – icons or a mouse, after programming, images were output through the use of plotters. At first this only facilitated the simplest of drawings, but towards the end of the 1960s, some plotters managed exceptionally complex responses. That is, one of the main sources of output was the plotter, a mechanical device that holds a pen or brush and is linked to a computer that controls its movements (e.g., Wands, 2006). The computer guided the pen or brush across the drawing surface, or, alternatively, moved the paper underneath the pen, according to the computer program directed instructions. This meant computer systems could "add precise detail and perspective to any drawing or create with the aid of statistical information, detailed graphs and charts, translating verbal and mathematical factors into visual displays" (Davis, 1973, p. 98).

In the absence of ‘user interface’ and little pre-existing software, through creating their own programs, artists and computer scientists were able to experiment with the computer’s creative potential. Other than that, as the concept of user-friendly applications was still a distant construct, most artists needed to establish programming skills. Evidently, the resultant artwork owed much to the traditions of Constructivism and, the then popular, Systems Art that was the dominant aesthetic in many European postgraduate programs like that at Slade (e.g., Brown, 2003). Programming for artistic work entails understanding computer language in order to master its tight rules of syntax and structure. Thus, just as traditional artists strive to understand their material, programming for artwork demands knowledge of computer material and mastery through practice and application. This involves a meticulous approach and thorough understanding of the structure and grammar of the code that can be likened to that of traditional artists (e.g., Richardson, 2006). For instance, Lillian Schwartz’s work involved developing data bases containing information on colour palettes and structures of paintings, sculptures and graphics by artists such as Picasso and Matisse which she used to analyse the choices of those artists and to investigate the creative process itself (Schwartz et al., 2001). In keeping
here is Franke’s (1985) view: “The reproach that computers are replacing creative activity is unacceptable to those who are familiar with programming” (p. 163).

6.9 The meaning of the technological developments for artists

The technological advances during the 1960s that extended the computer’s potential for creative practice included some moves from analogue to digital computer systems, smaller components, and increased storage capacity, lower cost hardware and increased flexibility of the computer (e.g., Benthall, 1972; Franke, 1985). Other advancements that provided vast changes to the previous off-line mode of punch cards, involving slow mechanical graphics, were seen as having opened up exciting aspects of computer technology to the visual arts, including improved colour, dynamic display and interactive use of graphics (e.g., Franke, 1985). The advantage of such advancements for art practice is variously described, but overall the proponents of computer art believed that rather than replacing traditional media, computers could transcend them by offering artists the possibility of processes, which would otherwise be very difficult. For Rockman et al. (1964) an important influence on artists’ attitude to working with computer technology is that their joy of the creative effort “inheres, not only in the completed object, but also in the actual work, in the struggle with recalcitrant material. To the artist … the means is also part of the end” (p. 367).

In Reichardt’s terms (1971) computers captured artists’ imagination and inspired the pursuit of particular idioms, styles and forms of art, and Davis (1973) saw that: “The computer represents the ultimate creative tool for the artist-engineer-scientist, the ultimate fusion” (p. 97). Yet, he stressed that the artist’s creative spirit must be at the heart of the fusion, and recalled that Nicolas Schöffer, Hungarian-born French artist and “father of cybernetic art”, stipulated that each artist’s: “creative imagination” (p. 121) is central to the aesthetic use of technology. In keeping with these perspectives, media artist and educator, Richard Wright (1988) writes:

> It has been suggested that we can either use the computer in a premeditated way for a particular end like any other medium or tool, or else leave it to operate without human interference as much as possible, presenting the results later, for the viewer to provide semantic content. But we cannot unload our artistic responsibilities onto the computer quite so easily as this. If we agree that art is a language and that its functioning depends on our sharing a common cultural context, then we must concede that an artist and his or her public do not operate in isolation from one another. (p.116)

Accordingly, Benthall (1972) contends: “The posing of riddles like: “Can machines be creative? Or are computers merely tools? Can be a waste of time, though many miles of print have been devoted to them” (p. 45). Resonating here is Nake’s (2005) recollection of Max Bense’s aim to preserve the integrity of human creativity when he coined the term ‘artificial art’ in the early
1960s. On one occasion, Bense described the artistic process with reference to Nees' work:
“The machine had been controlled by a paper tape that had before been calculated by a computer, which was, in turn, controlled by a program written by Nees. But the machine was certainly not creative” (p. 54)

In urging artists to express their own inventive spirit in the technology of their era and to find their own historical and individual level of creative being, Lillian Schwartz (1975) writes:

The computer can act as an intelligent being: process information, obey intricate rules, manipulate symbols, and even learn by experience”. But, as it is incapable of initiating concepts, it cannot be truly creative. “It has no access to imagination, intuition, and emotion. (p. 1)

Schwartz (1975) also describes her journey from a traditional art background where she studied free-hand drawing at the University in 1948-1949, oil painting in St. Louis, Missouri, watercolours and woodcuts in Fukuoka, Japan and finally came to the New York area in the 50’s and continued to study art. Her intense interest in new materials and its stimulus to the creative process, is explained thus:

The awesomeness of such a tool places the artist in quite a humble position. There is a necessary kind of readjustment for the artist for here is a medium that may take some of the burdens from the artist. To find the real justification for the use of the computer by a painter would be to shift the emphasis by stimulating a new angle of approach; to maybe relieve the formal elements of some of the conscious emphases which are necessary and place more stress on content…. The computer has ... assisted me in the visualization of sculpture in three dimensions. Programs can be used to rotate sculptures, to view them stereoscopically, to place in a given site – all before any execution has taken place. (p. 1)

Schwartz (1975) equally underlines the need for high-level thought in composing computer-based images, especially as great care must be given to the selectivity of elements. With respect to her own experience, she says this includes editing images into their final form and making decisions as to which of the many elements are brought out of their general order, out of their appointed array, and raised together to a new order and form:

It seems clearer that the results of this medium may well fall into direct ascendancy of the hieratic forms of Seurat and the mosaics of Byzantium. The artists in India also worked from set Sudras. Even among the more recent artists Delacroix, Cezanne, and Matisse, the same desire for system and regularity for an ordered universe seem to dominate. (p. 1)

Franke (1985) believed computers reduced the need for artists’ manual skills, and so defied the traditional notion of manipulating materials by hand. In describing the “incredible achievements” amidst the computer revolution in the 1960s, he predicted further aesthetic capabilities of computer technology. He also referred to the initial rather primitive visual images being created
at the MIT Lincoln Laboratory, as being a clue for artists as to the future possibilities of this medium, and believed that: “The irruption of the computer in the sphere of the arts; for the first time it has become possible to insert a mechanical aid into the creative phase of artistic production” (p. 1). Above all, it signified the adaptation of:

The machine to man, not vice versa…. While the static computer picture was still a realization in line with the usual forms of representation in the fine arts, computer graphics now became the instrument for a form of artistically created sequences … allowing free graphical play with colors and shapes…. Thus, even free improvisation is surely the most stimulating form of artistic activity. (p. v)

Artist Ruth Leavitt (1976) writes that her computer use did not entail relinquishing her traditional role as artist because the ‘machine’ acts as a multifaceted tool, which she controls. Although when she began to use the computer she had no knowledge of programming, after taking a course on Fortran she understood how the machine processes information, thereby gained control over her work. While she does not actually code her programs, she knows what to ask for and how to ask for it. Consequently, the machine allows her to create artworks that would probably be impossible to produce in any other reasonable way:

With the aid of the computer I can now explore areas which artists in the past only thought possible to dream about…. It is the option to create one’s own work tools, which, in my mind, makes computer art unique. A new role is now open to the artist in addition to the traditional one of making objects. (p. 1)

6.10 Differences in artists’ approaches to computer implementation

In keeping with the view that different people make the computer their own in their own ways (e.g., Leavitt, 1976), Candy et al.’s (2002) study of early computer art confirmed that the final artworks remain the province of the artist’s decisions: “For each artist, the particular points in the creative process when he chooses to interact with the computer language and the outcomes it generates, are different” (p. 4). Leiser (n.d) points out that the variance of artists’ approaches to computer technology applies to those who have worked either within one phase or across the three phases of computer art. Benthall’s (1972) research of early computer art reveals that artists’ approaches to the computer differed in two fundamental ways. Some based their work on traditional supports, and others used the computer as primary support for their conceptual work where the computer represented a pragmatic means to an end.

Decades later Popper (1997) adds that some artists use the computer as “a tool, a canvas or an extensive palette” (p. 78). For others, involvement with computers stimulated forward moves in conceptual thinking – to reformulate the boundaries of their artistic scope, and to see the challenges inherent in working with computer technology as a strong influence in breaking with
their existing conventions. For some artists the computer: “possesses capabilities analogous to human intellectual processes and may even be considered as a creative entity in its own right ... for some of these artists, science acts as a creative catalyst” (p. 83). As Yoshiyuki Abe (1992), a Japanese pioneering computer artist, who not only practiced the art, but also researched the topic extensively, stated: “Computers have opened up a new universe of artistic possibilities, pushing back the boundaries traditional artistic technics placed on the artist's imagination” (p. 1).

Consonant here is Ihde’s (1990) concept: “A double sense in which technology may be used ... that it might be used simultaneously both as something through which one experiences and as something to which one relates” (p. 93). Ihde also acknowledges that while some artists with firm reputations in traditional media made long-term moves to the computer art field, there were those who only worked with computer technology on a one-off basis. Benthall explains (1971) that many artists simply preferred traditional media because of the familiarity of technologies that have been absorbed into traditional art practices. Traditional practices not only usually allow artists more independence and control than computer applications, but also accord with established styles and conventions that provide a familiar art practice framework. Therefore, artists were not typically prepared to relinquish a hand crafted-aesthetic (e.g., Leavitt, 1976).

Irrespective of differences in artist’s individual approach to computer technology, even when artists work in vastly diverse art forms a notion of artistic unity exists through the force of the creative impulse, inspiration drawn from science and nature, and the continual pursuit of technical and aesthetic excellence (e.g., Popper, 1997). As Marshall McLuhan (1964) stated: “The serious artist is the only person able to encounter technology with impunity, just because he is an expert aware of the changes in sense perception” (p. 33). Implicit here is that although, computer art was not generally regarded as art in the conventional sense, the principle of aesthetic value applies to all work created with artistic intent. As all artists need to engage with and understand their material, artists who create digital artefacts share much in common with other artists in that the material may change, but the underlying ethos and attitude is much the same (e.g., Richardson, 2006).

6.11 Artist/engineer nexus
The artist-engineer might signify a paradox, yet Davis (1973) confirms that the artistic applications of computers are specifically attributed to the early amalgamation of science, technology and art during the 1960s, involving traditional artists and computer specialists. In extolling this symbiosis, he refers to his conversation with Nicolas Schöffer, a key proponent of
artists and engineer collaborations, who believed that art could add to the evolution of new technology through its extraordinary conceptual freedom, which has always permitted it to escape mundane pressures. Davis (1973) also asserts:

Leonardo felt no hesitancy in assuming the engineer’s as well as the artist’s role. He … constructed field guns, flying machines, and kinetic theatres. It is not accidental that our time, which is post-industrial in nature, thanks to the computer, is witnessing a rebirth of the artist-engineer. This rebirth had to await the passing of certain well-founded anti-machine attitudes. (p. 16)

Another notable computer art proponent Charles Csuri, was exceptionally active in computer art, and unlike many artists who relied heavily on the support of engineers he designed his own systems (e.g., Reichardt, 1971). Even so, he worked with colleague James Shaffer, a computer programmer to highlight the inherently rich scope of computers to support visual modifications, including abstraction and successive de-structuring of images (Franke, 1985, p. 105). Their collaborative Sine Curve Man series (Davis, 1973, p. 98), achieved the 1967 Computers and Automation Computer art contest prize for its sequences of fine line tonal drawings based on the mathematical sine curve concept.

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By contrast, Csuri’s other early works comprise particularly fluid images. These include Hummingbird -1967 a ‘still’ from a computer-generated film, again in fine line grey scale mode (e.g., Davis, 1973, p. 103), and Computer Generated Drawing -1970 (Davis, 1973, p. 64). Reference is also made to Csuri’s Computer Sculpture, a series of three dimensional computer drawings of four perspectives of one surface (Reichardt, 1971, pp. 38-40). In the same period Csuri’s combined work with engineer Ivan Sutherland, transcended several computer art genres (e.g., Davis, 1973). With the support of a Natural Science Foundation grant, their work
advanced from the creation of ‘still’ computer images to those with movement. As Davis (1973) recalls, Csuri, whose drawing routine was designed with an “artist in mind rather than an engineer” (p. 35), explained: “I can draw on the display tube, and move my drawing around…. I can turn any form over and around, watch countless options, instantly…. the moment of creation and editing become one” (p. 102).

The broad premise behind the artist and engineer collaboration was that the artists and scientists needed to learn how to work together (Davis, 1973). Another crucial factor was the artists’ background in art discipline knowledge, and an awareness of the creative potential of computer technology as indicated for example, by Sonia Landy Sheridan’s successful shift from her traditional art background towards computer art in the late 1960s. Sheridan worked with technology designers to develop electronic tools specific to her creative visions, and is perhaps best known for her experiments in the 1960s with the emerging forms of imaging, and as the founder of the Generative Systems program at the Art Institute of Chicago (e.g., Preble & Preble, 1994). Another interesting example pertains to Lillian Schwartz who, as mentioned earlier, worked with the Bell engineer Kenneth Knowlton who developed computer images from her original paintings. In this context, several of her ‘traditional art’ art media portraits and still life compositions, were replicated as grey scale computer images (Reichardt, 1971, p. 25). Schwartz, who described these as examples of “technological pointillism” (Reichardt, p. 23), saw the computer as something that can merely compliment the material provided in the first place by the artist (e.g., Preble & Preble, 1994). Decades later Schwartz, who is now in her eighties, explains her initial exploration of pointillism, to Leo Kent (2012):

Some of my artist friends wouldn’t accept the computer, they thought you sat and pushed a button and stuff spills out. In order to explain the connection to the art world, I went back to Seurat and I coined the term ‘Technological Pointillism’ where you use dots of colour and from a distance you saw one thing and up close another. (Kent, 2012, p. 1)
Knowlton, writing in 1970, explains:

I expect art to come from artists or artists working closely with programmers – I do not expect much art to come from programmers alone, solely by virtue of their clever gimmicks for doing cute things. What this means in practical terms, then, is that we need to develop a great deal of collaboration between artists and programmers in order to develop meaningful, understandable, and useful sets of tools and ways of using them. (Forsberg, 2011, Para. 6)

Ken Knowlton is acknowledged for having contributed several graphics languages for animation (e.g., Dietrich, 1986), and for his work with Leon Harmon, an engineer colleague at Bell Laboratories. Here, they created the first computer nude – ‘Studies in Perception’ – 1967, which represents early experimentation in scanning and converting photographs through specific processes prior to printing (Davis, 1973, p. 99). It is indicative not only how computer pixilation of images can be create pointillism effects, but also how artists’ drawings or paintings can be manipulated more readily with computers than by hand to create multiple versions of an original concept. Importantly, Knowlton and Harmon invented the necessary scan technology to create digital images, which were output in a curious array of typo-pictography that corresponded to the originals’ levels of grey (e.g., Acevedo, 2003).
According to Reichardt (1971) artist Stan Vanderbeek (1969), also acknowledged the advantage in working with computer engineers. He worked with a variety of traditional media before the computer captured his attention in 1965. From that time he looked on the computer as a creative challenge and met a programmer who introduced him to scientific researchers working with computers. Subsequently he was tutored in programming and began to work in computer logic systems and process of image making, which he found to be: “difficult … somewhat dangerous and unpredictable … however-in time-speed-memory-ideas and forms, it is breath taking” (p. 79). Alvy Ray Smith (2001) emphasises the reciprocal exchange between artists and technologists in terms of the ‘ease’ of use of his 1970s NYIT Paint program. In this context, his collaboration with artist Paul Xander, and subsequent mutual benefit resulted directly from the requirements of Xander who, as the first principle user of the Paint program could not master the difficult menu or keyboard sequences without support. Consequently, Smith sought the simplest user interfaces he could find and found that: “This, of course, was an excellent discipline that served me well for subsequent decades…. Paul was able to paint hundreds of dazzling pictures (p. 3). Artist and mathematician Duane Palyka, who has participated in the development of computer graphics since the late 1960s, agrees that advancements in technology require a symbiotic commitment by those who make artists’ tools and artists to develop creative work programs (e.g., Deitrich, 1986; Preble et al. 1994).

While the artist/technician collaborations largely came out of necessity, Davis (1973) notes that it exemplified a concept that Gyorgy Kepes (1955), author, artist, and educator associated with the Massachusetts Institute of Technology during the 1960s, explored in his book: The new landscapes in art and science. In brief, Kepes recognized the symbiotic relationship of art and science in that each could be strengthened when nurtured by the other. In reinforcing this view Davis (1973) notes two examples of the reciprocal benefits as reflected by both an artist and an engineer. The first of the following two quotes relates to Davis’ reference to Kepes’ experience and the second to that of the engineer/artist Billy Kluver:

1. I learned to my surprise how uninitiated some scientist and engineer colleagues where when it came to the most basic values of artistic sensibility. Gradually … I came to believe that artists and scientists could be equal partners in this great transformation … By becoming involved in the artist’s imaginative processes, the scientist can discover in himself avenues of imaginative power that might ordinarily be bypassed. (p. 117)

2. The artist cannot handle the complexities of technology all by himself – even if he has proper access. For the engineer, working with the artist means taking on new, complex and interesting problems that will help increase his professional standing. A new approach always stimulates new ideas…. The collaboration is a success when the artist and engineer can see each other’s works and get stimulated by each other’s contributions. (p. 139)
Taken together, the descriptions of the aforementioned descriptions of artist’s perception of the computer as a pivotal force in their creative development, evoke the words of the renowned Russian composer, Dmitri Borisovich Kabalevski (1904-1987):

True creativity is always the unity between innovation and tradition, that is, between forging ahead, aspiring towards the future, and preserving ties with the past (p. 13). By its nature creativity is based on the desire to do something never previously done by anyone, or if it has been done before, to do it differently, in your own way, and better.... The creative principle in man is always as aspiration to advance, to achieve something better, to make progress, to perfect and, of course, to achieve the beautiful in the most lofty and widest meaning of the concept (p. 27). (Kabalevsky, 1988, as cited in Forrest, 2009, pp. 13 & 27)

6.12 Precarious collaborations

Some of the collaborations between artists and engineers prospered for many years and lead to successful accomplishments in customised art specific programs (e.g., Dietrich, 1986). However, it is also often noted that many collaborations were not without difficulty. The aforementioned engineer Ken Knowlton attributed the difficulties to two distinct mindsets. First, artists are somewhat illogical, intuitive and impulsive. By contrast, scientists are constrained logical and precise (e.g., Franke, 1971). Reichardt (1971) highlights the intricacy of the relationship between the artists and scientists is highlighted by Reichardt (1971) with reference to William Fetter’s characterization of the three essential computer art stages:

First the communicator has an idea, second, the communication specialist decides the best problem solving strategy, third, the computer specialists selects the computer equipment and deduces the problem so that it can be managed by the computer. It frequently happens, of course that the communicator, the communication specialist, and the computer specialist are one and the same person. (p. 15)

By the 1970s, a number of artists were teaching themselves to program, rather than rely on collaborations with computer programmers. Many of these came to the computer from a traditional fine art background, as opposed to the scientific or mathematical background of the earliest practitioners, but were nonetheless attracted to the logical nature of the computer and the processes involved. However, these were only people who had access to relevant resources and information while others needed to work with technologist (e.g., Candy et al., 2002). Consequently, individual efforts in computer art was dependent on support from small interest groups often sustained by having some form of access to specialised knowledge and facilities. For instance, the international organization of Experiments in Art and Technology (EAT) was founded in New York in 1966 in an attempt to establish a better working relationship among artists, engineers and industry (Schwartz, 1975), and to provide resources “not accessible to the layman” (Reichardt, 1971, p. 90).
The poignancy of the artist-engineer relationship for traditional artists was acute during the period from the mid to late 1960s, when it was unusual for artists to interact with engineers. Moreover, as many of the collaboratively created images appearing in related publications are attributed in the names of both the engineer and the artist, artists were in the unprecedented position of sharing the ownership of their work with engineers (Candy et al., 2002). In addition, Rockman et al. (1964) who, like other early computer art proponents, were disappointed by the low number of artists embracing computer technology, and the difficulties they observed with respect to collaborative activity, stated: “Collaboration and multimedia are not impossible, only extremely hard and rarely successful. But then, so is most activity of a high ambition, high risk, innovative nature” (p. 365). The challenges they mention include the difficulty of computer specialists in developing awareness of the potential contribution of the artists, and a respect for their “pattern of perceiving and pattern generating abilities, for their trained sensitivity to the exploration of novelty” (p. 365). In lamenting that engineers, mathematicians and industrial designers have carried out most of the visual design done with the aid of the computer, they concede: “Few painters and sculptors have shown any interest in this field. Perhaps their lukewarm response is a result of ignorance” (p. 365).

Evidently the challenges were excessive for many artists and engineers who, “retreated from the difficulties of operating in the no man’s land where art overlaps with science and technology” (Benthal, 1972, p. 72). In extending this point, Reichardt (1971) notes that the aforementioned Noll, a key advocate of computer art, who eventually withdrew from the field of computer art, due in one part, to disheartenment over the inability of some artists to articulate their aesthetic goals to engineers, and in the other part due to artistic results not being commensurate with the effort applied. A similar tone of disillusionment is encapsulated in a note written by a Tokyo based Computer Technique Group to Reichardt (1971):

> We must report you many things. First we dismissed our group on 1st October 1969…. The reason … is very much complexed…. One reason is that so-called collaborations of engineers and artists is not so easy as we had expected. They are different from each other. (p. 96)

### 6.13 Early computer art competitions

The initial aesthetically orientated computer graphics created with the aid of large digital computers were promoted in 1963 through the first computer graphics competition sponsored by Computers and Automation periodical (U.S.A.). Interestingly, although the selection criteria was aesthetically based, the earliest awards, judged by the previously noted Leslie Mezei
(Taylor, 2004), were received by the US Army Ballistic Missile Research Laboratories, Aberdeen, Maryland for the following three works:

1. 'Splatter pattern' in 1963, which was "drawn automatically by a dataplotter.... The pattern is actually a graph of the radial and tangential distortions of a camera lens" (Rockman et al., 1964, p. 365).

2. ‘Stained glass window’ in 1963.

3. ‘Trajectories of a ricocheting projectile’ in 1964. These anonymous works were considered as "exceptionally successful examples of digital graphics" (Franke, 1985, p. 97).

The ‘Stained glass window’ (Franke, 1985, p. 100) whose form evokes the work of Victor Vasarely, a Hungarian-born French Abstract Painter (1908-1997), one of the founders and foremost exponents of the Op Art movement during the late 1960s and early 1970s (Murray & Murray, 1983), is described as being “produced by a dataplotter from an area-filling equation whose solution was found by a computer” (Rockman et al., 1964, p. 366). It was also regarded as: “One of the first digital graphics made as an exercise in aesthetics, and generated on the principle of the “snow-flake curve” (Franke, 1985, p. 100).

Image removed due to copyright restrictions.

*Figure 11*: Unspecified artist: ‘Stained glass window’ (Franke, 1985, p. 100)

**6.14 Early computer art exhibitions**

As previously noted, artists’ uncertain efforts in using computer technology for creative purposes date back to the 1950s, yet their computer art was not shown publicly until after the 1960s period (e.g., Franke, 1971; Davis, 1973). Primarily because of its experimental nature, people with backgrounds in science, engineering, and mathematics as well as artists were
beginning to tentatively present their computer art to a “sometimes puzzled public” (Reichardt, 1971, p. 12). However, as the challenges associated with collaborative activity involving people without traditional fine art backgrounds, or conversely, no programming skills, and the fact that as an ‘outsider’ computer art was not embraced by galleries until after the 1980s the early exhibitions that indicate high commitment to innovative practice include:

1965 - January - Studio Galerie, University of Stuttgart. Work by the aforementioned German artist, Nees (Franke, 1985, p. 97).

1965 - April the first graphics exhibition in the USA, The World Exhibition of Computer Graphics, at the Howard Wise Gallery, New York, which celebrated the development of new art forms for eleven years, but closed in 1970 (Benthall, 1972). This comprised works by Bela Juez and the aforementioned Noll (Franke, 1985) who were scientists/engineers at the USA Bell laboratories (Davis, 1973). Interestingly Juez, like other technologists did not intend create fine art, but became inspired by finding the possibility of using the computer to “produce patterns of some originality and interest” (Taylor, 2004, p. 30).

1968 - The first international exhibition, Cybernetic Serendipity, at the Institute for Contemporary Art in London, instigated by Bense, and organised by Jasia Reichardt of the Institute of Contemporary Arts, London (e.g., Reichardt, 1971).

This latter exhibition, which was representative of all the pioneers of computer graphics and toured the United States and Japan, inspired many young artists to be involved with computers (e.g., Brown, 2003). By attracting worldwide attention, the exhibition illustrated that the scope of interest in computer art was international, and provoked by the unprecedented notion of working with computer media, technique, and method as distinct from an artistic ideology. Rather than exclusively concerning itself with computer work, the aim of the exhibition was to explore the relationships between technology and creativity. In Reichardt’s terms (1968): “Cybernetic Serendipity deals with possibilities rather than achievements, and in this sense it is prematurely optimistic” (p. 5). Thereby, no lofty claims were made because: “computers have so far neither revolutionized music, nor art, nor poetry, in the same way that they have revolutionized science” (p. 5). More specifically, Reichardt who believed that the computer is merely a tool which at that moment, still seemed far removed from those polemic preoccupations which concern art, states:

The possibilities inherent in the computer as a creative tool will do little to change those idioms of art, which rely primarily on the dialogue between the artist, his ideas and the canvas. They will, however, increase the scope of the art and contribute to its diversity. (p. 71)

The lasting impression of 1968 Cybernetic Serendipity exhibition (2002) is encapsulated in Brent MacGregor’s (2002) article: ‘Cybernetic serendipity revisited’ where he writes that
Cybernetic Serendipity “lives in popular legend as a seminal event in the history of computing and art”. Allied to this, MacGregor recalls that a farsighted journalist, Nigel Gosling (1968) who found the exhibition “baffling, not to say impenetrable”, wrote in an Observer article ‘Man in an automated wonderland’: “We shall look back to it one day as a landmark” (p. 1).

6.15 Growing international interest

By 1972 the computer art movement had spread to numerous countries including, Austria, Britain, Canada, Germany, Italy, Japan, South America, and USA. Interest in applying computer technology to the broader field of art had developed by the 1980s, by which time computer art had embraced many forms of traditional art (e.g., Franke, 1985). By the early 1980s many computer art events revealed a stimulating time for experimental art characterized by collaboration among technologists and artists where people with different skills and backgrounds combined their expertise to facilitate art practice (e.g., Candy et al., 2002). Nonetheless, Franke (1985) claims the centre of the earlier progress was in the USA where the following key exhibitions were held during the 1978-1980 period:

1978: Computer Generated Art Exhibit. Old Dominion University, Norfolk, Virginia.  
1979: Cybernetic Symbiosis. Lawrence Hall of Science, Berkeley, California.  

6.15 Critical reflections

The consistent range of enthusiastic perspectives regarding the early development in computer art was clearly tempered through the practitioners’ critical reflection on the aesthetic implications of the work produced. For instance, from Franke’s (1985) artistic lens, due to the brief period in which computer art has been researched, it had understandably not qualified as a well-accepted art form. Yet, he believed that there were early works that were remarkable:

Not because they surpass, or even approach, the beauty of traditional forms of art, but because they place established ideas of beauty and art in question;  
Not because they are intrinsically satisfactory or even finished, but because their very unfinished form indicates the great potential for future development;  
Not because they resolve problems, but because they raise questions and expose them. (p. ix)

Frieder Nake (2005) in reflecting on the early computer art during his involvement at the Stuttgart University in the 1960s, states: “The pure visual appearance of the drawings was not too exciting…. The challenge really came from the principle that emerged … its idea gained a new kind of power” (p. 56). Mezei (1964), who similarly argued that the early beginnings of any
endeavour may appear primitive and indeed much of the work done so far in the field of computer art may often, in itself seem hardly worth the effort, maintained:

It is during the primitive stage that the basic principles are worked out. This is true of the early history … Nevertheless. Many programs for the computer … might easily result in … a high degree of aesthetic merit. (p. 365).

Franke (1985) also asserted that compared to the innovations which the explorations of computer use for art practice brought to society, it appears to be of secondary importance whether the results of unfettered creativity with the aide of the computer are recognized as true or not. It remains a “fact that it has made clear the effects and counter effects of art, technology, and science, as no other medium did before. This is enough gain for today – and a challenge for tomorrow” (p. 167). Davis (1973) adds, that as understanding of technology increases, the questions of success or failure will diminish:

The focus of the interest will then be on the incredibly rich and varied possibilities of technology… A work of art loses its interest if it is only judged according to predetermined norms…. you want technology in its relationship with art to be adventurous rather than mechanical. (p. 139).

Reichardt (1971) agreed early computer graphics are predictable in comparison with images that also involve randomness, but which are created by hand, such as action painting. Yet she concedes that although to date, there are no computer art masterpieces, it should be considered as an art movement of unique social and artistic significance. In Leavitt’s (1976) view assumptions about computer art range from the naive belief that computers will replace human artists, to the more sophisticated belief that the Leonardo of computer art will soon come. This person would be the true universal person: “A scientist, programmer, humanist, and artist. Computer art challenges our traditional beliefs about art: how art is made, who makes it, and what is the role of the artist in society” (p. 20).

6.16 Enduring worth of the early explorations of computer art
The early computer artists who clearly encountered a range of difficult challenges are acknowledged as risk-takers whose focus on their creative pursuits took precedence over any will to be conventional in the traditional art sense (e.g., 2002; Wands, 2006). As Popper (1997) states: “It is the artistic creation and aesthetic exploration that concerns technological artists more than the production of finite works of art” (p. 181). Nonetheless, many of the early images, reflect not only skilful use of cumbersome drawing devices – plotters of the time, but also the fact that the artists sought inspiration and aesthetic cues from the work of acclaimed traditional artists. For instance, the worth of Laposky’s work was noted nearly thirty five years after its creation: “Even today, the images created by Laposky, which he termed oscillations or electronic abstractions, remain consummate achievements, and even with contemporary
instruments, a substantial improvement is hardly conceivable” (Franke, 1985, p. 97). Charles Csuri’s Leonardo da Vinci ‘inspired linear interpolations’ (1965), and his ‘Sine curve man’ (1966-69) were also recognized decades later as having manifested a fluid and subtle intuition (e.g., Acevedo, 2003). Likewise, Noll’s (1965) Computer composition with lines, an algorithmic simulation of Piet Mondrian’s painting Composition with lines (Franke, 1985, p. 160) is considered as being among the notable artworks of the time (e.g., Acevedo, 2003; Schwab, 2003). Nake’s (1968) Hommage à Paul Klee is another example of algorithmic simulation. In both cases the timeless artworks were used as a starting point of investigation of stylistic regularities, which were then incorporated into computer programs (e.g., Franke, 1985).

The enduring worth of other computer artists is also appreciated in ways that resonate with Zimmerman’s (2009) view: “Creative people frequently do not fit into a domain, and only after sustained effort and time are their accomplishments recognized and valued” (p. 386). These include Nees’ plotter-based piece, ‘Cubic disarray’ (1968), described as “a poetically elegant computer graphic rendering of order and chaos” (Acvedeco, 2003 p. 8). This particular artwork, and Nees’ ‘Maze’ created some time before 1971 are regarded as aesthetically based works that underlie the reciprocal relationship between art and mathematical concepts (e.g., Franke, 1985). They also evoke the interdisciplinary work of the Dutch artist Maurits Escher who explored maths and art concepts, predominantly through traditional print making processes such as woodcarving and lithography (Escher, 1974). For instance, as the American artist and computer graphics consultant Frank Deitrich (1986) notes Manfred Mohr’s work centred on the cube and concisely devised successive transformations that modified an ordinary cube.

Figure 12: Frieder Nake: ‘Hommage à Paul Klee’ 1965 (V&A no. E.951-2008).
“The complex set of possible transformations was then plotted, and the transformations were displayed simultaneously as a single image” (p.166). Other examples of computer art with maths concepts include, Ruth Leavitt’s 1975 *Diamond variation 1*, and 'Circle' by Julius Guest of RMIT, which is characteristic of early computer use for synthesising mathematical and aesthetic concepts including line, shape, repetition and symmetry and repetition.

*Figure 13: Ruth Leavitt: ‘Diamond variation 1’ 1975 (Franke, 1985, p. 75)*

*Figure 14: Julius Guest: Circle in seventeen parts (Franke, 1985, p. 35).*
Also of interest is the link between visual arts concepts and the computer based work of French American mathematician Benoît Mandelbrot in 1975 who coined the term ‘fractal’ based it on the Latin frāctus meaning ‘broken’ or ‘fractured’, in extending the concept of theoretical fractional dimensions to geometric patterns in nature.

Image removed due to copyright restrictions.

*Figure 15*: Benoît Mandelbrot: ‘Apfelmännchen’, illustrating a mathematical connection in the field of Julia sets (Franke, 1985, p. 78).

**6.17 The controversy**

Despite the progress made during the early phases of computer art, the practitioners’ achievements were not at all universally appealing. As King (2002) notes: “Computer art has never been mainstream and has also been dogged by its association with the non-artist and art-naïve practitioner from the computer sciences” (Para. 4). Allied to this, Benthall (1972) recalls that Maurice Tuchman (1971), an early observer of computer art, claimed that the concept of art and computer technology held low appeal for traditional artists and spectators, and described Kitaj, a highly regarded traditional artist, as “feeling utter boredom when ever art and science try to meet” (p.16). Cynthia Goodman’s (1987) discussion on the uneasy liaison between technology and art attests that, most artists considered that the medium failed to prove itself to be “accessible or refined enough to venture into” (p. 25). For Henry Clauser (1988), editor of the *Research Technology Management Journal*, computer art: "lacked the vast bank of styles and images built up in the conventional art disciplines" (p. 116). Similarly, Michael Rush (1999), in *New media in the late 20th century*, considered that the “aesthetic bar” (p. 172) of computer art was only raised enough around the mid 1990s for it to warrant any mention.
As a result of such negative responses, the New York Howard Wise Gallery, which had been prominently supportive of computer artists closed in 1970 due to lack of public support (e.g., Benthall, 1972). Benthall agreed that aside from a few notable exceptions, artists were not yet making remarkable advances in new media: “But there is not much good art about in any medium” (p. 16). However, he concluded that initial work created in any new medium is bound to be good in that it sets its own criteria rather than being subject to conventional standards of good art. He also acknowledged that early technology exhibitions were often undermined by technological problems that were beyond the artists’ control.

The negative tenor was not confined to the United States. Evidently, the artistic community in West Germany reacted to computer art exhibitions with distrust, “even unrest” (Taylor, 2004, p. 32). Interestingly, Kepes’ (1965) overall observation that traditional artists miss the possible vital connections with the contemporary intellectual and technological reality because “they come together in small groups in the safety of little circles that shut out the rest of the world” (p. 121) parallels Nake’s (2005) reflections on an event hosted by Max Bense:

> On the 19th of February 1965, the first exhibition worldwide of digital art — as we would call it today — was staged at the Stuttgart University Studiengalerie. Georg Nees had conceived of, programmed and realized the works. The Stuttgart artists reacted in an unfriendly manner because they had been confronted by an attack against the validity of their productions which, without hesitation, were called art by everyone first and for all because of their origin in the artist’s studios, which he confirmed with his signature. Some left the scene generating noticeable noises. Max Bense tried to calm their moods: it was only artificial art what they saw on display, he declared. (p. 54)

Likewise in Japan, the artists who did not use computers were “extremely suspicious of computer art” (Taylor, 2004, p. 32). Of resonance here is Franke’s (1985) lament: “But even today’s applications have caused remarkable unrest in practice and theory of the contemporary art scene. The question of the possibilities of new machine-dependent techniques, of evaluating the creative elements of expression and beauty are being raised anew” (p. 167). In general terms, Franke (1985) thought that computer art has overtaxed many a critic, especially as it is so difficult to apply the usual historical or psychological yardsticks, and to make matters worse:

> It is obvious that many critics make no effort to look for new standards that would have to cover the formal and configurative aspects, but go on trying to form opinions from generalized view points having but little to do with art. It is patently far too crude a reading of art history to assert, that because until now machines have not been used for the creation of plastic art, computer creations cannot qualify as art; yet such a defensive position is still being maintained by a number of critics. (p. 153)
6.18 Factors contributing to negative perceptions of computer art

In view of the controversy surrounding the emergence of computer art, Taylor (2004) argues that visual computer art has long been unduly underrated in comparison to other fields of technological art. For Taylor (2004), this is indicative of the central humanistic tradition within the visual arts community who consider the computer in the hallowed domain of fine art as an undesirable dimension of increasing developments in science and technology. In addition, he argues that zealous technologists who, following the 1950s discourse on artificial intelligence, explicitly placed computer art within the “man versus machine” construct, did little to ameliorate negative attitudes. Essentially, they thought the computer would reduce the “unwarranted mystique” of art, whereas most art critics perceived machine made art as diminishing the integrity, purpose and essence of art and its history:

The computer threatened to invade the “territories of art”. Like Charles Baudelaire in his reaction to photography, critics and artists were fearful that this could ultimately usurp and corrupt human activity. Many critics viewed the computer as an “interloper, as something alien to the creative process”. Fearing the computer, mainstream artists felt they were surrendering the privilege of creating art to a mere automation. (p. 14)

Ultimately, Taylor (2004) regards the objections to computer art as being more a reflection on the machine than on the art in that the reception of computer art was more emotive than critical because computer art had discrete aesthetic parallels with abstract work of the time. In much the same way, Reichardt (1971, p. 95) saw that: “The relationship between art and technology has given rise to sometimes heroically nonsensical comments, and at other times pin point the essence of this relationship and its possibilities” (p. 95). Thereby, computer art, which is an extreme departure from hand-controlled work, will inevitably lead to something quite unusual and unanticipated. In illustrating this point, she draws an analogy between the inherent spirit of the computer artists and abstract artists including Kandinsky, Mondrian and Gabo whose daring advance also implied a departure from the accepted cannons of mainstream modernism by focusing on the pure relationship of form and colour without any explicit sociological and ideological implications. Taylor (2004) aptly recollects Cynthia Goodman’s (1982) description of a situation when Lillian Schwartz’s computer artwork, which she submitted for a 1969 New Jersey based competition was rejected. The next year when the same piece was entered under the title of silkscreen print rather than computer art, was only accepted, but purchased as a permanent museum collection item. Brown (1996) conveys a consonant view:

It’s reported … probably via apocrypha, Michelangelo was advised … not to use stone as a medium. It was not befitting an artist who should … have been using marble…later the Impressionists were reprimanded for using paint from tubes … we find the Constructivists being criticised for using modern
industrial materials ... Dadaists... were scathingly attacked for their use of found materials instead of paint out of tubes like the more commendable of their colleagues. The lessons of history seem plain: the art mainstream is hideously reactionary and beware any creative soul who experiments beyond the boundaries they prescribe. (p. 1)

In another context, Brown (2003) explains that computer art was emerging at a time when late modernism was replaced by what has become known as post-modernism which became quite quickly the dominant critical and curatorial aesthetic. Thus computer-based artwork challenged the understanding of the humanities-trained theorists, and the mainstream art community who wouldn't at that point in time have had any exposure to computer systems. In effect, the computational work was identified with technological absolutism and the modernistic emphasis on intrinsic media qualities. If computer art had emerged later "it might have been more correctly identified with more postmodern concerns like non-linearity and emergence. But, at the time, these concepts were almost unknown outside a small scientific community” (p. 2).

Another obvious influence on the mainstream art community was the participation of scientists, programmers and technologists who had little knowledge of the arts. Hence, although computer art has at times lacked subtlety, global aesthetic judgments should be suspended in preference for context specific judgment of an immature art form (e.g., Mealing, 2002). Similarly, that a historical method of evaluation is important: “because much of the work reflects the research into information technology at the time it was carried out, and was used to demonstrate its achievements” (Schwab, 2003, p. 3). In considering the advances involving a vast range of electronic age art exhibits, Popper (1997) concludes: “Although technological art is a relatively new art form ... its aesthetic, sociological and cultural value, can be established” (p. 8).

At the heart of the incongruence of computer art to mainstream visual art are several other factors. First, aside from being produced in research laboratories, computer graphics was aligned with mathematics and unlike traditional art practices, it was disseminated by computer science journals and debated across the disciplines of art, science, computer science, mathematics and engineering (e.g., Taylor, 2004). Second, for many years few people had access to computer systems, therefore computer art was associated with a "renewed trend of being limited to elitist circles" (Franke, 1985, p. 163). Third, computers were seen as the servants of huge commercial and military establishments (e.g., Taylor, 2004). Fourth, “the term “computer art” is, “in itself a provocation … because the very terms in which art is often characterized –"humanity, “warmth”, “spontaneity”, “sincerity”, originality and such are "laden with implicit prejudice against the values of which the machine is a symbol” (Benthall, 1972, p. 51). Thereby “art has courted technology in the twentieth century with conflicting emotions, with
a mixture of passion and love, loathing and fear” (Davis, 1971, p. 15). Nonetheless, the emerging discourse holds that: “The future and present are favoured over the pasts when it comes to evaluation of art” (Taylor, 2004, p. 3).

6.19 Summary
A scan of various layers and dynamics involved the early phases of computer art has revealed that pioneering artists played a critical role in the evolution of art towards new media and that the scepticism surrounding computer art are somewhat similar to those relating to other art movements that were considered as being avant-garde in their time. Apart from this, two key interrelated considerations emerge from the literature as having relevance for art education. First, collaborative practice was central, albeit often awkward, to computer specialists and artists who combined their skills to open up a range of new art practice possibilities for art practice. Implicit here is that just as computer artists and computer specialists needed to collaborate, so too will art educators, students, and those with distinct technological inclinations and artistic sensitivities need to combine skills in order to generate conceptual and technical skills. Second, for some traditional artists, computer technology created fresh stimuli and purpose, or an ideal driver for conceptual and technical development in new realms of creative activity that was explored and approached in diverse ways. Therefore, just as computer technology inspired people from non-art backgrounds to explore their aesthetic sensitivities, it may similarly inspire students who are otherwise disinclined to work traditional art media. Beyond this, the fact that many of the early computer artworks demonstrate the potential for seamless exploration of interdisciplinary concepts in art or generalist classrooms, aligns with the current curricular perspectives that not only call for ICT integration, but also for cross disciplinary approaches to arts education (e.g., VCAA, 2009).

Finally, while it was not ever expected that computer art should replace traditional art practice, the notion of computer art as a valid art form should not be dismissed on the basis of any preconceived notions. Although philosophical and practical constraints tended to dominate early computer art activity, it would be wrong to infer that computer technologies should not be integrated in art education or that there is any theoretical justification for regarding computer art as a medium limited to art of minor quality. Similarly, it should not be assumed that because more recent developments in computer technology have reduced fiscal constraints and the need for programming skills, that computers could be readily assimilated in art education programs without careful planning and preparation. Just as computer art is crucially a cumulative art, dependent on the building of related strategies, evaluation and refinement,
successful computer integration in art education requires a thoughtful approach in developing rich programs, and continual critical reflection and refinement.

Just as early computer artists invested a great deal of sustained time in exploring both the aesthetic possibilities and confines coupled with technical inquisitiveness and creative risk taking, art educators need time to develop technical skills and aesthetic sensitivities through explorations of computer technology. This includes coming to know how to use computers with discernment and acknowledging that just as many of the early traditional artists preferred traditional art practice media, so will too many students. In all, as a visual arts educator, I now understand the need to inspire students to consider the work of the computer art pioneers coupled with that of new artists. In all: “The search for visual intelligence is a critical aspect of this genre. It is the quality of art ideas and of the realization of them that makes digital art of interest to us in our age” (Prince, 2003, p. 1). Thus, “let’s hope that the best in contemporary digital print work is recognized … all the while, embracing the notion that it is more important to be timeless than timely (Acevedo, 2003, p. 2).
Chapter 7
Findings of the study

7.1 Introduction
This chapter provides an overview of the conclusions drawn from the study data. It begins by restating the research questions and briefly recapitulating the purpose of the study, the visual arts education context specific to the study and the underpinning pedagogical concepts. It then discusses the data drawn from the written questionnaire responses, interview conversations, class-based observations, and the participants’ visual journals and art practice artefacts along with vignettes of the participants’ perceptions of their ICT integration experiences. The findings of the research are discussed from a subjective perspective generated from multiple sources of rich information to form a narrative that preserves the intricacy of: “Human action with its interrelationship of temporal sequence, human motivation, chance happenings and changing interpersonal and environmental contexts” (Polkinghorne, 1995, p. 7).

7.2 Research questions
As identified in chapter 1 the research questions guiding this study are:
1. What are the factors that influence student teachers’ attitudes to ICT integration in and beyond visual art education coursework?
2. How do student teachers respond to the opportunity to use ICT in visual arts courses?
3. What do the student teachers regard as being the key limitations and advantages of using ICT in their coursework?
4. How do the student teachers relate this use of ICT to their work in primary school classrooms?

7.3 The study purpose
The study centred on the quest of promoting student teachers’ attitudes to ICT integration in visual arts education and gaining insights into the factors that shape these. As such, it aligns with the calls, as indicated in previous chapters, for concerted approaches to ICT integration in preservice teacher education, and the advice that consultations with students are fundamental to promoting their agency and involvement in their own learning (e.g., MacBeath, Demetriou, Rudduck & Myers, 2003). It also acknowledged that purposeful relationships within a learning environment that are based on mutual respect and trust require mutually rewarding interactions among the students and the teacher (e.g., Miller, Imrie & Cox, 1998).
7.4 Brief reflection on the start of ICT integration

As explained in the introduction to the thesis, the groundwork for the study focused on an exploration of the fundamental requirements of promoting student teachers’ attitudes to ICT integration within my own visual arts education context. As this setting lacked ICT resources and the essential technological expertise, my aim to pique the students’ interest in ICT integration required substantial groundwork, based on the premise that the success of ICT integration depends greatly on teachers’ sense of their self-efficacy in that their capacity to work effectively with technology determines patterns of computer use in classrooms (e.g., Wang, Ertmer & Newby, 2004).

Following the groundwork, as detailed in chapter one, was the need to acculturate a community of practice (e.g., Wenger, 1998) and co-inquiry (e.g., Irwin et al., 2008). This entailed introducing students to the conceptual and practical facets of ICT and supporting their learning needs, interests and preferred ways of working. The drive was to engage students in a mutually rewarding knowledge building process around the factors that enable them to build an awareness of the potential and the constraints of ICT as a tool to support and shape learning within a given discipline: “Teachers need the capacity to: “orchestrate the affordances and constraints in the setting” (Loveless, 2011, p. 309). This means knowing why, how and when ICT applications are appropriate in terms of both the pedagogical and artistic relevance (e.g., Comte, 1993; Delacruz, 2004). Equally important is a teacher’s, understanding of the fundamental principles of a student centred learning environment broadly defined as: “A place where learners … support each other as they use a variety of tools and information resources in their guided pursuit of learning goals and problem-solving activities” (Wilson, 1996, p. 5). In practice this means learning environments should promote deep approaches to learning through embodying the plurality of intellect notion (e.g., Gardner, 2007). With specific reference to ICT integration, Loveless (2007) who, like Johnson and Daugherty (2008), considers the importance of creativity in educational contexts as an emerging research topic, urges teachers to support students’ interactions in informed ways and to understand that: “free play with digital technologies … does not guarantee effective or creative engagement or development” (p. 9). This includes creating opportunities for students to reflect on, discuss, appraise and learn about their own art and the art of others, especially as a creativity framework provides “opportunities for students to step outside of conventional reasoning processes imposed by the rest of the curriculum” (Michael, 2001, p. 36). Other researchers describe a conceptual framework for
promoting creativity as one that encompasses an interaction between creative processes and affordances of digital technologies (e.g., Loveless, Burton, & Turvey, 2006).

7.5 Outline of the research context: Pedagogical framework for creativity

As explained in the methodology chapter, the main component of the study encompassed two visual arts education courses: 1. The visual arts education method course within the first year of the four-year Bachelor of Education program, and the one-year Graduate Diploma of Education program. 2. The optional visual art elective comprising twelve weeks of three hourly classes for third and fourth year Bachelor of Education (primary) students. Rather than applying a sole focus on ICT use, the above courses were underpinned by the view that pedagogical design needs to express the congruence between the content, teaching strategies, learning environment, and to reflect underlying theories of learning and value (e.g., Kalantzis & Cope, 2004). Similarly, that students’ readiness for learning is dependent upon how they are able to examine their own values, especially as “each student stands at a different point on both the emotional and intellectual growth continuum” (Schmier, 1995, p. 22). Allied to this were the pedagogical concepts of scaffolding, collaborative learning and creativity in ways that clearly align with the following pedagogical understandings, including those that have emerged as significant elements of the discourse around the educational use of ICT since the inception of the research:

First, our theoretical understandings of pedagogy have developed beyond Shulman’s (1987) early characteristics of teacher knowledge as static and located in the individual. “They now incorporate understandings of the construction of knowledge through distributed cognition, design, interaction, integration, context, complexity, dialogue, conversation, concepts and relationships” (e.g., Loveless, 2011, p. 304). Allied to this, inline with the academic ideal of igniting student motivation (e.g., Biggs et al., 2007; Gardner, 2007), learning activities need to promote powerfully transformative learning (e.g., Cranton, 2007) through self-actualization and or creative stimulation, and to build confidence in an uncompetitive way. Applicable here, is the view that: “creativity is not a special faculty with which some students are endowed and others are not, but that it is a form of intelligence that can be developed and nurtured like any other mode of thinking” (Robinson, 1982, p. 29). Thus, students need support in advancing their artistic skills to higher conceptual levels, particularly in taking intellectual and intuitive risks to extend the boundaries of what they thought is possible.
Second, whilst individuals may engage with creative activity, creativity can be, as noted with respect to the concept of a/rt/tography in the methodology chapter, supported through interactions within a community of practice. As Csikszentmihalyi (1999) notes: “creativity is a phenomenon that is constructed through an interaction between producers and audience” (p. 313). With respect to higher education, McWilliam (2008) links the development of creative attributes to “an external world of team players, social processes and organisational settings” (p. 28). From this perspective, as discussed elsewhere (e.g., Culpan, 2009), the process of creation is not essentially an isolated activity, reified in the myth of the artist secluded in the garret. While creativity is often viewed in relation to individual self-actualisation, whereby the individual defies the crowd (e.g., Sternberg & Lubart, 1995), the social facet of creativity can be nurtured within a group context (e.g., Cropley, 2006), particularly when the participants are at the embryonic phase of exploring their capacity for creative work.

Third, while art education facilitates learning in and about art, it is essential to foster the creativity that is integral to all education. Therefore, the promotion of knowledge about ICT integration with art education includes fostering skills in observation, perception, imagination and curiosity, and acknowledging that these are also important in adding force to learning in any discipline and are fundamental to the generation of new knowledge through practice and research (e.g., Culpan & Hoffert, 2009). An allied concept, which is particularly pertinent in preservice teacher education, is that through a mix of formal sessions and self-initiated exploratory and collaborative experiences, students are more likely to step beyond their comfort zone (e.g., Culpan & Macmillan, 2006). Specifically, while arts education centres on enhancing creative thinking processes and learning across disciplines, and making a range of skills and knowledge accessible to all students, it should not equate to nebulous ‘creative work’ of low cognitive value. Thus, the importance of continuity, diversity, breadth and depth … firmly grounded in sound aesthetic understandings and practices, is emphasised. “The imagination must build on sound preparation to achieve the actual” (Hoffert, 2004, Para. 9).

7.6 The fundamental elements of ICT integration within the visual arts courses

Given the need to address “the quality, not the quantity, of the integration of computers into the school curriculum” (Selwyn, 1999 p. 87) within each of the aforementioned courses, students were introduced to the basic ICT applications such as the use of a
flatbed scanner, digital camera, PowerPoint, KidPix, MicroWorlds and, where appropriate, Adobe Photoshop. They were also free to use their own personal software or to access freeware when needed. Support materials included journal readings, software manuals, and visual material on various forms of traditional and computer-mediated artworks. Above all, was the view that while technology is thought to promote constructivist approaches to teaching and learning, “computer technology, in and of itself, does not embody a specific pedagogical orientation. Different types of software can be used to explore different learning goals” (Niederhauser & Stoddart, 2001, p. 29).

Importantly, there was no mandate in terms of assessment requirements for students to actually use ICT in creating or presenting their artwork. The exclusion of an assessment component on ICT use was based on the premise that as the art studio only had one flatbed scanner, two Mac desktops, one laptop – my own, and four borrowed – for each class session from the central staff store, one data projector, also borrowed from the central store, and one colour printer, it was unreasonable to expect all students to access the equipment for the length of time required for sustained exploration of any one application. Further, a mandate on the use of ICT would have countered the ethos of the research which centred on identifying the influences on students’ inclinations to use ICT as distinct from reinforcing the ICT rhetoric, or having them use ICT simply because of a top-down directive imposed on them (e.g., Loveless, 2011). The intention was to facilitate authentic modes of ICT integration and explorations of the advantages and limitations of ICT so that the students could freely form and articulate their own judgments. While this approach may not be entirely consistent with: “The vision of technology-supported constructivist classrooms” (Means & Olson, 1994, p. ix) fits neatly with the ‘practicality ethic’ (e.g., Delacruz, 2004, 1977) as previously explained in the chapter 4.

7.7 Discussion of the data findings

The questionnaire, which was designed to gain insights into the respondents’ background experience in visual arts and ICT applications, served a tripartite purpose. First, it was a way of acknowledging that preservice teachers bring their individual interests, abilities, and skills into the learning context (e.g., Murray, 1996). Second, with respect to both visual arts practice and ICT, it provided a scan of the students’ prior level of knowledge and skills. Third, it not only aligned with Murray’s suggestion that in the area of new technology, we should determine what knowledge and skills
prospective teachers bring to our teacher education programs, but also assisted in understanding the questionnaire responses.

It is acknowledged that the resulting questionnaire data is restricted to what respondents conveyed in short written comments, and that some may not have been able to identify or express in written form all that they knew at that time. Yet, while some the questionnaire items were not answered, the questionnaire data together with the qualitative data, provided firm insights regarding why at the start of the method course, the majority of the students conveyed a sense of apprehension or of being overwhelmed by the concept of engaging with both basic art practice and ICT applications. From the start many within the method course spontaneously stated either that they were not ‘creative’, ‘good at art’ or not ‘technological’. Conversely, some students, albeit the minority, were clearly more familiar with both visual art practice and ICT applications. As such, they engaged with art practice, technology applications and presentation tasks in a more fluid manner than those who were striving to learn basic ways of combining the fundament concepts and processes of visual arts and ICT. The following table, which shows the responses to questionnaire items Q.1-3, supports my perceptions of the distinct differences in the students’ sense of confidence in visual art and ICT learning. Of the total twenty-five questions, the responses to these were the most useful in ascertaining the participants’ perceived level of confidence or prior experience in art practice and ICT applications.

Table 5: Summary of respondents’ prior experience in visual arts and ICT applications

| Q.1: Please rate your experience in traditional visual arts practice prior to the current art education course | Low (47%) | Med (32%) | High (19%) | No Response (2%) |
| Q.2: Please rate your experience in creating electronic presentations for art education purposes | 52% | 39% | 9% |
| Q.3: Please rate your experience in using computer software to create or manipulate visual images prior to RMIT. | 57% | 33% | 10% |

As seen in the above table the majority of the respondents indicated that they started the visual arts courses with either a low or medium experience in both visual arts and ICT learning. This data affirms my own observations, especially with regard to the
method course, where there was an overall lack of understanding in basic ICT applications. For instance, in using a scanner to either create or to capture images, or a digital camera as a source for artistic manipulation of their own photographs, and minimal knowledge in importing images into either Word or PowerPoint documents. Question 4 aimed for insights into the respondents’ opportunities to see ICT integration in art classrooms.

Table 6: Opportunities to observe ICT use in visual art classrooms.

<table>
<thead>
<tr>
<th>Q.4: Have you seen school students working with computers to research art topics / present artwork / create visual artwork in any school settings? If YES please expand a little here, but don’t enter the name of the school:</th>
<th>No%</th>
<th>Yes%</th>
<th>NA%</th>
<th>Written response%</th>
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<td>32</td>
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The above table does not adequately reflect the respondents’ overall experience in observing ICT integration in visual arts. Yet the written responses suggest that notwithstanding some notable instances, very few respondents had actually observed ICT use in visual arts classrooms as distinct from some forms of ICT use that might be broadly regarded as art related activity in general classrooms. Several respondents who had observed school children in generalist classrooms using computer software that involved, what might be described as a “fixed path that has already been pre-determined, and a ‘drill and practice’ routine” (Eisner, 1985, p. 144), regarded this practice as being counter to the university-based focus on stimulating children’s confidence in generating their skills and ideas. For example, most of the respondents’ written comments were along the following lines:

I have seen how children can do computer artwork in the classroom. But, it is not creative work just busy work…. They really just cut and paste ‘clip art’ pictures in to their projects, or scan pictures to paste in their work sheets (Anonymous questionnaire respondent 1).

While such comments might be an indicator of students’ understanding of discerning use of ICT, it is possible that some might not yet recognise the difference. However, one of the interesting aspects that emerged from the written responses was the ability of some students to identify with the teacher’s role, and to reflect critically on the obstacles that teachers could not resolve in order to implement ICT. Rather than being critical of the teachers, they generally recognised that the teachers’ overall responsibilities leaves little time for them to implement ICT applications, access ICT
resources and find adequate space for ICT and traditional media equipment. With respect to generalist classroom teachers in schools lacking in specific provision for discrete art classes, there were some enthusiastic notes, as described by one questionnaire respondent:

In my grade four class, the teacher does great things … the children write a story about themselves and then scan photos of themselves or their family or their bedroom and insert these in a picture book about themselves. They have also taken photos of each other in the classroom and distort and colour these in bizarre colours on the computer. (Anonymous questionnaire respondent 2)

The lack of opportunities for observation in art classrooms corresponds with my survey at the start of semester 1, 2004, of fifty PP schools, which found that only three of the art classrooms had some form of ICT for art learning and teaching purposes. The following table summarises the provision of art specific classrooms and ICT within Professional Practice schools.

Table 7: PP schools provision for visual arts education (Culpan, 2004, p. 4)

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The above table relates to the limited opportunities that preservice teachers have to access ICT savvy art teachers as identified during the groundwork of the study. As the nature of ICT provision in placement schools is beyond both my own control and that of the RMIT School of Education Professional Practice program directors, an interim strategy was implemented during the study period. This involved Lilly, a local art teacher, from my professional network, who during the groundwork phases of the study, offered to come on several occasions, on a pro bono basis to discuss her ICT integration experiences with our students. Specifically, she was acutely aware of the general lack of effective ICT integration in local art classrooms, and that this requires teachers to apply sustained effort in acquiring relative skills and resources.
Lilly engaged the students in discussion around a range of exemplars of her students’ individual and collaborative use of ICT. Likewise, how her efforts in learning to use art specific ICT applications, followed by lengthy negotiations with the school administrators, culminated in a class set of laptops, and exciting new learning opportunities for her and the children alike. In encouraging the student teachers to acquire the essential knowledge during their art education courses, she explained that as graduates they might not have the time to develop the confidence required to substantiate their negotiations with school managers regarding the investment in the necessary ICT resources. The impact of Lilly’s input was evidenced through some of the students’ journal notes as the following vignettes show:

1. I had no idea what to expect from the session with Lilly. I had my reservations about the effectiveness of computers in art…. I was concerned that the children would lose control of their art piece or that the tool (computer) would create limitations for the child's expression or imagination. Instead I sat in awe amazed at the incredible artwork the children had produced from their original ideas through to the interactive moving artwork and skits. I had no idea of the possibilities … available to children with computers in the art room. (Angela - Visual Journal - Semester 2)

2. I agree with Lilly that children have inquiring minds and that they grow and develop at varying rates and are enticed to learn when the activities are meaningful. Children within an encouraging environment develop self-esteem and I believe that they will begin to take risks when they are comfortable in their class. I agree that multiple exposure to a tool or activity brings with it greater opportunity for the children to explore and develop their ideas as they … learn to explore … possibilities. Computers in the art room have the potential to build on these attributes and provide the children with a new medium of expression. (Adam - Visual Journal - Semester 2)

3. To think that a few short years ago Lilly had little experience with computers shows the degree to which she pushed herself to become computer literate and then discover how it could be implemented into her classroom. I agree … that children today generally are confident using computers … giving it a go does not daunt them. I really
appreciate the process implemented within the classroom … that the children … produced their artwork by traditional means, and … were encouraged to create another version using the computer. (Glendy - Visual Journal - Semester 2)

4. The multimedia tools utilised (in Lilly’s classes) included scanners, digital cameras, multimedia projectors, and the Internet. The way in which the children were exploring and developing their ideas, and then applying the techniques and processes … was most inspiring. Art elements of line, shape, colour, tone, and texture were used in the art works that Lilley showed our class and included examples of perspective, harmony, balance, proportion and movement. I really loved the doodle idea. I did that at home with my family members. I asked them to draw the scribble and then use the original marks to make an image. The objects and creations we found in the scribbles were great. The evaluations that the students and teacher make with regard to the work produced are very important to the success of technology-assisted artwork. (Tammy - Visual journal - Semester 2)

7.8 Perceptions of the value of ICT integration in visual arts education

With respect to questionnaire items 5-12 the table below shows that while the majority of respondents acknowledged the value of ICT use in visual arts courses, there was a high level of inequity in their personal access to ICT equipment and software. While the table does not explain the respondents’ reason for stating the importance or otherwise of ICT in the visual arts courses (i.e., item Q.5) these are explained in the written responses, mentioned below the table:
While the above questionnaire data, and the written responses, indicate high consensus on the importance of ICT use in visual arts education, a number of respondents noted that they experienced challenges in learning to use ICT in visual arts mainly because of lack of prior knowledge, and constraints in access to resources and the time required for sustained computer use within the course. This does not suggest that these factors of themselves caused negative attitudes to ICT as distinct from impeding their use of ICT. For example, the main reasons for ICT in visual arts courses, as inferred from the questionnaire and the qualitative data, were quite affirmative, albeit varied:

Table 9: Reasons for ICT in visual arts education - in order of the most consistently cited in the written questionnaire responses.

<table>
<thead>
<tr>
<th>Reason</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. A way to link art learning with other subject areas both at university and school level, especially in promoting maths and literacy learning through art</td>
<td></td>
</tr>
<tr>
<td>2. Opportunity to learn to create images rather than relying on the standard Word Art and Clip Art images.</td>
<td></td>
</tr>
<tr>
<td>3. Ideal way to learn skills that can be used in classrooms, and for creating and presenting concept maps, visual journals, posters, professional portfolios and teaching resources.</td>
<td></td>
</tr>
<tr>
<td>4. It is important to provide students and school children with options to use ICT for art making rather than just traditional media, especially for those who are not interested in art.</td>
<td></td>
</tr>
<tr>
<td>5. Problem solving involved in using both traditional and digital image constructing mediums.</td>
<td></td>
</tr>
<tr>
<td>6. Opportunities to explore concepts of animation and filmmaking, especially for engaging school children.</td>
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</tbody>
</table>

Apart from the above factors, a number of the students stated that they wanted to learn more about ICT applications because they have felt particularly uncomfortable when the school children in the generalist classrooms of the practice schools, are more adept in using ICT than they are. Evidently, some children within their school settings have
actually expressed annoyance when a student teacher was unable to assist them in working through an ICT issue. Conversely, a number of visual arts elective students noted that as a result of their increased confidence in ICT use, they valued opportunities to share their skills and pedagogical understanding with the in-service teachers in their practice schools. The first of the following is a direct quote from a visual journal:

As a pre-service teacher, I have worked with experienced teachers in contemporary classrooms where the latest technology is available yet perhaps not utilised to its potential… Being a small school, the staff turnover is low therefore young, more digitally adroit teachers are in the minority. This became pronounced in listening to feelings of uncertainty … In response to direct observations and professional discourse with teachers, I identified the chance to assist teachers to better understand the value of incorporating visual arts concepts in all learning areas to engage students. (Dianna - Visual Journal - Semester 2)

The next account is an encouraging finding of the study in that some students had formed firm ideas about when ICT use is or is not appropriate. In other words, a step in addressing any apprehension regarding technology initiatives in education entails understanding that computers will be appropriately integrated with more traditional forms of learning (e.g., Laurilland, Swift & Darby, 1993). As the following paraphrased account of a student’s experience, as explained during an interview, indicates:

Tasha had discussed with the professional practice school teacher her lesson plan for grade four children to explore the use of colour, line, shape and symmetry through hand drawing images based on the ‘Mandala’ concept. The teacher approved the idea, but as she thought that it would be too hard for the children to draw their own images, she accessed a collection of Mandala design colour-in sheets from the Internet for the children to colour in as apposed to drawing their own compositions.

Whilst Tasha could see that this was the teacher’s well-intended way of supporting her idea, she tentatively explained that she hoped the children could generate their own ideas and skills rather than use stereotypical designs. Evidently, when the teacher saw that each child had exceeded her expectations by composing their own interesting Mandala drawings, she commended Tasha on her initiative in not taking an easy alternative to promoting children’s ideas and skills. Implicit here is the importance of students being confident not only in using ICT, but also in making informed decisions about its pedagogical and artistic relevance. (Tasha - Interview, 2004, November 8)

Having noted, in part, the enthusiastic attitudes to ICT, it is important to also note that
important for preservice teachers to learn computer art applications for art education purposes?) wrote brief comments indicating a particularly strong sense of philosophical opposition to ICT use in art. Specifically by stating that computer use is not 'creative' in art. While, regrettably two of these respondents did not explain their beliefs, one who also circled 'No', wrote the following thought provoking note:

Kids are bombarded with technology... The art room is one of the few places they can escape to something different... In the art room, the same kids love to draw real pictures and they need this balance.... This university is over the top on computer use... there are more important ways to learn than with technology (Anonymous questionnaire respondent 3).

7.9 How students responded to the opportunity to use ICT

The following section shows that although the visual arts method course only comprised six weeks of three hourly classes, many of the students, who often voluntarily experimented with ICT applications well beyond scheduled class times (as explained in the following chapter) found that the joining of seemingly dissimilar phenomena triggered some innovative thinking (e.g., Alvesson & Skolberg, 2000). The first of the following examples pertains to Phoebe who started the course with minimal experience in traditional visual art practice. Nonetheless, she quickly developed fine techniques in observational drawing, which she then used as a basis for creating a repeat pattern by scanning and multiplying the original hand drawing in a basic software program. In turn, she saw this as an ideal opportunity to assist children in her professional practice school to use their own drawings as a starting point to grasping the concept of repetition and pattern when teaching maths.

![Figure 16: Annotated as: Pencil drawing scanned and digitally multiplied to form a symmetrical pattern. (Phoebe - Visual Journal - semester 1)](image16.png)

The second example comes from Larissa who came into the course with a degree in fine arts and a strong commitment to visual arts education, but no prior experience in
using computers at all. While she was not particularly keen to use technology for art practice, her innate artistic curiosity seemingly led to a series of annotated simple experiments including the following two:

**Figure 17:** Larissa: Posing Women - Annotated as:
Computer generated image: Drawing directly using mouse as extension of hand. Image source: existing pencil drawing used to test how closely use of mouse can replicate prior drawing. As yet seems a very uncomfortable/unnatural technique. Almost feels as if being drawn with the incompetent left hand. Transparency of line explored. Extension: to manipulate the surface with visually simulated collage as well as true pieces of collage. Use as one step in the continuum to develop a more complex result. (Larissa - Visual Journal 1- Semester 1)

**Figure 18:** Larissa: Postcard Women - Annotated as follows:
Simplicity of the design evokes Matisse’s paper cutouts. Exploring use of -photocopier to extend work in creating textured woodblock images. Materials/tools: original woodblock prints reduced in scale, giving various sizes to manipulate and rearrange.... Extend original print
possibilities by repetition and scale relationships. Simple and accessible way to use technology in classes where there are no computers. (Larissa - Visual Journal - Semester 1)

Another student Tim, who confidently engaged in all traditional art practice work, but had no prior experience in using computers for creative work created a series of images. He was not in the least daunted by the prospect. As noted in his journal:

I just went nuts with exploring ways to change my drawings after we were shown what we could do with Photoshop … I had no idea it could be so exciting.

Image removed due to copyright restrictions.

Figure 19: Tim: Imaginary creature using ICT hand drawing with digital addition of background text and colour - An exercise related to topic on drawing imaginary creatures. (Tim - Visual Journal - Semester 1)

The following is a collaborative collage created by a group of three students that had not previously used ICT for art purposes, but were enthused enough to experiment through several lunch times and after hour sessions.
Figure 20: Group work: Untitled - annotated as: We scanned our hand painted papers as a part of learning to paint textures and then spent ages on the computer to form shapes for our collage. But the colours looked better on the screen than when it was printed. Although this took a long time, it was worth the effort … we now understand how we can make it better, and even bigger. (Katya, Irina & Abby - Visual Journal – Semester 1)

7.9 How ICT was used within both the method and the visual arts elective course.

In keeping with Unwin’s (2007) observation: “it is not the availability of the technology which is important, but how it is used” (p. 7), the study participants’ descriptions of their ICT use for visual arts education often related specifically to the applications they had either used themselves or had observed their peers using. The following table shows the applications that were consistently mentioned in the visual journals relating to both courses, as having piqued the participants’ interest in terms of perceived usefulness:

Table 10: How ICT applications were used during the study

<table>
<thead>
<tr>
<th>ICT tools</th>
<th>How ICT applications were used during the study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flatbed Scanner</td>
<td>As a device to photograph their own traditional art practice work for:</td>
</tr>
<tr>
<td></td>
<td>(i) Importing into Adobe Photoshop prior to exploring multiple possibilities of extending/changing their original ideas.</td>
</tr>
<tr>
<td></td>
<td>(ii) Exploring the concept of Scanography to compose collages of select 2D and small 3D images directly on the glass platen of the scanner in much the same way as the pioneering computer artist Sonia Landy Sheridan initiated the use of photocopiers to create imagery though physically arranging select objects on the copier platen (Retrieved from <a href="http://soniasherridan.com/gallery">http://soniasherridan.com/gallery</a>).</td>
</tr>
<tr>
<td></td>
<td>(iii) Scanning various real texture surfaces to import into Adobe Photoshop and then incorporate in the creation of digital artworks.</td>
</tr>
<tr>
<td>Digital Camera</td>
<td>Exploring art concepts through manipulating their own photographs as distinct from those located on the Internet</td>
</tr>
<tr>
<td></td>
<td>Creating photomontage compositions with reference to renowned artists such as David Hockney</td>
</tr>
<tr>
<td></td>
<td>Photographing images of:</td>
</tr>
<tr>
<td></td>
<td>(i) 3D hand made characters for animation purposes. (ii) Artists’ work found either in books or during visits to NGV - as a part of documenting their research on art and artists.</td>
</tr>
<tr>
<td></td>
<td>(ii) The ‘in progress’ stages of their work - for inclusion in either visual journals or Power Point presentations.</td>
</tr>
<tr>
<td></td>
<td>(iii) The work of the students in their PP settings.</td>
</tr>
</tbody>
</table>
KidPix software

- Basic exploration of image creation processes as discussed for example in Mary Stokrocki’s (2001) study on *The Apache children share images of their home.*

Microsoft Draw & Paint

- Exploration of basic visual arts and maths concepts - colour, line, shape, repetition, rhythm, symmetrical and asymmetrical balance.

Adobe Photoshop

- Advanced exploration of image creation processes through use of transparent layers with reference to their original hand drawings, paintings and collage.

PowerPoint

- Preparing presentations of their learning processes and designing or formatting lessons.
- Creating resources for teaching visual arts concepts in either art specific or cross-curricular classroom settings.
- In many instances these included text, visual images and sound.

Internet

- Research on:
  - (i) Art forms including traditional and the computer art genres. “Mainstream art history should not be discarded but take its place as one story among many” (Efland et al., 1996, p. 96).
  - (ii) Ideas for art lessons.
  - (iii) Graphics freeware, and
  - (iv) For connecting with artists for collaborative activity relative to visual arts project.

The above table, which pertains to both the method and elective courses, and stems from the participants’ journal entries, the interview conversations and the class-based presentation sessions illustrates a diverse, though basic, range of approaches to ICT use.

7.10 Visual arts elective course data

The next section draws on the data relating specifically to the visual arts elective course, as distinct from the previous section pertaining to the method course. In doing so it also interweaves vignettes of the students’ perspectives on ICT integration within their own visual arts course work learning and, where applicable, those that relate to their practice in primary schools. At times the vignettes are, as in the previous section, prefaced by my own brief description of the student teachers’ individual visual arts background experience, or my own perceptions of their level of confidence in art practice at the start of the course. Some of these are accompanied by images of the art practice artefacts created with the aide of some form of computer technology. In the
main, the vignettes represent the voice of an individual, identified through pseudonyms, and are drawn from one of the following three sources:

1. Students’ visual arts elective journals where they discussed their project ideas, and a rationale followed by successive entries of their perceptions of their learning including the inspiring and daunting elements, and a summative discussion often accompanied with photographs of their ‘in progress’ and finished work. Allied to this, they often specifically mentioned the source of their artistic inspiration and where applicable how they gained support in overcoming certain technological difficulties.

2. Interview conversations, where the participants often openly explained both the frustrations and the highlights they experienced with ICT, and how these experiences influenced their perceptions of the value of ICT in either their professional practice school-based teaching or in their future classrooms. In addition, some discussed their observations of the way ICT was integrated by professional practice school teachers, and their own experiences in using ICT for certain purposes in the lessons they implemented in their professional practice school classrooms.

3. Students’ comments during the class presentations of their final work, about the difficulties, the advantages and/or the ICT specific limitations they experienced either whilst working on individual or collaborative artwork and allied research, or in preparing for the presentations. They also often acknowledged sources of information, inspiration and support in realising their goals. In the case of collaborative art-based projects, the ways in which each group member contributed to the learning process were also noted. In addition, there were visual journal entries and end of semester presentations where students reflected on how their learning about the capabilities of ICT lead to more complex goals than those that they had set at the start. Conversely, some recognised the need to modify their initial goals in light of understanding the complexities of certain constraints, including access to certain resources and the limited time available to complete complex projects.

The following examples show how the participants’ work fits within the general descriptions of the use of ICT for creative practice, involving: "processes of capture, manipulation and transformation of media" (Loveless, 2002, p. 4). In this regard, the students were variously engaged in selecting the medium for a particular concept, and incorporating a combination of sound, text images, and movement to present their ideas.
As such, digital creativity included selecting, editing and transforming text and images (e.g., Loveless, 2002), including photographs in that technology has altered the way in which some artists create and communicate (e.g., Popper, 1997). Indeed, many of the students used digital photographs and graphics software as a starting point for their work. However, they only used the photographs that they had taken, as distinct from Internet accessed images, they avoided any misuse of other peoples’ images that cause legal and ethical dilemmas (as discussed in the chapter on cautionary perspectives on ICT with reference to Mercedes (1996).

Example 1: An outline of how Julia incorporated digital photography in an art lesson with children in her practice school:

Julia whose professional practice placement was in an independent school, renowned for its support of arts learning, extensive art learning resources and art specialist teachers, implemented a lesson on iconic architecture. After a trip to the city of Melbourne, where the students photographed various parts of selected buildings, they used the photographs as a reference point for their hand drawn compositions. The culmination of this work was later exhibited in the school foyer. A particularly interesting point with respect to Julia’s art teaching experience is the extraordinary effort she applied in identifying, and securing a placement in a school with a strong ‘arts culture’. Clearly, Julia sought to fit within an environment where she could best learn and practice her specific passion for visual arts education and ICT. (Julia - Visual Journal, Semester 2)

During the presentation session (2004, October 11) Julia explained that she was inspired by the way both she and the school students were free to choose whether or not to use ICT in art classes, and that, even though the art studio was well equipped with ICT, the art teachers focussed on promoting creative activity irrespective of the media used. Consequently, she observed varying levels of seamless integration of traditional and ICT media where neither one took precedence. Sadly, she is one of the few students who were able not only to see a firm level of integration of art and ICT practice, but to also implement their associated skills and interest in an actual teaching context. By detailing her experience, and the copies of her students’ artwork, Julia contributed to our insights into possible uses of ICT and stimulated much discussion within the peer group about individual student teachers’ experiences in either teaching or observing art education type classroom practices. As I described in my journal:

The vibes of this class discussion suggests that the students’ opportunities for collegial dialogue around their teaching or observational experiences where they see how ICT use can either support or impede art education in school classrooms, have a more powerful influence of their attitudes to ICT than any policy rhetoric or
Example 2: A participant’s digital photograph taken during an overseas trip, which she and a peer, who was also interested in exploring the Adobe Photoshop software, used for creative exploration:

Image removed due to copyright restrictions.

*Figure 21: Jenna and Kim: David Hockney inspiration piece - Annotated as follows:*

The original image was abstract and intricate ... we experimented to make it even more abstract. We really liked the way the building was layered.... Artist David Hockney uses layers of colour and photo segments…. This inspired our idea of abstraction and subtle layering of translucent colours. As we were not confident in using Photoshop we faced quite a few problems. With the help of the online tutorial, we finally built a photo collage. It is not perfect, but it is a start to what we
tried hard to achieve. We soon realised there was a lot more to creating a digital composition than we had originally thought. (Jenna & Kim - Visual Journal - Semester 2)

Aside from the participants who focussed on ICT purely as a part of their discrete art learning or teaching activity, many considered that the main advantage of ICT related to taking cross-curricular approaches to art education. For example, the work of the various ‘pioneers’ of computer art, which combined maths and art concepts such as form, perspective and repetition in intricate fine line computer drawings, inspired a number of students, as did the work of MC Escher. In particular, they incorporated such concepts in their own compositions, and in planning lessons for school children.

Example 3: One aspect of a visual arts project by Tanya that linked ICT applications with maths and visual art concepts of symmetry and tessellation. In her journal Tanya explained her ideas for developing a unit of work in either a general or art classroom:

It is common to compartmentalize art rather than integrate it with other Key Learning Areas, yet art can allow students to creatively explore the notion of symmetry and tessellations by studying the works of Escher and making connections to knowledge gained in mathematics. Drawing parallels between mathematics and art assists students with a predominant ability in one area and a deficit in another. It can help understanding of an abstract idea by practically exploring the concept through visual art activities. For example, students can create a simple symmetrical image by hand and scan this into the Publisher program, before exploring the concept of transformations by ‘inserting a picture’, using tools to ‘rotate’, ‘translate’ and ‘slide’ to create an aesthetic tessellation pattern, with or without the use of colour options.
Figure 22: Tanya: ‘Moroccan flower’ – Annotated as follows:
One of a series circle based patterns. It took a number of attempts ... once I understood how ... the drive to experiment kept propelling me to make new discoveries.... I valued most in using Microsoft Paint was that each time I looked at my work another math concept became clear ... even though the symmetry of my initial image was three-fold, I noticed that by electronically rotating the image and placing a copy over the original I had developed an image with six-fold, rotational symmetry.... I overcame my fear of maths through art, and hope my students will benefit from the same approach.... I need more practice before ... creating mathematical symmetry at Escher's artistic level ... he specialized in reflecting an altered curve of a polygon and rotating it by 180 degrees about midpoint of the line to achieve the visual aesthetic impact of his compositions. The limitation with 'Paint' was that once the shape is placed and released it couldn't be repositioned ... when drawing circles there is no way of verifying that they were in an exact position; I needed to reposition several times.... My experience shows the need to allow students ample time to practice before expecting them to develop effective patterns. (Tanya - Visual Journal - Semester 2)

The advantages of ICT for children “who are not confident in drawing, but can draw one shape by hand and then copy and paste this to develop their design, include: 1. The ‘colour fill’ option allows easy selection of preferred colour schemes. 2. The flexibility allows experimentation with visual ideas.... 3. Students can extend drawing, math and ICT skills simultaneously”. (Tanya - Interview 2004, November 8).

Example 4: Hand drawing and digital tessellation by Tammy:

Figure 23: Tammy: CD Rom cover design of Tammy’s folio work
Figure 24: Tammy: Lion and fish tessellation. Annotated as:

Inspired by Escher: Hand drawing and computer editing to arrange tessellating segments using Adobe Photoshop 7.0 each segment was rotated 240°, the lions meet head to tail separated by fish … the key to the fulfilment achieved … was that I have over come many hurdles. This means more to me than simply producing a product. (Tammy - Visual Journal - Semester 2)

Example 5: Joss who started the course with minimal experience in traditional visual art practice and no experience with ICT for creative artwork, but reflected high interest in developing traditional art practice skills, and only minimal interest in computer use for anything other than research. Nonetheless she explored numerous options and conveyed a critical perspective with respect to her work and how it might relate to teaching children:

After downloading a number of Kandinsky’s paintings, I played with Microsoft Word using the ‘draw tool’ box to create preliminary drawings with line and shape elements that I could develop by hand to include texture and colour using real paints and brushes. After creating … hand painted organic shapes I became inspired to develop these in Microsoft Word. Using the ‘draw’ icons…. This took much longer than I expected. I gave up on the hand painting idea, as with a mistake in my hand painting, I had to wait for the paint to dry…. Whereas when using the computer the ‘edit undo’ button mistakes were easily corrected. This gave me confidence in experimenting as I could change things…. What amazed me most was that my images were created on a basic program rather than a highly expensive graphics one.
However, this program did not allow development of images to the extent of transparent overlays of colour where the shapes overlap, or to incorporate very fine textures as in some of Kandinsky’s work. I realize … I need to use Photoshop, which has more sophisticated tool options for creating higher level art…. I see that this type of activity could be readily implemented in an art room … it is a great way of advancing ICT skills in visual arts without preventing children’s ‘hands on’ experiences with pencils, brushes and other art tools. The advantages include: 1. Using the computer to develop a picture the children have drawn by hand, printing a copy and using different mediums to add colour and texture. 2. Creating images on the computer, printing these to use as components of a collage with or without other materials or images. 3. Providing options for students who don't feel confident in drawing by hand. (Joss -Visual Journal - Semester 2)

Figure 25: Joss: ‘Imaginary landscape’ - combined use of Microsoft Paint and gauche hand painting. (Joss -Visual Journal - Semester 2)

Example 6. Kahly who, like some other students believed that she was not ‘creative’ with traditional media, but was adept with ICT, and assumed that she could create ‘good art’ by using computers. Interestingly, although these students viewed computer technology as a creative catalyst, they invariably applied more effort in developing aesthetic skills than they had anticipated. In other words, despite their initial perceptions, for many of the students the software did not enable them more control over their learning than traditional art methods as suggested by some art educators (e.g., Hausman, 1991; Dunn, 1996). Their efforts in developing aesthetic sensibilities support Crowe’s (1988) research, which found that students who understood the elements of design and composition were more successful in creating computer art and graphics. Evidently, some of the students in Crowe’s study, just as those in this study, found that if they were not familiar with the principles of composition, their work lacked the strength that should be present in fine art, especially as computer mediated art calls for a blend of design skills, composition and ability with the manipulation of the
computer and its software. Kahly for instance, explicitly stated that her only reason for choosing the visual art elective was the option to use ICT applications, especially as she had no confidence in passing the course by learning to use traditional art mediums effectively within one semester. However, she was confident in using ICT even though she had not used this for creative activity. Her learning journey became more intense than expected, because she became:

Just so engrossed in exploring ways to create an aesthetically interesting artwork, and actually finished up with 102 images” after trying a 3D Max - very difficult to use ... designed more for professionals than ... amateurs, Adobe Photoshop, which ... I found difficult. I was unfamiliar with the options, and the location of the tool bars. I’m not great at drawing accurate lines free hand or with a mouse, so I opted for PaintShop Pro that allowed a step-by-step approach. I then played with Macromedia Flash with the idea of creating a 3D animated model, but changed my mind ... my skill level didn't match my enthusiasm! I also tried Adobe Illustrator and then I decided on incorporating a background, a friend recommended the airbrush tool ... this was no better or worse than the same tool in PSP, so decided to stay with PSP which I came to be very confident with, and with Poser V4 for creating my figures and 3D Studio for the background. (Kahly - Visual Journal - Semester 2)

During the interview Kahly explained that as:

A direct result of her sense of achievement in the above experience she was able to design and implement a highly successful unit of work in her practice school where she taught adolescents with ‘special needs’ who had minimal experience in both visual art and ICT and no

Figure 26: Kahly: ‘Torso’ (Kahly - Visual Journal - Semester 2).
CHAPTER 7: FINDINGS OF THE STUDY

traditional art room facilities. Kahly also presented a CD with inspiring images of her students’ work, but sadly ethical considerations prevented inclusion of these here. (Interview 2004, November 8).

Example 7. Journal extract illustrating a quite different approach to ICT use that involved a firm level of collaborative learning through a small group project:

Our project required us to work collaboratively to re-tell a written storybook in the form of a Claymation.... It requires critical analysis of a text and creativity to produce the final project. We intend to use our final project in primary school classroom. We would use our Claymation as a starting point for the children to undergo their own project along the same lines. We hope by asking children to work in groups it will give them the opportunity to achieve higher standards than what they could achieve alone, relating to the Vygotskian theory of the 'zone of proximal development'.

We collaborated as a group to decide how we would go about creating our Claymation movie. None of us had any experience with Claymation so this was a new learning journey for all of us.... We constructed a list of all the things we would need to have/create in order to start filming ... including a camera, a copy of Elmer by David Mckee to work from, clay for our models and a computer program capable of processing loads of images. The most important (and exciting) aspect was creating our clay animals.... There was much discussion among the group as to how well our models would hold together and the idea was raised we may need to make wire frames for the clay models. (Tia, Tom, Julz & Sam - Visual Journal - Semester 2).

Figure 27: Groopwork: ‘Claymation characters’ – A hand modelled clay Claymation character photographed, and then coloured, multiplied and distorted in Adobe Photoshop (Tia, Tom, Julz & Sam - Visual Journal - Semester 2).

Example 8: Description of teamwork by two students involved in creating three-dimensional props for a puppet show, and an exploration of visual art, math, literacy and ICT concepts suited to children in a general primary school classroom as explained in their visual journal:
The resources included the Light Wave animation program, digital camera, computer, and materials to create props, namely cardboard, clay, fabrics, coloured paper and glue. We concentrated on hand drawing model designs and traditional materials and construction techniques to create puppets and other props. The ICT work involved taking digital photos of the working stages for the electronic presentation of the finished work and using a DVD recorder to film the puppet show and record the narration.

We decided to integrate ICT in our visual art project because it is such a big part of our lives. In art we wanted to try something that we hadn't used before, such as filming. We had to play with filming techniques, using a determined trial and error strategy, especially in deciphering the instruction manual. After we eventually completed the filming it was necessary to work out how to format the DVD so that it could be played on either a computer or another DVD player … the ICT aspect of our work could be a very valuable classroom resource. It is a good way for children to develop visual art skills such as drawing and making with basic art materials, and to then learn about using ICT to show what they have learned and made. Lisa & Adrian - Visual Journal – Semester 2)

Example 9. A group project journal entry regarding a project proposal:
We intend to create a short digital animation sequence … as we have an interest in ICT and wish to develop our artistic skills in this area … the skills we develop will assist and improve our teaching practice. Being a digital era … these skills are highly important, relevant and engaging for our students. We will design a set and storyboard. This piece will be achieved by a series of digital photos of each frame of the storyboard, which will be edited to create an art piece. A stop motion technique will be adopted and numerous frames will be created. (Josh & Tia - Visual Journal - Semester 2)

Example 10. Description by Misha, whose project entailed research on the French Impressionists rather than her own art practice, explains another way that ICT was used:

Producing a PowerPoint presentation of my research was a lengthy but thoroughly valuable process. As the research had already been done, it was just a matter of scanning the visuals and summarising the text into point form; but even this took about four two-hour sessions. I was familiar with creating a text type PP, but had difficultly attaching sound, as I had not attempted this before. Although I managed to attach sound to one slide I couldn’t do so in ‘continue’ mode throughout the slide-show until fellow 4th year student Linda offered great support and e-mailed instructions that night (included below in italics). When giving the presentation during the art class, the unthinkable happened – the sound didn’t work! With some extra advice from Linda (as shown bellow in italics) I have attached sound a second time. It works on my home computer; let's hope it works when I present it to 1st yr. students! !!
Burn your MP3 music file to the CD that you will be using for your power point presentation once it is finished. Go to the first slide that you want your music to start on. In the tool bar click on insert> Movies & Sounds>sounds from file. Select the file you wish to insert (the one you burnt to the CD earlier) press ok. Click where you want the sound to start automatically or not (I suggest yes)

Now that you have the sound icon on your first slide click on it so that you have those little square or circle handles on it. Right click on the icon>custom animation. There is a section that appears on the right side on the screen for custom animation. Your file will appear in the central box. Right click on your file>effect options. The first section says start playing - leave that option as it is. The second option says stop playing, click on after and write in the number of slides in your presentation if you want the music to continue to the end of the presentation. Otherwise just say how many slides you want the music to be playing for. Under sound settings, select a volume that is loud enough to hear but lets you talk over it and then click ok. You now have continuous music on all your slides. Good Luck!! Linda PS:

If you have any trouble visit www.cadtutor.net/dd/power/mp3/mp3.html (Misha - Visual Journal - Semester 2)

At the time of submitting the CD, Misha attached the following note:

I really hope the file runs well on your computer. I feel I've taken a huge risk in producing something electronic, so I have to trust in my work…. I became quite involved in this project … my increased confidence in the technology will be a real advantage in my teaching practice and the ability to view and discuss these ideas critically with my colleagues. So, I could talk about it forever! (Misha - Note attached to submitted work - 2004, October 11)

Example 11. Vanessa’s account of a different perspective on PowerPoint:

Although the idea of linking art and computer technology didn’t feel right at first, I realized that it might be a powerful tool to share work processes with others…. Seeing the process of an artist allows for a deeper appreciation of the creative journey they have been on. I was worried at first that everyone would be using Power Point, but when I saw that there would only be a few and that they were really different to mine I had to quickly learn how to do it…. It is something I will consider introducing to the children I will work with. It would help show them how much they have done and where they have come from. PP to present my work was effective because it helped me to separate my information into slides, which meant that I only discussed one issue at a time. It also allowed me to show single thoughts/sentences separately which meant that the audience was able to focus on one section at a time rather than reading on. This encouraged my peers to make more comments and developed some interesting discussions during my presentation. (Vanessa - Visual Journal - Semester 2)
7.11 Disappointments along the way

The final two examples (12-13) illustrate that irrespective of the students’ use of ICT as described to date, it is impossible to deny that there were many moments of disappointment when they had applied a good deal of sustained effort only to find that their creative vision fell short of their own expectations due to inexperience with new media, or unanticipated technological glitches:

Example 12. A solo filmmaking project described by Tony during the presentation session:

The main thing I learnt ... was what not to do. I would have loved to have had time to film again and know what shots were going to work and what were not. I also would have used a separate audio track from the camera’s audio track to improve the ambiance of the entire film. To edit the film I used: Windows Movie Maker and Cyber Link’s Power Director, which I have never used before. It was easy enough to use, but I was excited about learning how to use a new program that did not have as many limitations as Movie Maker. I was amazed at how much personal learning about film making occurred for me, the next time I make a movie I will think so much more about how each shot is going to take place and how it will convert to the editing room. (Tony’s comment during the class presentation - Researcher Journal 2004, October)

Example 13. A group-based journal note explaining another disappointment:

The week before we were due to present we had ensured that all of the props and characters were completed and brought to uni in order to film the presentation, which would then give us a week to edit the film. After waiting nearly an hour for the ICT man to come and fix the computer in the room (in order for us to use the projector) our video camera decided it didn't want to focus on anything. So instead of stressing out ... we decided to try our best at presenting our working processes to the class in the following week by showing our actual props and talking about the work we had done. Anyway, maybe we will be able to place it on the web site. (Tom, Troy & Emma -Visual Journal - Semester 2)

7.12 Negotiating challenges

The preceding discussion relates in part to research question 3 - What do the student teachers regard as being the key limitations and advantages of using ICT in their coursework? As such it shows that the identification of the main limitations of ICT is perhaps the most complex research question to answer conclusively. In the main, the students’ constructive use of ICT might be largely attributed not only to their willingness to work well beyond their initial comfort zone, but to also take affirmative rather than negative attitudes around the numerous difficulties that arose along the way or to
attribute blame to any aspect of the technology per se. Specifically, after the initial settling in period where the students utilised opportunities to explore and generate at least basic conceptual and technical skills, and thereby gained confidence in their own ideas, they became increasingly proactive not only in exploring new media and processes, but also in identifying the ICT applications that best suited their purpose. Where applicable, they also focussed on finding solutions as a matter of course. Rather than reflecting negative attitudes to ICT use, they seemed to realise it was not so much the limitations of the ICT per se, but that in most cases, it was their own inexperience in terms of knowing how to use certain applications, or unexpected technological malfunctions that caused frustration.

7.13 Assuming responsibility
In all, most students, especially those within the six-week method course initially tended to rely on explicit teacher direction for artistic stimulus and technical support, but as their confidence grew, they started to tentatively take risks, explore options, and draw on the support of more confident peers. This trend is totally consistent with Jonassen, Peck and Wilson’s (1999) view that the implications of implementing constructivism include students having to grapple with the responsibility that comes from being in control of their own learning, especially, as some students are initially apprehensive in assuming this responsibility. However, Jonassen et al. (1999) also advise, that when given the opportunity most students, as in the case of this study, come to take an enthusiastic, proactive approach. In fact, judging by researchers’ accounts of deep and surface approaches to learning (e.g., Biggs et al., 2007; Ramsden, 2003) in which students who apply minimum effort to meet the course requirements engage in surface learning, whereas those who aim to apply appropriate cognitive activities display a deep approach to learning, it appears that many of the study participants adjusted to the latter category. In particular, those within the visual arts elective course, typically not only became quite enthused about using ICT in various aspects of their work, but also reflected a mutual respect and understanding of computer technology and art. In doing so, they exemplified practice in autonomous learning, risk-taking, inquiry, critical reflection, and co-constructing knowledge through self-initiated projects that incorporated ICT. A most valuable aspect of the students’ engagement with ICT was that they seemed to become increasingly attuned to Csikszentmihalyi’s (2003) concept:

Of all human talents, among the most precious … is the ability to discern opportunities around oneself, when others do not. In a given situation, one person will say 'there is nothing to do,' whereas another will find dozens of things to do and enjoy. The individual who is truly
engaged with the world, interested, curious, excited, is never at a loss for opportunities to experience flow. (p. 46)

Importantly, the data shows that the students not only often found, and shared ways of resolving a range of ICT challenges, but also took the initiative to locate and present a range of information. For example, on Australian and international artists’ use of computer technology, as well as information about advancements in relative ICT resources. In addition, as their sense of achievement grew, some welcomed invitations to present the culmination of their learning of ICT integration to students in the first year classes. Importantly, in these situations, they often succinctly explained their conceptual development. This included why and when they felt it was appropriate to use certain software programs rather than traditional mediums in terms of the “pedagogical or artistic relevance” (Comte, 1993, p. 163). They also reflected constructive critiquing skills of their own use of ICT resources, including Internet-based information. The following table, which summarises the way in which some of the inherent challenges of ICT use were addressed, coupled with the accounts of the way in which students worked with ICT, suggests that they were prepared to move beyond a surface approach to learning.

Table 11: ICT challenges ameliorated or redressed

<table>
<thead>
<tr>
<th>Challenges ameliorated or redressed specifically through peer scaffolding or collaborative problem-solving, albeit not always ideal for all students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss of work when computer freezes</td>
</tr>
<tr>
<td>Lack of interesting texture effects within all of the graphics programs</td>
</tr>
<tr>
<td>Art work looks better on screen than when printed on paper as hardcopy output</td>
</tr>
<tr>
<td>Limited colour palette in Microsoft Paint program</td>
</tr>
<tr>
<td>Drawing with a mouse is very awkward</td>
</tr>
<tr>
<td>Screen size limits viewing of work in progress</td>
</tr>
<tr>
<td>Print size is limited to A3 max</td>
</tr>
<tr>
<td>Art practice work requires more hard drive storage space than that allocated for students</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Minimal opportunities to implement ideas for ICT integration in art classrooms</td>
</tr>
<tr>
<td>Students have limited access to graphics software on their personal computers and some freeware ‘free trial’ graphics programs are limited to short time use or are particularly difficult.</td>
</tr>
<tr>
<td>Insufficient access to computers and scanners in art studio</td>
</tr>
<tr>
<td>Often work produced on personal computer is not transferable to the art room computers, especially when different software is used</td>
</tr>
<tr>
<td>Computer or Internet malfunctions cost valuable time.</td>
</tr>
<tr>
<td>Difficulty in using software, for example inserting music into a PowerPoint file</td>
</tr>
<tr>
<td>Difficulty in using Kahootz - multimedia software for 3D animations using the pre-made objects and backgrounds.</td>
</tr>
<tr>
<td>Incoming students need insights into ways of integrating ICT in visual arts education courses</td>
</tr>
</tbody>
</table>

The information within the above table does not suggest that all of the challenges confronted were well addressed in terms of long-term solutions, yet when taken together with the accounts of the students’ learning experiences, it aligns with Loveless’ (2008) research into creativity in the field of ICT use. Specifically, Loveless, who found that digital technologies provide tools that can facilitate active learning and creative endeavour, stressed that the real potential for creative learning resides not in the technologies themselves "but in the interaction with human intention and activity" (p. 64). Within the context of this study, it was precisely this factor that culminated in a far greater level of learning for all concerned than that which could have been achieved.
through teacher-centred pedagogy, or the students’ sole reliance on their teacher’s lofty intentions, ICT knowledge or skill base. The breadth of work collectively covered by student teachers not only by far exceeded my expectations, and my own ICT skills – especially in filmmaking, but also added immeasurably to my knowledge base for informing and inspiring students in subsequent visual arts education courses.

The study data also indicates the students’ working processes were similar to those of conventional artists who gather, process, and select materials; make trial arrangements, alter, adjust and finetune their compositions, and negotiate conceptual and technical challenges. The media has changed, but the thinking and work sequences remain much the same. Importantly, the students came to see that there are diverse ways of working with varying levels of technology. Some worked exclusively with ICT, while others combined traditional media and process with the new.

Regardless of the extent to which individual or small student groups used ICT, they all needed to develop what Eisner (2002) describes as cognitive skills that entail complex and subtle forms of thinking: Noticing subtleties, conceiving of imaginative possibilities, interpreting metaphorical meanings, exploiting unanticipated opportunities…. the improvisational aspect of one’s intelligence or flexible purposing that calls for the ability to change directions and redefine goals” (p. 35). Even the students whose art practice did not focus on ICT, gained insights into the way ICT can be use within the discipline, and engaged in rigorous debates around the associated philosophical, ethical and practical issues. In some instances the students whose art practice was based solely on traditional media, explained quite logically why they chose not to use ICT. As noted for instance in the following journal entry made during the class presentation session:

Kim stated that she was quite competent in using ICT, but really needed to develop traditional art practice skills. Whereas Jill explained that as her part-time work entailed presenting Power Point presentations to her employer’s clients, she wanted a change from working with ICT. (Researcher Journal 2004, October)

7.14 The most powerful message emerging from the data

The study data has provided valuable insights into the factors that inspired, slowed or precluded the students’ use of ICT in either the visual arts course classes or in professional practice schools. In some cases, the factors that emerged pertained directly to what the student teachers’ regarded as the limitations of the specific software they had used, or their own lack of experience in using certain software programs or equipment in the art making process. Given that the actual use of ICT in the art practice
work was not a compulsory assessment course component, perhaps the most powerful message conveyed through the research is that the students’ overall ICT use can be largely attributed to their search for a creative synthesis of aesthetic and new media concepts. Likewise, that the spirit of their artistic engagement resonates with what Csikszentmihalyi (1997) regards as experiences of intense engagement where deep involvement often causes people to lose track of time and to engage in risky but rewarding work:

Concentration is so intense that there is no attention left over to think about anything irrelevant or to worry about problems. Self-consciousness disappears, and sense of time becomes distorted. An activity that produces such experience is so gratifying that people are willing to do it for its own sake, with little concern for what they will get out of it, even when it is difficult or dangerous. (p. 71)

**7.15 Summary of the factors that shape students’ attitudes to ICT**

In addition to the motivational force of the students’ search for a creative synthesis as noted above, the overall data suggests that more firm ICT attitudes are undoubtedly associated with a higher level of experience in their use, and the subsequent development of more efficient strategies in negotiating aesthetic and technological elements. Equally important was an intricate interplay of the following factors that amount to the important overlapping spheres of influence that shaped their attitudes to ICT integration in visual arts education:

1. **Beliefs about the contribution that technology can make to the processes of visual arts learning and teaching.** This factor relates particularly to the students’ emergent understandings about the pedagogical and artistic relevance of ICT. Although this element aligns somewhat to the findings of previous researchers who, as Teo (2012) notes, have identified ‘perceived usefulness’ as a key influencing factor on teachers’ attitudes to ICT, the meaning of usefulness in the context of this study differs markedly from Teo’s reference to usefulness: “as the utilitarian aspect of computer use in terms whether its use would result in higher productivity or not” (p. 19). Specifically, a consistent perspective emerging from this study data was that ICT integration was particularly useful for heightening students’ explorations of they way in which ICT can support and extend their ideas rather than increasing their productivity in implementing these. The explorations related to four key areas: (1) Research on art, artists and art lesson ideas. (2) Art practice for its own sake, where the students’ diverse use of ICT suggests that the versatility of the media was central to their understanding of how it can be used to facilitate a range of approaches within the creative realm. (3)
Documentation and presentation of their in-progress and final work, including where applicable numerous versions of their art practice work. (4) The potential usefulness of ICT in bridging art concepts with other curriculum areas, especially with reference to developing teaching resources for promoting children’s learning of visual arts maths, and/or or literacy concepts in the general classroom.

The importance placed on the cross-curricular perspective, relates to research question 4 - How do the student teachers relate this use of ICT to their work in primary school classrooms? The consistent reference to the cross-curriculum factor highlights their perceptions of the relevance of their work with ICT to their teaching aspirations. Irrespective of whether or not students aspire to work in art specific classrooms, they generally perceive a greater chance of securing a graduate position in a generalist rather than an art specialist classroom.

2. Perceived ease of use of ICT media compared to traditional art media. There are three aspects to this factor. First, ‘perceived ease’ is a relative term in that what seemed to be a basic and easy to use ICT application for those with some background in both art practice and ICT, for others, even the most basic applications often signified a considerable challenge. Second, even when students came to understand that the use of ICT for art practice was more complex than they had envisioned they often modified their original ideas, but were not at all deterred from continuing their work with ICT. Third, some students were particularly attracted to ICT applications that they were not familiar with, precisely because they represented a high level challenge, and thereby an enticing opportunity to simultaneously extend their skills and exercise their innate curiosity by exploring new territory. As one student wrote: “I feel like one of the pioneer computer artists we read about, I needed a lot of help to get started with Photoshop … can’t imagine how they [the pioneers of computer art] managed to do this on old computers” (Kim - Visual Journal - Semester 2).

3. The learning and teaching environment. This factor encompasses the following areas:
(i) Access to resources within the classroom context, or personal access to required resources. While, as many previous studies, have shown, access to ICT resources is an obvious essential in empowering teachers with ICT integration skills. However the ‘relevance’ of certain ICT tools is subject to change. As the students' interests and skills advanced, so did their need for more complex software. For example, many started by using Microsoft Draw and Paint tools to explore the creation of patterns through the
manipulated repetition of line and shape, but when they saw how others had achieved multilayered effects through the Adobe Creative suite software their need for access to more complex software increased. In turn, they inevitable found as for instance Kahly in example 5 stated, her sustained work (on her home computer) in graphics lead to the need for a computer with faster processor capacity, external storage hard drives, and a quality color printer (Researcher Journal, 2004 October).

(ii) Class time and technical support. The fact that the students within the twelve-week visual arts elective demonstrated a higher level of autonomy and exploration of ICT than those within the six-week method course indicates that the time available for developing conceptual and technical skills has a powerful influence on their understanding of the relevance of ICT within the discipline. Although I had not intended to make any comparisons between the attitudes of the students in the two courses, it was evident that many of those within the six-week method course, as distinct from the twelve-week visual arts elective, had fewer opportunities for ICT exploration and support. Therefore, in comparison to those in the elective course, they were not all ideally positioned to develop firm attitudes to ICT integration through sustained experience.

(iii) The spirit of community, which emerged as a particularly strong motivational force for ICT use relates to three factors: (a) Teacher scaffolding as a start to independent investigations. (b) Opportunities for self-initiated individual or group work, supported through supportive interactions among the students. The latter point underlined the power of peer influence. (c) Access to inservice teachers, such as the previously noted art teacher Lilly, IT services staff, and ICT savvy people within the students’ personal network who constitute an extended learning community of support based on the students’ individual learning needs and interests. inspiration and support that the students drew from each other underlined the power of peer. This point is consistent with the perspectives of other researchers who have, as noted elsewhere in this thesis, highlighted the importance of social practices in the field of technology education, rather than the technology in itself (e.g. Loveless, 2011).

7.16 Course delivery constraints
The following section relates to my own perceptions of what might be best defined as the course delivery constraints that applied predominantly to the visual arts education method six-week course rather than the third and fourth year twelve-week visual arts
elective. Although many of the students within this course were able to gain some fine ICT integration experiences, there were times when I felt that the opportunities were not ideal for all of them. More specifically, within this course, the lack of students’ prior experience in using ICT, and in student-centred learning, illuminated the delivery constraints within the visual arts course. This was especially so when the students came to see how various ICT items could be used to support and extend their traditional art practice. For example, within this method course many of the 30 students became particularly interested in using the flatbed scanner as a device for transferring images of their two dimensional artworks into either a word document, or in some cases, into the Adobe Photoshop program. That is, the particularly enthusiastic students were interested in using the latter as a starting point for exploring ways to extend their traditional art practice techniques.

Importantly, as very few had previously used a scanner, they needed extended time-slots to explore its potential, and thereby others needed to wait patiently for their turn in using the only available scanner. As the same situation applied to those waiting to use the computers, many chose to concentrate only on developing their traditional art practice skills. While this showed that the students were keen to use the class time constructively, I sensed the loss of opportunity for them to begin to develop informed attitudes to ICT use.

Many students who had a scanner and appropriate software, and even technical support at home chose to continue their ICT work as ‘homework’. For instance, one student wrote: "rather than waste time waiting, I decided to do this for homework, my mum is an architect and has all the stuff I needed to do this" (Ava - Visual Journal - Semester 1). There were also as previously mentioned a number who quite proudly brought their own laptops to the art classes, but as these only had standard image processing software, they were not able to use the more advanced applications such as Adobe Photoshop. Apart from that, their fine intentions to engage with ICT and to reduce the wait for computer use worked well, even though it added to the sense of inequity of access to resources as very few had their own laptops. However, as noted previously, in light of the class time computer congestion, and: “the need to value effort … and to develop attitude” (Schmier, 1995, p. 21) an impromptu strategy on my part was to open up opportunities for students to work in the art studio during lunch times, and when possible, after other daily classes. As Eisner (1998) suggests, researchers
should continually fine-tune their approaches and adjust to any unpredictable circumstances.

Another dimension to the delivery constraints relates to the lack of students’ confidence in both visual arts and ICT, and their lack of involvement in collaborative and student-centred learning. Some students, again, mainly within the method course, who seemed to be intimidated by the concept of generating and openly expressing their own artistic ideas, seemed to expect a higher level of direct personal teacher instruction and reassurance in each part of their working process than it was logistically possible to provide. Consequently, while the majority of students quite quickly came to contribute to the overall class dynamics by sharing ideas, frustrations and their own problem-solving strategies, and to offer assistance to their less confident peers, I was aware that there were still those whose expectations for direct teacher support were not met. As Niederhauser, Salem and Fields (1999) suggest, preservice teachers’ instructional expectations are often firmly entrenched and resistant to change “because of their experiences as students in traditional classrooms” (p.157). Similarly, that the concept of restructuring their beliefs, often creates feelings of uncertainty and discomfort” (p.158).

More importantly, apart from the fact that I had not anticipated that the students’ overall prior ICT learning experience would be so low, there were instances where I had not expected that some would be reluctant to articulate the basic barriers to their learning. In this regard, a number of students stated in their journals that they did not access the range of course learning support materials on Blackboard because they did not know how to negotiate the university website. On the other hand, a number of students who had stated that they did not have Internet access at home were promptly supplied with a disk or hard copy either by one of their peers or myself. A subsequent, systematic strategy includes closer observations of individuals’ specific learning needs, and keeping reserve copies of the course materials.

7.15 Summary.
This chapter has recapitulated the characteristics of the study context, the purpose of the study and the research questions, followed by the findings of the data collection processes with reference to the research questions. Specific questionnaire items were discussed as were a number of written and visual vignettes of the participants’ ICT learning experiences. Allied to this, was the inclusion of several tables that summarised particular findings. The accompanying discussion was supported through reference to
numerous literature perspectives, including those drawn from associated research studies that are cited within the literature review of the thesis and those that have entered the more recent literature discourse. The final part of the chapter noted my own perceptions of the course delivery constraints, but it is interesting to note that these constraints did not emerge as a notable issue for the study participants through the study data.
8.1 Introduction
This chapter revisits the main focus of the study by recapitulating information covered in the introductory chapter about the focus of the study including the main rationale. It then outlines the way in which the key literature perspectives on ICT integration in education have been incorporated within the chapter of the thesis. This section is followed by my own reflections of the study including the overall impressions gained about the students' responses to opportunities for ICT integration. Although the limitations of the study have been presented in the introductory chapter in terms of possible challenges for future research, some additional comments of this type are made at the end of this chapter, along with mention of how the findings of this study support previous researchers' recommendations.

8.2 Outline of the study purpose
As described in the introductory chapter of this thesis, the study was designed to simultaneously promote preservice teachers' opportunities to explore the artistic and pedagogical and artistic relevance of ICT within the visual arts education courses and to gain insights into the factors that shape their attitudes to ICT implementation within their coursework and their work in school classrooms. The impetus for the study stemmed from the increasing focus on ICT integration within the visual arts curriculum documents, the national and international visual arts education discourse, as well as that within the sphere of preservice teacher education (e.g., ACDE, 2001, 2009; RMIT, 2002). Collectively, these spheres of discourse accentuated the urgent need to address the glaring lack of ICT resources and technological-pedagogical expertise within my own preservice teaching visual arts education context.

In light of the above, the rationale for conducting the study within my own visual arts education context centred on the imperative of accepting the onus of revising the visual arts education courses and ensuring that the student teachers' had opportunities for ICT integration that were explicitly commensurate with the demands of the education system within the 21st century information society. Second, given, as inferred from the literature, the importance of promoting teachers’ attitudes to ICT integration, especially in the early stages of their ICT knowledge and skill acquisition, the need for insights into the factors that inspire or limit students’ attitudes to ICT was paramount. Allied to this was the need to work with students in building a fundamental knowledge base around the ways in
which ICT can best support a visual arts education framework that has relevance within the immediate visual arts education context and their work in either general or art class rooms.

The process of introducing the student teachers to ICT integration in visual arts education was underpinned by the perceived need to empower them to make their own informed decisions around the advantages and cautionary facets of ICT rather than engage with the pro technology in education rhetoric. Importantly, this entailed providing opportunities for them to develop conceptual and technical skills in both traditional art practice and digital media as distinct from privileging either, especially so that they could determine their own preferred way of working whilst demonstrating the willingness to move beyond their comfort zone. This approach was based on the understandings I had developed through the groundwork of the study, as described in the introductory chapter, coupled with the constructive and the cautionary literature perspectives on ICT use in education, namely in the field of visual arts. Specifically, irrespective of the plethora of multilayered arguments for ICT integration and numerous philosophical and practical issues raised within the literature regarding the inherent intricacies of ICT implementation within my field, there was little advice about visual arts educators could redress any context specific deficits.

Nonetheless, as a result of the literature search together with a sustained level of groundwork, as discussed in chapter one, I determined the potential of ICT to offer exciting opportunities for learning and teaching within the discipline. I also understood that the realisation of this potential was clearly contingent on the establishment of a sound pedagogical framework which incorporated a co-inquiry approach where the student teachers and I could engage in a reciprocal exploration of the pedagogical and artistic relevance of ICT. Therefore, rather than focusing solely on the promotion of technology use per se within the visual arts education context, the study drew heavily on the multifaceted literature on effective pedagogy, and learning theories as a basis for facilitating the best possible learning environment (e.g., Huber, Hutchens & Gale, 2005). Accordingly, reference to the underpinning pedagogical concepts of scaffolding, collaborative and autonomous learning where students’ ownership of their learning is encouraged has been consistent throughout the thesis. The associated choice of the arts-based practitioner methodology for the study has been highlighted in the methodology chapter of the thesis along with an explanation of the key characteristics of the study context and the data collection processes which aligned with Eisner’s (2002)
notion of arts-based research and the complementary, and the concept of A/r/tography (Irwin et al., 2008) which encompasses the ethos of community of practice and co-inquiry.

Due to the need for an understanding of the impact of the ICT agenda with respect to the position of visual arts education within the broader educational context, as well as its inherent link to the historical and contextual features of artists’ practice, a scan of the relevant literature has been presented in the chapters that follow: Chapter 1: Introduction to the study and Chapter 2: Methodology, and precede Chapter 7: Findings of the study.

• Chapter 3: The impact of computer technology advancements on education.
• Chapter 4: Cautionary perspectives on the ICT agenda in education – including visual arts education.
• Chapter 5: Constructive perspectives on computer technology in visual art education.
• Chapter 6: Computer art: An overview of historical perspectives.

8.3 Dilemmas and rewards of the educator-researcher identity
The spirit of the following discussion encompasses Eisner’s (1997) notion of narrative:

[T]he telling of stories and to the sharing of experience. To the extent that experience itself can be conceived of as the primary medium of education, stories are among the most useful means for sharing what one has experienced. Narrative – which means a telling - makes it possible for others to have access not only to our own lives when our stories are about them but also to the lives of others. (p. 264).

Due to the intricate dual teacher-researcher role, I acknowledged that: “Qualitative researchers must “make … explicit the ‘subjective I’, be cognizant of their assumptions and explicit about the influences that these assumptions have on their search since they are the ‘instrument’ in the research design” (Jones, 2002, p. 463). Accordingly, although I was most reluctant to overtly influence the way in which student teachers worked, I acknowledge that the overarching aim of this study was to empower them to make and articulate their own critical judgments about the topic with reference to their own explicit exploration of the conceptual and technical aspects of ICT use along side their learning of traditional forms of art practice. I was particularly intent on promoting students’ understanding of ways to combine ICT use with traditional art practice media rather than privileging either media so that both could be understood as serving similar aesthetic processes and purposes. As Fuller (1987) writes in the preface to Abbs Living...
powers: *The arts in education*, Abbs was concerned about the ‘desire’ within some circles “to eliminate ‘messy’ traditional activities, like painting and sculpture from higher education, and to see them replaced by vocational pursuits based on … computers. All this is like destroying the forests” (p. xii).

I also acknowledge that it was necessary to ignite the students’ interest from the start through discussions around a range of literature perspectives on art and technology, and a collection of both traditional and computer mediated art created by both artists and school students. This included some dynamic discussion around the appropriateness of using other peoples’ images in the context of constructing their own artistic compositions (Mercedes, 1996). In line with Hennig’s (2000) suggestion, I also discouraged students from incorporating the stereotypical clip art images in their own work, especially as I thought it would be a more rewarding learning experience for them to explore ways of generating their own images. Moreover, and in contrast to Hennig’s (2000) recommendation that teachers should “allow and encourage use of copyright free images that can be scanned or downloaded and manipulated into new ones” (p. 40), I encouraged the students to create their own images entirely as an alternative to incorporating other people’s images in their compositional work. Also necessary was fundamental guidance around the ways in which both traditional and ICT media and processes might be used for research, art practice, documentation and presentation of their work, especially with respect to the use of complex software programs such as those within the Adobe Creative Suite. In effect, at times it may be counter productive to expect all students to construct their entire learning (e.g., Arnone, Grabowski & Rynd, 1994). As Eisner (1997) explains: The absence of guidance leaves students … without the skills … to use the medium well. The result can be a visual disaster, even though the intention is a noble one and the display of courage beyond question. (p. 226)

Following the introductory aspects of ICT integration, the students were encouraged to formulate their own learning goals with reference to their choice of media. In this respect, my role as the facilitator of the inquiry process was to be “willing and able to encourage participant initiatives, to step into the background when these occur, to become an ordinary group member; and yet be willing … to take the stage again when the situation requires it” (Reason, 2002, p. 175). Allied to this, it was necessary to advise many students of the need to reconsider very ambitious project goals, especially in terms of what could be realistically achieved within the available course time and resources.
Given the low student computer ratio there were some awkward moments when I was quite uncertain about how to place limitations on the time that each person could spend on computer activity. This challenge of ensuring equitable access to resources was a particularly new and uncomfortable dilemma, as in the past when only traditional media was being used, I could always provide a full class set of paint brushes, palettes and so on. However, the issue of low student computer ratio was eased significantly when some of the students brought their own laptops to class, and others chose to work in pairs at a computer. One strategy that proved to be highly useful was to encourage the use of the art studio computers after scheduled class times. This was not always a straightforward process because the art studio was heavily scheduled for other classes, and many students had significant family or part-time work commitments, which precluded their ability to work after hours. Nonetheless, some spaces were identified where small groups of student could conveniently access the art studio beyond regular class times. Consequently, it was evident that the changes to the regular class culture were not simply due to the use of ICT, but as a result of the limited ICT resources having to be shared, and thereby the need for new forms of organisational flexibility and collaboration.

8.4 Autonomous learning

Depending on the nature of the students’ self-initiated learning goals, they chose to work either on a small group or solo basis where Bonk and Cunningham’s (1998) notion of ‘internalization’ came to the fore. Here, internalization is described as: “the process of taking new information that was experienced or learned within a social context and developing the necessary skills or intellectual functions to independently apply the new knowledge and strategies” (p. 29). Internalization occurs through processes first performed with others on a social basis and then effectively executed in independent learning activity. In Vygotskian (1978) terms, as often cited in educational literature, this form of social interaction extends the “zone of proximal development” (p. 86) to foster students’ skills that were first active in collaborative or assisted learning situations, but were gradually internalized as independent self-regulatory processes.

8.5 Making connections with preservice teachers’ visual arts education and their teaching roles

The participants’ process of internalisation seemed to be integral to their understanding of the ways in which ICT implementation might be appropriate in either art specific or
general classrooms. In fact, for many of the students, the opportunity to discuss various facets of ICT use among themselves seemed to trigger individual ideas not only about using ICT in their own work, but also how certain ICT applications might be used in their own teaching. At the same time a number of students noted that they would need to plan activities according to the available ICT resources and the duration of the available class times within their schools. Even though as beginning teachers, their repertoire of learning and teaching activities were still in the embryonic stage, they were often able to articulate sound ideas about how ICT might inspire children’s learning of visual arts concepts, and linking these with other curriculum areas. In turn, their ideas around the purposeful use of ICT emerged as being significant in fostering their learning of ICT applications during the visual arts education courses.

Thus, despite the view that preservice teacher education subjects tend not to provide opportunities for students' modeling across a range of subject matter (e.g., Downes et al., 2001), the students came to share their views on the potential value of ICT not only in art as a discrete curriculum area, but also as an asset for promoting cross-curricula perspectives to visual art education. This is consistent with the view that “one of the strongest platforms for art education may be the integration of art with other key learning areas” (Hudson & Hudson, 2007, p. 5), and the new, across the curriculum focus on inquiry and intellectual judgment:

Making connections within a major, between fields, between curriculum and co-curriculum, or between academic knowledge and practice is critical for well-formed learning…. Students must play an important role in making this happen, but their success depends in large part on commitment and creativity from everyone involved. (Huber et al., 2005, p. 6)

8.6 Promoting thought and action

My interpretation of the data suggests that the underpinning pedagogical approach within the visual arts education context complements the view that: “Helping students to become more self-aware and purposeful, more intentional about their studies is a powerful idea” (Huber et al., 2005, p. 4). Similarly, that students’ reflection on their own art practice can assist in the development of their teaching skills (Hudson, Lewis & Hudson, 2011). Also confirmed, from my educator-researcher’s perspective, was Reason’s (2002) view on how working in a group of people who trust each other, support and challenge “one other to look experience in the face and take risks in developing new forms of practice, is a very special experience” (p. 172). With respect to art-based inquiry, a consonant lens is projected by Irwin (2004) in her *A Metonymic
métissage: “Thought and action are inextricably linked, and through a hermeneutic circle of interpretation and understanding, new knowledge affects existing knowledge that … affects the freshly conceived existing knowledge. In this way “the circle is unbroken: action-reflection-action-reflection…” (p. 33). In Whitehead’s (1966) view, the hermeneutic circle signifies:

A theory, which is experienced as participatory phenomena, where the person engages in dialogue with theory bringing each person’s biography and values to the interpretation. The intention is not to explain … for control purposes, but to reinterpret in order to provide greater understanding. (p. 176)

8.7 Flexible purposing
The students’ persistence in working through a range of creative problem solving issues, and the progress made as their work moved from the simple to the more sophisticated use of graphics software (Hurwitz & Day, 2001) was especially heartening. They generally conveyed a palpable sense of achievement and ownership over their work when they found ways to negotiate a range of both practical and conceptual challenges. In much the same way, Schunk (1989) identified that motivated students show exemplary effort and perseverance in the learning process. With respect to the students’ art practice with ICT they experimented with a range of graphics software programs including Adobe Photoshop, which they invariably identified as being quite difficult to learn. Yet, after a period of exploration, they often noted that it was particularly flexible and versatile in allowing for a wide range of approaches to more substantial art practice.

This versatility factor prompted the students to exercise the “flexible purposing required for shifting directions and solving problems, as challenges within their art practice arose” (Eisner, 2002, p. 52). As the flexibility involved moving fluidly between traditional and ICT art practice modes, their interests were piqued as it opened up their art practice options, especially with respect to focussing on either the creation of ‘still’ images, animations or film clips. Irrespective of the degree to which digital media was incorporated, all students were able to gain insights into the fundamental features of graphics software for the incorporation of text, pictures, sound and movement as an added dimension to traditional art practice (e.g., Hubbard, 1995). This multiplicity of uses mirrors Hennig’s (2000) perspective on the need to address the plurality of learning styles within an art classroom. It also supports the notion that digital media surpass the scope of traditional media to meet diverse students’ wide-ranging needs in different instructional contexts, and that the value of digital media’s flexibility for
classroom application includes its “versatility and transformability” (Rose & Meyer, 2002, p. 64).

The extension of traditional art practice was exemplified through students’ use of the digital camera. This entailed learning more than merely how to use a digital camera, namely to see it as an expedient means of conveying images to any regular computer monitor where specific software is used for adjustments, manipulations and exportation to other applications (Vaughan, 1996). In this regard, professional artists’ work that demonstrates how composition, framing and focal point are important elements of effective photographic images inspired some students to experiment with this type of work. Among the examples of artists’ use of photography as a creative medium that held particular appeal for students was Connie Rodriguez’s *L’Echappe* (1991). This depicts a surrealistic event of diverse subject elements “created by montaging and using geometric distortion and elaborate photo-retouching on the computer” (Preble & Preble, 1994, p. 196).

The flatbed scanner was also a popular choice as it enabled clear electronic images of existing parts of the students’ artwork as a starting point for developing ideas and dispensing with the difficulties of manipulating the mouse for accurate drawing (e.g., Walters et al., 1989). For example, some experimented with ways to create a range of textural effects through hand rubbings of various surfaces and hand painting papers that were scanned and imported into Adobe Photoshop as a way of creating the background effects for their digital compositions. These scanned textural elements proved to be an inspiring alternative to the standard textures that could be applied instantly through the graphics software menus. Small pieces from the students’ collections of assorted miscellaneous ‘found’ objects and papers were also scanned and variously resized, recoloured or distorted and incorporated in their visual compositions via Adobe Photoshop. Many also found ways of using the scanner in combination with graphics software to create digital collages as described by Brommer (1994).

The versatility of ICT was also explored by students who were intent on printing or transferring copies of their ‘still’ images on to either specialist digital print papers or through the use of specific solutions that allow the transfer of either black and white or full colour images on to two dimensional surfaces. However, as the achievement of high quality print output was a time consuming or intricate exercise, some students went to
print shops where they had their work enlarged and printed on to their choice of paper or canvas. Alternatively, some found that they could add visual impact to their computer prints by applying hand colouring and textural effects and thereby transforming the visual quality of the print copy. Through the development of these techniques they were able to achieve not only subtle and different versions of their work, but also images that could not be readily replicated either digitally or by hand.

The scope of the above options prompted students to see that there was no reason, other than their individual preferences, to limit their choice of media to either the digital or traditional forms for art practice, as they could combine both in the one project. They could also see that the potential of computer media for art practice needs to be seen in light of its limitations as well as its assets especially as for some drawing tasks it can be slow, if not awkward (e.g., Walters et al., 1989). Although, as noted in the previous chapter, some students found that the mouse is not an ideal freehand tool, it was useful for experimental combinations of mark making and exploring colour effects. More importantly, all students came to recognise potential of the media in relation to the aims of the project since each media requires the development of distinctive sensibilities and technical skills (e.g., Eisner, 2002). This factor aligns with Candy et al.’s (2002) research into artists’ creative practice which found that the challenges inherent in working with digital technology can encourage artists to break with their existing conventions, “a development that is a core element of truly innovative practice” (p. 73).

8.8 Embracing opportunities for collaborative group work

The majority of the students embraced the spirit of collaborative learning by sharing ideas, support and feedback, but some quite validly chose to work on an individual project. Whereas those whose project ideas centred on creating animations recognised that as this would be an exciting, albeit complex task, it could be accomplished best in a group situation where individual interests, skills and efforts were well synchronised. Thus, the collaborative work provided opportunities for students to devise more ambitious creative projects than one person could achieve, and to understand that collaborative learning is maximised when each group member takes responsibility for extending their own learning, and contributing to the learning of others (e.g., Culpan & Macmillan, 2008; Slavin, 1989). This entailed not only ensuring that each member’s contribution was valued, but also that agreed communication commitments and work completion timelines were honoured. Allied here is Hooper et al.’s (1995) view, though with respect to mathematics education rather than visual arts, three significant
differences between cooperative learning and traditional instruction. First, the teacher does not transmit information to the students. Instead, students support each other’s learning in small groups. Second, students must ensure that every member of their group achieves the desired objectives. Third:

These experiences appear to benefit students of all abilities where the more advanced students gain from the cognitive restructuring associated with teaching, and less advanced benefit from the personalized attention available from group members. Moreover, groups appear to create environments in which all members benefit from exposure to diverse attitudes and opinions that are often unavailable in the traditional classroom. (p. 163)

Candy et al. (2002) offer an interesting artist’s perspective on how collaboration can stimulate more than one viewpoint about the creative process:

One artist notes how the process of collaboration … and the kind of discussion that it requires encouraged her to reflect on different views about how to proceed with the work and what method to use to produce it. Collaboration helps the participants to address tasks via a number of parallel channels of thinking, which draw upon different types of knowledge. From this process, entirely new understandings can emerge that transform the outcomes of the creative work. (p. 73)

8.9 Quis Docet Discit - Those who teach learn

As the high level of student interest in creating animations and the incorporation of sound clips was well beyond what I had expected and planned for, it became immediately apparent that their experiential knowledge of certain software programs quickly exceeded my own by far. However, given the wide range of possible applications of ICT in visual arts practice, I was well prepared to accept that technology is not something that must be “mastered beforehand and presented to students in a controlled and systematic way”, and that teachers should “encourage and expect students to appropriate the technology in ways that could not be anticipated” (Hooper et al., 1995, p. 157). At the same time I could relate to the notion of teaching as a two-fold process. First one learns in preparing to teach students, “and then one learns from them as one works with them” (Britzman & Pitt, 1997, p. 65). As such, my experience as a teacher, learner, and researcher resonate with two pertinent concepts. First, “the development of our teaching involves the kind of personal enquiry and openness to change that informs our ability to make educational judgments in the light of personal and professional values” (Rowland, 2000, p. 13). Second, “the teacher is a learner, and the learner is, without knowing it, a teacher – and upon the whole, the less consciousness there is, on either side, of either giving or receiving instruction, the better” (Dewey, 1916, p. 160).
A complementary view with respect to visual arts education is that although the teacher is usually the connoisseur in the fine arts classroom – the one who has the most expertise and experience, “there are often varying degrees of connoisseurship amongst the students themselves” (Eisner, 2005, p. 51). The notion of the mutually enhancing teacher-student relationship clearly came to the fore: “The teacher … is taught in dialogue with the students … students while being taught also teach and become jointly responsible for a process in which all grow” (Freire, 1970, p. 53). While, as others have noted, few would disagree that, even in the face of rapid technological advances, the teacher’s role in higher education is vital (e.g., Skilbeck, 2001), students need to know that the teacher is not the sole source of knowledge:

They need to feel that it is fine to go ahead and find things out for themselves, then tell you how they did it. It is vital to set up a comfortable environment where everyone is acknowledged as being somewhere along the continuum of learning. Discussing how we each learn differently is a good way to introduce the meta-cognitive understanding that can empower students to self-directed learning in the future. (Hennig, 2000, p. 40)

8.10 Intrinsic motivation

With respect to the aesthetic quality of the students’ artwork, it soon became evident that they were exploring the elements of design, and that the visual appeal of their work was particularly important to them. There was also tendency for students to refine their work in response to peers’ comments in ways that are consistent with the view that feedback is a key factor in student engagement, development and improvements to learning (e.g., Marzano, Gaddy & Dean, 2000). Thus, although Hooper et al.’s (1995) research found that ICT could detract from learning by diminishing the amount of effort a student invests most of the students were intent on undertaking deep exploration of technical processes in order to improve the visual appeal of their work. As Eisner (2002) posits, the acquisition of technique is not merely a technical achievement. It is a mode of thought whereby “the changing features of students’ artwork are the results of change in the way in which they think” (p. 146). The students’ experimentation with compositional layout options by cropping and resizing select parts of their compositions also fits with Eisner’s (2002) notion of artistry, which consists of having an idea, the imaginative ability to conceive the technical skills needed to work effectively with some material, and “the sensibilities needed to make the delicate adjustments that will give the forms the moving qualities that the best of them possess” (p. 81). Likewise, with Vaughan’s (1996) advice to novice multi-media artists:
How you blend elements, how you choose colours and fonts, what strategies you use to catch the eye, how adept you are at using your tools - these are the hallmarks of your skill, talent, knowledge, and creativity coalesced into the all-important visual connection to your viewers. (p. 286)

For some students, the option of using Adobe Photoshop to create images and text in the one composition added to their incentive of drawing inspiration from the work of various children’s book illustrators, particularly the Australian artist Shaun Tan. In this instance, they generated ideas for creating art rich picture books with the view of engaging children in writing stories to accompany their drawings of imaginative creatures and landscapes. They also gained insights into how the potential of ICT for creating multilayered illustrations within multiple formats can be imbued with possibilities to work tangentially and to cultivate visual literacy as advocated by the numerous authors cited in the preceding chapter. In effect, the students’ work was propelled by their intrinsic task interest (e.g., Bonk et al., 1998; Borkowski et al., 1990) where their innate urge for creative work, and higher order thinking and natural curiosity all contributed to their motivation to learn ICT applications. As Bonk et al. (1998) describe: “Intrinsic motivation is stimulated by tasks of optimal novelty and difficulty, relevant to personal interests, and providing for personal choice and control” (p. 29).

The importance of promoting students’ sense of ownership over their creative work is highlighted by Candy et al. (2002) who hold that the locus of control - establishing the manner of the creative process is paramount to promoting creative attributes, particularly in risky endeavours that entail resisting inflexible and formulaic approaches. The trialling of concepts and media may initially lead to failure, but such situations stimulate a shift beyond conventional possibilities because creative people are not readily averted by prickly challenges at the cost of achieving creative aspirations. As ideas do not emerge from “thin air”, the conditions for creativity are very important, in which case “the use of complex tools, such as computers, forms a significant part of the context in which these conditions for creativity exist” (p. 73).

8.11 ICT as an entry point for artistic engagement

In general terms, the students’ work with computers certainly supported Walters et al.’s (1989) early research findings that, the computer can provide an entry into higher levels of artistic problem solving, especially for beginners: “It can provide students with a flexible “sketch pad” on which their ideas can be sketched and changed, where
experiments can be conducted, and with which contrasts can be drawn” (p. 110). However, as the students were almost entirely new to art practice digital technology, there were high, and perhaps unrealistic, expectations of what they could do with the technology. Therefore, they needed to devote considerable time in trialling simple aspects of their image development and in deciding whether or not they were sufficiently satisfied with their results, or if they should start again. Of relevance here is the view that students’ “critical thinking entails the reflective thought about solution options and perspectives before any one resolution is reached”. This way, they “can resist early closure when they aim to resolve complex, open-ended problems” (Lampert, 2006, p. 47). In the many instances where students worked through the trial versions before achieving what they deemed to be an effective composition, they included these in their visual journals as a record of their how their ideas and confidence developed through experimentation.

Perhaps more importantly, the time required to refine artistic ideas and technical skills, and to complete their subsequent version/s diminished as their confidence in the use of the hardware and software, and visual art concepts increased. In this respect, many students stated that the chance to see other students' work in situ was more immediately inspiring and conceptually accessible than searching Internet sites or revisiting the collection of professional artists’ digital work placed on the course Blackboard. The main creative inspiration seemed to come when they drew ideas from each other in ways that resonate with Henri’s (1923) sentiment:

> The technique an artist uses must be evoked by the spirit of the things that [he or she wish] to express…. To create a work of art, or to inspire others to create a work of art, teachers must both be guided by their own internal and individual visions and also go to kindred spirits … and study their ways and means, learn from their successes and failures. (p. 55)

### 8.12 Different learning styles

Significantly, the integration of ICT within the visual arts education courses was also a way of drawing together aspects of the students' learning of pedagogical concepts, and to see how, as Stone (1961) describes: “Each of us has his own alphabet with which to make poetry” (p. 380). As the nature of their individual or small group-based work was quite diverse, the students were able to consider Gardner’s (1993) notion of multiple intelligences and different learning styles in relation to student-centred pedagogy, and the ethos of collaborative and creative learning, and how these ideas might be incorporated within their own teaching. The notion of interpersonal intelligence was also
discussed, especially in relation to collaborative projects where each group member needed to be aware of others’ sense of confidence in contributing to the project and in understanding when each person might have need for quiet reflection times for processing their own ideas (e.g., Culpan & Macmillan, 2006).

8.13 Accepting the challenges of technological glitches
Consistently evident through the data was mention of a range of technical glitches that caused students frustration and significant time delays during their working processes. But, instead of pessimistically dwelling on these factors, their discussions tended to centre quite eloquently on the practical and conceptual challenges that they had encountered as being an integral part of their learning with respect to their own work. At times they also mentioned how they have seen a range of similar technological issues in their PP schools, or how they might need to negotiate similar challenges in their own teaching contexts. It seemed that the negative facets of their experiences with ICT were outweighed by the notion of embarking on an inspiring challenge in their quest to achieve their self-initiated learning goals. The value of this factor relates to a clear concern:

When teachers begin teaching they find the answers they have been given in their training often do not work for them. Since they have not been given the analytic processes to discover why it doesn’t work and to generate new answers, they often blame those who taught them. The credibility of staff in universities is thus eroded. (Davies, Edwards, Gannon & Laws, 2007, p. 37)

With respect to students’ class based presentations, the multi media capability of the ICT used was regarded as providing the most interesting way for them to represent and share the knowledge that they had acquired. This often included their own interpretations of various forms of information they had distilled along the way. However, three interesting points, which have not been evidenced in my literature searches, emerged through the students’ discussions during the presentations and have since been taken into account during subsequent courses: First, the general appeal of the presentation sessions centred on the mix of presentation formats, including PowerPoint, film clips and traditional art practice work, including the traditional hand written visual journals, rather than a single concentration of one media type. Second, with respect to the group projects, the students described the way in which each group member contributed to the collective progress, and the advantage of working in a group where they were able to take on a well-defined role, and had one technologically adventurous member. Third, even those who worked on an individual
project, acknowledged their sources of information, inspiration and support they had received either from peers or from more knowledgeable others beyond the university. Fourth, several students validly mentioned that some of the PowerPoint presentations were far too long and that there should have been a limit placed on the number of slides that could be included in any one presentation. I could also see that some of the PowerPoint presentations showed some clever incorporation of digital effects such as sound and movement, but it seemed that the overly enthusiastic use of ‘special’ effects detracted from the substance of the content that they were seemingly meant to highlight. Hooper et al. (1995) offer an apt analogy for such situations: “Misusing the capabilities of the instruments or underemphasizing the composition of the musical score will detract from the final production of the symphony” (p. 163).

With respect to the students’ use of the Internet, many mentioned a range of interesting sites that were useful to their immediate research interests or teaching purposes. Some also described a sense of being overwhelmed by the scope of information available, and the time required for locating the most reliable or relevant written or visual information. Surprisingly, some students emphasised that they prefer to spend time in the library rather than get lost in the vast space of the Internet. This point seemed to apply especially to those who did not have Internet access at home. However, the use of ICT for research and presentation purposes undoubtedly added to the cooperative learning between and among students, thus contributed to their skill set for real-life work situations (e.g., ACDE, 2001).

**8.14 Overall impression**

The overall impression gained in working with and observing the students coupled with my emergent understandings informed by hermeneutic cycles of interpretive readings of the data (e.g., Myers, 1995) is that once they had time to develop confidence in using a number of traditional art practice and ICT applications through guided, open-ended explorations, they began to generate their own ideas. They also supported each other in learning to use ICT and extending their engagement with traditional media. By allowing exploration, the students were encouraged to build on the insights they gained from the introductory discussions and readings on the possibilities and limitations of ICT and to discover interrelationships that are often missed in traditional presentations of lesson content and to search for information that meets individual needs (e.g., Hooper et al., 1995). By engaging with the spirit of collaborative learning and sharing images of digital artists’ work during the class presentations, the students could see that the
collective work produced during the study period represented just a tip of the iceberg when it comes to possibilities for creative exploration of new media.

The most encouraging overall finding of the study in terms of the students’ development of constructive attitudes to ICT integration was that they represent a significant contrast to the concerns expressed by other researchers. Specifically, those who note, though not necessarily with respect to ICT use, that many higher education graduates lack creativity, communications skills, analytical and critical thinking, and problem-solving skills (e.g., Neo & Neo, 2011; Teo, 2012). For instance, as indicated in the previous chapter, with minimal teacher intervention, the students particularly those within the twelve-week visual arts elective course, developed a range of visual and written learning and teaching support materials in the form of both hard copy output and Compact Discs. These were shared at the end of the semester on a whole class-group basis at the end of the semester, and added to the learning resources that inform and inspire the visual arts education experiences within subsequent courses. Significantly, the synergy of the collaborative inquiry provided understandings that the students and I could not have gained through a teacher-centred approach. The overall insights gained into the influences on the students’ use of ICT added immeasurably to my own evolving understandings, not only about ICT integration within visual arts education, but also of the importance of promoting their voice through engagement with the notion of “co-inquiry”. The students’ involvement with multimedia projects proved to be an ideal way to extend their self-directed learning abilities, to learn to think effectively, and to practice the setting and resolving of creative problems, as well as the associated decision-making strategies, on either an individual or collaborative level (e.g., ACDE, 2001).

### 8.15 Implications for preservice teacher education

The study has found that although ICT has long had a significant impact on educational policy, and the expectations of school and university teachers, the integration of ICT in visual arts education can be more complex than commonly thought for both the students and educators for a number of reasons other than the obvious shortage of ICT resources. These include, the considerable differences in the ICT competency of entry students, their varying skill levels in visual arts applications of ICT, and preconceived ideas about the validity of ICT in the art classroom. In addition, the shortage of ICT resources within most of the professional practice school art classrooms precludes student teachers’ opportunities for any sustained experience in either observing or implementing ICT inclusive art lessons. As such, the findings of the research underline
the importance of seeking ways to empower all incoming students with the decision making process about the ICT integration practices that will be most beneficial to them, rather than allowing practices to emerge from any policy directives.

In this regard, the pedagogical approach encompassing a rich blend of pedagogical concepts formulated by numerous revered scholars, emerged as a significant factor in ensuring the students had opportunities to develop informed attitudes to ICT integration through, as the old Latin expression holds *Non verbis, sed rebus* – not by words but by things, namely their own understanding of ICT as a creative learning medium that can be applied in visual arts and general classrooms. The allied notion relates to promoting students’ engagement with reflective practice where they learn ‘through’ rather than learn ‘about’ practice (e.g., White, Dixon & Smerdon, 2004, p. 2). More importantly, the study found that a concerted focus on ways to introduce students to the fundamental features of ICT use within the discipline coupled with the establishment of a student-centered co-inquiry learning context can go far in promoting their informed attitudes to ICT integration in and beyond the visual arts education context.

The study data also suggests that educators cannot assume that all of the incoming students will be conceptually and technologically adept in synthesizing technology applications with visual arts coursework as a matter of course. This point raises questions about how much art educators, and indeed policy makers, can realistically expect novice art and ICT users to achieve within the short time frames of certain courses. For students with minimal ICT skills at the start of the course, the more realistic short-term goal is to assist them in acquiring the basic insights and ICT competencies relative to the a discipline area rather than impose unrealistic expectations that they should all learn effective use of ICT as a matter of course. As Eisner (2002) so aptly reminds us: “The aim of the educational process inside schools is not to finish something, but to start something. It is not to cover the curriculum, but to uncover it” (p. 90).

**8.16 Implications for future research**

The methodological contribution of the study is the establishment of a formative framework for building successively deeper levels of ICT integration and creative practice in the preservice teacher visual arts education courses. However, the limitations of this study are clear. These have been defined in the introductory chapter under four specific stands, which offer a range of exciting challenges for future
researchers. Specifically, the study has lead to a firm start to ICT integration within a specific context, and has addressed the defined research questions. Yet this progress of it self does not diminish the imperative of ongoing exploration into ways of improving students teachers’ ICT integration experiences. In other words:

The educational system must continue to evolve and adapt to remain effective. There will never be a final solution or conclusion and to be searching for one means that one is missing the point. The classroom learning environment should constantly change to meet the challenge and potential provided by new understandings of how people learn.... Appropriate application of basic knowledge for some useful purpose is what defines educational technology and living up to this definition is the hallmark of [its] evolution phase. (Hooper et al., 1995, p. 158)

Allied to this, future researchers might include a range of study specific visual data that shows how emerging technologies enhancing specific learning and teaching constructs. Ideally the dissemination of future research findings would align with the following two views: First, “questions are more important than answers; knowledge and, more important, understanding should evolve from the constant probing of such questions” (Gardner, 1999, p. 4). Second, as the methods and procedures are really the heart of research, associated “activities should be described with as much detail as possible and the continuity between them should be apparent” (Weirsm & Jurs, 2005, p. 146). For instance, this thesis has described what Pellegrino (1999) defines as the more mundane issues that often combine to prevent loftier visions from being realized. Specifically, the availability of the ICT resources, educators’ own level of relative knowledge and skills, the entry skill levels of the students concerned, and the timeframe in which the described learning experiences occurred and the pertinent understandings evolved. It is the combination of these factors that undoubtedly determine what educators can expect to achieve in terms of promoting their students’ attitudes to ICT integration in any discipline.

8.17 Supporting existing research
The findings of this study support the many claims, as noted in chapter 4 of this thesis, that there are clear tensions between the idealised world of ICT integration as reflected in policy documents, and the realities existing within the higher education sector and the art classrooms of many schools. Also supported is the view that as ICT has advanced the way in which students in all discipline areas can now locate and retrieve current information, there is little need for students to accumulate anything but the most immediately significant information (e.g., ACDE, 2001). Although teachers now have a great task in scaffolding students’ discerning use of an unprecedented influx of written
and visual material, and distilling the most appropriate information for particular study purposes, traditional pedagogies focussing on the transmission of knowledge from teacher to student are less relevant. Instead, education should concentrate more on providing students with opportunities to work in a progressively more autonomous manner, and in collaborative settings, responding to change through learning, and in acquiring constructive approaches to problem solving and lifelong learning (e.g., ACDE, 2001).

The paradigm shift away from pedagogies designed for transmission of knowledge and towards more constructivist pedagogies that focus on knowledge building, as applied in the context of this study in preservice teacher education, attests to the validity of this advice. Implicit here is the potential synergy of new technologies and an epistemological shift in thinking about education. Similarly, that the ongoing advancements in ICT that might offer unprecedented features that can be selected as and when appropriate for stimulating learning and creative activity, preclude any scope for complacency in their use. The need for an ongoing review of the learning and teaching resources and practices is clear. This means that irrespective of how plentiful or sophisticated ICT might be, teacher knowledge and a commitment to cultivating environments that facilitate higher-order thinking and creativity with relevance to life in the 21st century is essential (e.g., Loveless, 2002). The study particularly supports Loveless’ (2011) view that ICT integration requires a pedagogical framework for creativity, where ICT is recognised as being: “more than ‘just a tool’, and contributes disruptive, distinctive relationships in pedagogical activities” (p. 311). Likewise, in preparing to use ICT, teachers’ pedagogical reasoning needs to consider the wider subject and community contexts for the learning experience. Just as important is the consideration of the expertise and roles of all participants, the affordances of the technologies for particular purposes: “Models of pedagogy need to be relevant, and grounded in teacher experience, flexible, complex … open to reflection and adaptation” (p. 311).

### 8.18 Concluding comments: Forward thinking

The intention in the presentation of the findings of the study, coupled with the noted limitations and the recommendations for future research, is to contribute to the broad spectrum of teacher education, which needs to understand the wider context, the tools and the content of teachers’ pedagogy with digital media. In fact, as Loveless (2011) recalls, Freire (1987) urged “We need to “read the world” of our practice (p. 97).
Encompassed here is unequivocal support for Worrall’s (2004) call for more international dialogue around the promotion of effective ICT integration in arts related disciplines. Specifically, in the interest and spirit of: “An empathy with inter-cultural exchange, so that different curriculum models can be examined” (p. 58).

The last and most personal reflection on the study is best expressed with reference to Freire’s (1998) sentiment about teachers’ acquisition of knowledge. My spirit in commencing this doctoral journey rested on the certainty that there were some things I knew well and many that I did not know at all, and that by retaining this conviction throughout my journey it was more likely that I may come to know better what I already know and better learn what I do not yet know. Now that I am near the end of the journey:

My security is grounded on the knowledge, which experience it self confirms, that I am unfinished. On the one hand, this knowledge reveals to me my ignorance, but on the other hand, it reveals to me that there is much I may still come to know. (p. 100)
References


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Wilks, S. (2004). Designing a thinking curriculum: Encouraging higher order thinking in
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Appendix 1

PLAIN LANGUAGE STATEMENT

Dear Students/preservice teachers,

My name is Arda Culpan. I am currently involved in a PhD study of the influences on preservice teachers’ attitudes to integrating information communication technology (ICT) in the context of visual arts education. I am particularly interested in the influences on preservice teachers’ decisions regarding the use of ICT resources to support visual arts education. Your willingness to contribute to this study by completing a questionnaire would be sincerely appreciated. But, it is most important to note that you are not obliged to participate in any way at all and that your decision to either participate or not is not associated with any assessment relating to your work in visual arts education or your standing in any other part of your course.

Preservice teachers who choose to complete the questionnaire will find that one of the questions asks if they are willing to be interviewed, and/or to provide copies of their visual journal and any relevant artwork to please enter their name and contact details in the appropriate place or to contact me in person arda.culpan@rmit.edu.au

Preservice teachers, who choose to complete the questionnaire, but not participate in the interview process, are not required to identify themselves in anyway.

Those who choose to participate in the interview process need to know that:

The ‘interview’- data collection phase will include:
• Questions requiring approximately twenty minutes.
• The time will be pre arranged in accordance with mutual convenience.
• The questions are designed to verify and expand on the data entered in the questionnaire, particularly respondents’ perceptions of the advantages and limitations of ICT relative to visual arts education.
• Participants’ verifying the data entered by the interviewer - for the purpose of validating transcripts. This means that interviewees will also be asked to check the interview notes that I write during the interview and to advise on any changes or deletions to be made before signing the copy as being correct.
• During the interview participants will also be asked if they are willing to submit copies rather than the original version of their visual journals or artwork to be used for the research. These can be provided in the form of paper photocopy, floppy or CD disk. A black CD will be provided upon request. These can then be placed in my locked mail box on level 4 or handed to me in person together with the signed permission form.
• All participants will be free to withdraw their participation at any time as well as any unprocessed data. Simply sending an email stating that you wish to withdraw can do this. You do not need to state the reason.
It is important to reiterate that preservice teachers’ participation in this study is OPTIONAL and is not related in any way to visual arts assessment tasks or any other aspect of the teacher education course. The questionnaires will be made available to pre-service teachers on a voluntary basis at the end of the semester. Completed questionnaires can be either handed to me or placed in my pigeonhole. Interviews will only be conducted after all visual arts assessment tasks have been submitted and assessed. The names of all interviewees and the data collected will be kept confidential at all times in the study and in any publications that may result from the work. A summary of the findings will be available to all participants. This will outline the findings of the main factors influencing preservice teachers’ decisions with regard to using ICT in the context of visual arts education. It will not include the true names or photographs of any participants.

If you are willing to participate in this research or would like to know more about any aspect of it, please contact me at the address below:

School of Education  
RMIT University  
PO Box 71 Bundoora, 3083  
Tel: 9925 7854 or 0419335495  
220.3.09  
Email: arda.culpan@rmit.edu.au

Alternatively, you may contact the Chair, Human Research Ethics Committee, Faculty of Education Languages and Community Services, RMIT University  
PO Box 71 Bundoora, 3083  
Tel.99257840

Any queries or complaints about your participation in this project may be directed to the Secretary, RMIT Human Research Ethics Committee, RMIT, GPO, Box 2476V, Melbourne, 3001. The telephone number is (03) 99251745

Arda Culpan
### Appendix 2

#### Preservice Teachers’ Questionnaire

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<td>1. Please rate your experience in traditional visual arts practice (prior to teacher ed. course):</td>
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<td>2. Please rate your experience in creating electronic presentations re visual arts (prior to teach. ed. course):</td>
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<td>3. Please rate your experience in using computer software to create visual images (prior to teach. ed. course):</td>
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Please expand here if you learnt computer art applications prior to RMIT, including where you learnt (e.g. secondary school, but don’t enter the name of the school) and which software programs you used:

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4. Have you seen students working with computers to research art topics/ present art work/ create visual artwork in any school settings? (Please circle as appropriate)

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<th>YES</th>
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If YES please expand a little here, but don’t enter the name of the school:

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5. Do you think it is important for pre-service teachers to learn computer art applications? (Please circle one)

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<th></th>
<th>YES</th>
<th>NO</th>
<th>Don’t Know</th>
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Please state briefly WHY YES or WHY NO

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Appendix 2

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<th>Question</th>
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<td>Do you have access to a computer at home?</td>
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<td>Do you have Internet access at home?</td>
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<td>Do you have a color printer at home?</td>
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<td>Do you have a CD burner at home?</td>
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<td>Do you have a scanner at home?</td>
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<td>11</td>
<td>Do you have a digital camera at home?</td>
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<td>12</td>
<td>Do you have art related or image making software at home?</td>
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<td>13</td>
<td>Do you have a laptop computer?</td>
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<td>14</td>
<td>Did you choose to use any computer related equipment &amp; or software to use in creating your visual arts work as distinct from presenting your work for this course?</td>
<td>YES</td>
<td>NO</td>
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<td>15</td>
<td>If YES to Q. 14. Can I use a copy of your work for my research?</td>
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<td>16</td>
<td>Have you used any computer related equipment or software related to visual arts in your PP teaching?</td>
<td>YES</td>
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If YES please list the software you have:

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Please expand here with regard to WHY you did or did not: (Please use back of page if you require more space)

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If YES can you please elaborate here, including what you used and how and why, but don't include name of school: (Please use back of page if you require more space)

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17. If **YES** are you able to show me any copies of students’ work? | **YES** | **NO**
---|---|---
18. Did you use the Internet as a resource for your visual arts project? | **YES** | **NO**
19. Did you create an electronic presentation of your visual arts? | **YES** | **NO**

If **YES** please elaborate here regarding any difficulties you encountered and any assistance you sought from peers, family, friends or teaching staff and whether or not you believe electronic presentations are useful in this context. If applicable, you may also comment on any instance/s where you assisted one or more of your peers: *(Please use back of page if you require more space)*

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20. Do you know of software programs suited to use in visual arts? | **YES** | **NO**
21. Have you seen any computer-assisted art created by students? | **YES** | **NO**

If **YES**, please elaborate briefly: *(Please use back of page if you require more space)*

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22. Have you seen any examples of computer-assisted art created by artists either in a **GALLERY**, **INTERNET** or **Book**? Please circle one as applicable | **YES** | **NO**
23. Have you visited the National Gallery of Vic. any time during the past: 1, 2, 3, 4 years (If **YES** please circle either 1, 2, 3, or 4) | **YES** | **NO**
24. If **YES** was this as a part of your art education program at RMIT? | **YES** | **NO**
25. Are you willing to be interviewed re any of the above questions? | **YES** | **NO**

**IF YES** please enter your name and email address or contact number here: