

The evolution of technology: landmarking Australian secondary school music

Renée Crawford

Faculty of Education, Monash University, VIC; Email: renee.crawford@monash.edu

Abstract

This paper will provide an overview of the history of the inclusion of technology in Australian education with a focus on music education. There will be a discussion of some of the arguments for its inclusion and how these may have changed over time. Technology has always been actively present in music and its practice. However, it was through more contemporary genres of music that composers and musicians began to experiment with sound and technology. Such diverse thinking about the way technology can be used in music produced notable examples of electronic music such as, Charles Dodges *Changes* (1970) and Paul Lansky's *Six Fantasies on a Poem by Thomas Campion* (1979). The professional music industry now considers technology a valuable commodity that continues to improve the practice of music. Similarly, society has defined what is valuable in education in different ways. Standards are set by the Australian federal and state government and various educational authorities, such as the Victorian Essential Learning Standards (VELS), to reflect what is considered valued knowledge in education. It is clear from such standards that Information and Computer Technology (ICT) is of importance. Technology has significantly changed business corporations, the industrial workforce, economic growth and the music and entertainment industries all over the world, yet only until recently; has its true impact on education been realised.

Key words: Technology, music education, music technology, electronic music, holistic teaching and learning.

Australian Journal of Music Education 2014;2,77-92

Introduction

Since the late 1960s, the presence of technology in education has been undeniable. Its influence continues to impact the way that music education is taught and learned. Discussion surrounding technology has shifted from the benefit of its inclusion in education, to how best to utilise its powerful platforms. It appears that there are significant dates in the recent past that are important to the evolution of technology in Australian education and subsequently music education, such as the arrival of MIDI (Musical

Instrument Digital Interface) in 1982. This article will explore the inclusion of technology into the Australian secondary school music curriculum since the late 1960s. This overview of the history of technology and particularly music technology in Australia provides some context for its present status. The 'history of the present' provides a historical lens to recent events. It is used to:

Expand the boundaries of possible approaches to contemporary problems by using historical investigations to permit a thinking of those problems in different ways. ... histories of the present take as their starting point questions

posed in the present and seek to make the terms through which those problems are currently understood an object of inquiry.¹

The histories of the present Victorian curricula can be understood in this context as “the making of histories that locate the present as a strange, rather than familiar landscape, where that which has gone without saying becomes problematic”.² To provide an explanation for each state and territory³ in Australia would be beyond the scope of this paper. However, it is intended that this will be a snapshot of the status of technology in music education in Australia.

Australia is currently in transition from state and territory based curricula to a draft national curriculum governed by the Australian Curriculum and Assessment Authority (ACARA). Currently, state and territory governments still have constitutional responsibility for schooling. In the past at a national level, pronouncements of strategic policy development and delivery of educational programmes and services are coordinated through the Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA). The Commonwealth⁴ government works cooperatively with the states and territories and non-government school authorities in pursuit of national goals that “focus on the learning outcomes of students and provide a framework for national reporting on student achievement and for public

accountability by school education authorities”.⁵ The Department of Education, Science and Training (DEST), also provides national leadership and works collaboratively with the various states, territories, industry, agencies and the community in support of the Government’s objectives. The Department explains their role as:

*We develop and implement policies to ensure the continuing relevance of education, science and training to contemporary needs and the growing requirements for lifelong learning. We also ensure high quality and value for money in delivering Government funded programmes.*⁶

Some of these national government pronouncements and programs will later be explored as they are relevant to the recent past and present inclusion of technology in music education.

Technology in Australian music education pre MIDI (1982)

While the focus of this paper considers the inclusion of music technology in secondary schools, it is important to chronicle the arrival of technology in music education that occurred in universities. It is important to consider the developments composers and lecturers made to the evolution of technology and its ripple effect on secondary school music education in Australia. The Elder Conservatorium at the University of Adelaide⁷ has an established history and pioneering reputation towards electronic music and music technology. In 1962, Dr Henk Badings⁸

1. D. Tyler & L. Johnson, “Helpful histories?” *History of Education Review*. Vol. 20, No. 2 (1991): 1-2

2. *Ibid.*, 2.

3. The states of Australia originated as separate British colonies prior to Federation in 1901. Their powers are protected by the Australian constitution, and Commonwealth legislation only applies to the states where permitted by the constitution. By contrast, the territories are directly subject to the Commonwealth government. The Australian Parliament has powers to legislate in the territories that it does not possess in the states. Australian Government Geoscience Australia, ‘National Mapping – Fab Facts, Dimensions, Area Facts’ (Commonwealth of Australia, 2006) [Online] <<http://www.ga.gov.au/education/facts/dimensions/areadime.htm>> (Accessed: 10/10/07).

4. Australia is a Commonwealth of states.

5. Department of Education, Science and Training, *DEST Annual Report 2002-2003* (2003) [Online] <<http://www.dest.gov.au/annualreport/2003/3.htm>> (Accessed: 18/07/05).

6. Department of Education, Science and Training, “Key issues & strategic priorities”. *About DEST*. (2005a) [Online] <http://www.dest.gov.au/portfolio_department/dest_information/about_dest.htm> (Accessed: 18/07/05).

7. The University of Adelaide is situated in Adelaide the capital city of South Australia.

8. Dr Henk Badings was a Dutch composer and scientist and the first visiting composer to the University of Adelaide. S. Wilkie, ‘Electronic Music Unit - History’ (The University of Adelaide, 2007) [Online] <<http://www.emu.adelaide.edu.au/about/history.html>> (Accessed: 10/10/07).

(1907-1987) was the first to introduce music concrete and electronic music to the University of Adelaide. English composer and educator Peter Tahourdin (1928-2009) graduated from London's Trinity College of Music in 1952 where he studied composition with Richard Arnell⁹ (1917-2009). He became the second visiting composer at the University of Adelaide in 1964 lecturing in Analog Synthesis techniques.¹⁰ Tristram Cary (1925-2008) established the Royal College of Music's Electronic Music Studio and commenced lecturing from 1967 to 1972.¹¹ He was founding director of EMS¹² (London) Ltd, co-designer of the VCS3¹³ Synthesiser and designed and built his own private electronic music studio, which was to become known as one of the longest established private studios in the world. The equipment from his studio was brought to Australia and incorporated as part of the studio at the University of Adelaide. Audio engineer Derek Jolly (1928-2002)¹⁴ purchased a Moog Synthesiser Mark III in 1969. This was not only one of the first Moog synthesisers to be exported out of the United States of America, but the first to arrive in Australia.¹⁵ Shortly after he granted access to the University of Adelaide allowing Tahourdin to lecture with it and establish the first practical course in Electronic Music in Australia. In 1969, Tahourdin's student Martin Wesley-Smith (1945-) was the first to compose a piece for Moog titled, Vietnam Image. Stockhausen (1928-2007) visited the University of Adelaide in 1970 as part of his world tour and stirred further interest in electronic music.¹⁶ In 1972, Tahourdin left the University of Adelaide to commence lecturing in 1973 at the University of Melbourne¹⁷ where he purchased

an EMS Synthi 100 that is now exhibited in the university's Grainger Museum. During this time Cary became a visiting senior lecturer to the University of Melbourne. After leaving Australia in 1971 to pursue postgraduate studies in Britain, Wesley-Smith¹⁸ returned in 1974 and took up a position as lecturer in electronic music at the Sydney¹⁹ conservatorium.

While at a tertiary level electronic music and music technology represented new musical thinking, still developing their place in the music higher education curriculum, innovations had begun to filter through to secondary school education. Although there remains an absence of literature on technology in Australian secondary school music education during this time, there is evidence of a positive attitude, for example, from the Victorian Journal *Agitato*. This journal was published in the 1970s and 1980s for music educators in the government or state secondary school system by the Secondary Schools Music Advisory Committee. This journal encouraged futuristic thinking and while not every edition incorporated technology or electronic music, the cover of the journal commonly had a picture of some form of music technology. A significant example would be the cover of the 1975 edition, which has a Moog Sonic Six synthesiser. Educators also occasionally wrote for the national *Australian Journal of Music Education*, a notable example was Tahourdin's 'Electronic Music in the Classroom'.²⁰ In this journal, Fine Music Australia Pty Ltd was advertising the VSC3 as not only a composition and performance tool but as: "A teaching aid. These synthesisers can, for the first time, allow teachers in schools and universities to scientifically

9. Ibid.

10. Ibid.

11. Ibid.

12. EMS is an acronym for Electronic Music studio.

13. VCS3 is an acronym for Voltage Controlled Studio with 3 oscillators also known as 'The Putney' electronic music synthesiser.

14. Dates not known.

15. Wilkie.

16. Ibid.

17. The University of Melbourne is situated in Melbourne the capital city of the state Victoria in Australia.

18. A. A. Thomas, "Wesley-Smith, Martin". *Grove Music Online*. (Oxford University Press, 2007) [Online] <<http://www.grovemusic.com.ezproxy.lib.monash.edu.au/shared/views/print.html?section=music.30147>> (Accessed: 09/10/07).

19. The Sydney Conservatorium is situated in Sydney the capital city of New South Wales in Australia.

20. P. Tahourdin "Electronic Music in the Classroom". *The Australian Journal of Music Education*. April, No. 2 (1968): 25-29.

demonstrate all the main acoustic phenomena.²¹ This can be landmarked as one of the first advertisements that targets music technology as a platform or tool for music education.

A survey conducted in the early 1970s investigated 'The State of the Art of Electronic Music in Australian Schools'. Despite a very positive response rate (92.9% return), the results indicated that the matter of electronic music in schools was quickly dismissed as experimental as it did not occupy "an established place in the curriculum of schools, and there was no evidence returned in the survey of developed and systematized courses in this field."²² Regardless of a number of contemporary works during the late 1960s and 1970s such as those of two major Australian composers Barry Conyngham's²³ (1944-) *Through Clouds* (1974) or Peter Sculthorpe's²⁴ (1929-) *Sun Music I* (1965), aleatoric music and electronic music were at their infancy in Australia. It is therefore no surprise that school music should reflect this situation. Teachers who wished to incorporate contemporary music were faced with practical issues such as how to present such music to students with an immense lack of available information and virtually no resources.

In 1971, Francois described the state of electronic music in Australian education very negatively in the following points:

- There are no professional composers in Australia.
- There are no professional performers either.

21. Fine Music Australia Pty Ltd "Think of A Sound...". *The Australian Journal of Music Education*. October, No. 13 (1973): 24

22. B. Chalmers, "Electronic Music in Education as Applied in Schools". *The State of the Art of Electronic Music in Australia*. Seminar August 9-13, (1971): 9.

23. Barry Conyngham was born in Sydney, New South Wales and has a combined distinguished academic career and compositional output. J. Murdock, *A Handbook of Australian Music*. (Melbourne: Sun Books, 1983): 37

24. Peter Sculthorpe was born in Launceston, Tasmania. He is currently Emeritus Professor at the University of Sydney, his extensive composition catalogue consists of more than three hundred and fifty works which are regularly performed and recorded throughout the world. Australian Music Centre "Peter Sculthorpe". *Represented Composer*. (2006) [Online] <<http://www.amcoz.com.au/composers/composer.asp?id=241>> (Accessed: 01/10/07).

- In the Universities, there are no electronic studios with permanently employed people working full-time in the studio.
- There is no research programme in music education.
- In the Universities, there is a complete lack of concern in musical problems on the part of other departments, and vice-versa.
- There is no electronic studio at ABC [Australian Broadcasting Commission].
- Recordings at ABC are bad jokes.
- F.M. in radio transmission doesn't exist yet.
- Contemporary music making is very low.²⁵

While this view appears biased, there was a generally recognised under-representation of electronic music in professional and academic music in Australia. Further, due to the paucity of literature available during the 1970s regarding this issue, some oral history was conducted to provide a more accurate depiction of the status of technology in Australian music education. An interview with Associate Professor Jane Southcott more positively highlighted that where possible, the latest technology was being used in Australian music education during this time: "In some Australian schools small synthesisers, such as the VCS3, were used in class music instruction from 1975. At the time this was seen as pioneering."²⁶

The arrival of the computer and MIDI, post 1980

In the early 1980s the microcomputer²⁷ or computer as it is now referred to, provoked

25. J. Francois, "Electronic Music is Education". *The State of the Art of Electronic Music in Australia*. Seminar August 9-13, (1971): 23.

26. Associate Professor J. Southcott, "Interview". Interview by the author on 9 October, 2007. Transcripts are in the possession of the author. Associate Professor Southcott studied music at Adelaide University 1972-1975 and subsequently taught music in South Australian secondary schools. During this time she incorporated electronic music into her teaching.

27. Computers were first referred to as 'microcomputers'. Essentially this would have been a computer from the mid 1980s that would have used a microprocessor chip such as the Zilog Z80A, the Intel 80386 or the Motorola 68030 for its central processor. P. Robinson, *Basic Facts: Computers*. Collins GEM Dictionary. Revised Edition. First Published 1983, Samways, B. (Great Britain: William Collins Sons & Co. Ltd, 1988).

mixed reactions to its use in music education. Stevens commented in 1987 at a symposium entitled 'Utilising Computer Technology for Music Teaching and Learning' why this medium was attractive for music education:

Highly sophisticated multi-voice and multi-timbral sound generation capabilities incorporated into the actual hardware system. There has also been a growing awareness among software producers of the auditory output possibilities of microcomputers which has resulted in the development of several highly sophisticated software-based music synthesis and music processing/printing systems. It needs to be remembered that theoretically the auditory output of a microcomputer is equally as powerful as the visual output which most people have traditionally associated with the computer-human interface.²⁸

This marked the beginning of the technology revolution or information age. However, while the ideas for the use of such technology presented endless possibilities, the pedagogical understanding for incorporating this medium in education was extremely modest. Music educators adopted technology for simplistic teaching and learning practices that could occur as they had without the use of technology at all. This was in direct conflict to societal views and interactive nature of technology. This landmarked the advent of the technology classroom gap in music education. This is the divide that 'exists between technology as it is used and accepted in society in general, and our educational technology as it is used in our music classrooms and reflected in our curricula.'²⁹ Traditional teaching and learning practices were entrenched and certain knowledge such as, Western art music notation, was regarded as valuable. The basic

use of technology through drill-and-practice programs for example, was to enhance traditional pedagogy. This also signified the beginning of the 'teacher as a technician' debate. This concept underpins much non-research based material available to teachers that essentially provided information about the software and hardware available during this time. This resulted in a lot of 'How to...' articles. Teachers were exhorted to become technically literate with a stream of technical jargon on hardware and software surrounding discussions. Also during this time several American and British articles influenced Australian music education in support of the 'teacher as technician': Hall (1986), Wagner (1988), Feldstein (1988), Wells (1988), and Morgan (1988 & 1989).³⁰

During the 1980s one of the most common computers found in Australian schools was the Apple II+, Apple //e and Apple //c. While each provided music generation *via* a single-voice, the Apple II+ and Apple //e had the potential to produce up to 16 simultaneous voices through the use of plug-in synthesiser cards which would insert into the computers' expansion slots through the motherboard.³¹ Other computers during this time that possessed in-built multi-voice and multi-timbral music generating systems include: Apple Macintosh, Commodore 64, 128 and Amiga, Atari 800XL and 520ST and BBC microcomputer.³² This multi-timbral and multidimensional sound thinking was further developed, laying the foundations for one of the most significant music technological inventions in history. In 1982 the Musical Instrument

28. R. S. Stevens, "Computers in Music Education: The Current "State of the Art" and "Future Directions and Opportunities" Revisited". Stevens, R. S. (Ed.). *Computer Technology and Music Education: The Australian Beginning*. (Victoria: Deakin University Press, 1987): 10-11.

29. D. B. Williams 'Viewports to technology and teacher training' *Music Educators Journal*. October, Vol. 79, No. 2, (1992): 29.

30. W. Vann Hall 'Conquering the MIDI Muddle'. *Music Educators Journal*. December, (1986): 26-29; M. J. Wagner, M. J. 'Technology: A Musical Explosion'. *Music Educators Journal*. October, Vol. 75, No. 2, (1988): 30-33; S. Feldstein 'Technology for Teaching'. *Music Educators Journal*. March, Vol. 74, No. 7, (1988): 35-37; C. Wells 'Microphones in Real Time'. *Music Teacher*. June, Vol. 67, No. 6, (1988): 37-38; N. Morgan 'Music Software for Atari'. *Music Teacher*. July, Vol. 67, No. 7, (1988) 29-31 & 'Multi-Track Recording'. *Music Teacher*. February, Vol. 68, No. 2, (1989): 17-18.

31. Stevens, 9-25.

32. Ibid, 9-25.

Digital Interface (MIDI)³³ was developed. This interface allowed various music technologies such as synthesisers and digital sequencers to connect to computers and other MIDI capable instruments for recording in either real-time (live) performance or step-time (programmed) performance. To some degree this revolutionised the way technology was perceived and used in Australian music education.

Contemporary positions on music technology in schools in the United States of America (USA) and the United Kingdom (UK) influenced thinking in Australia. At this time, in the USA music technology and computer technology in the form of Computer-Aided Instruction (CAI) was frequently used in developing a highly structured classroom setting. Such learning favoured intensive skill development and was dependent on simulated and guided instruction. In contrast, many music educators in the UK adopted a Computer-Aided Learning (CAL) approach that was used in a classroom setting that supported a curriculum promoting creativity and independent learning. This less skill intensive approach was considered more suitable for general music classes and encouraged problem solving. The principle ideas underpinning these two approaches for utilising technology in music education reflect the ways in which society and government engaged with technology. Although a polarity between the two positions appears to have developed in the mid-1980s, there was some crossover, due to the interactive nature of technology.

33. Musical Instrument Digital Interface or MIDI first appeared in 1982 following an agreement among manufacturers and developers of electronic musical instruments to include in their instrument design a common set of hardware connectors and digital codes. The MIDI 1.0 Specification was formally released in 1983 by the International MIDI Association. Therefore Roland, Yamaha, Korg, Kawai and Sequential Circuits all released MIDI-capable instruments that same year. J.Hass 'How does the MIDI system work?' Chapter Three: MIDI *Introduction to Computer Music: Volume One*. (2004) [Online] <http://www.indiana.edu/~music/text/MIDI/chapter3_MIDI.shtml> (Accessed: 19/10/04).

According to Stevens one of the most significant innovations in software developed in the 1980s had been the incorporation into instructional programs of disk-based record keeping of student performance data. Stevens explains:

During the early 1980's a typical drill and practice program in say interval recognition or note naming would have kept the user's score in its volatile memory until the completion of the lesson when the user would be given opportunity to record it on a hard copy pro forma score sheet. Within the past twelve months or so, many music software developers have incorporated user sign-on procedures and disk based record keeping into their programs.³⁴

This development meant that students could only access their own results and their privacy was protected, accurate records could be kept without worrying about the loss of data and teachers could evaluate students' performance progressively. Again, this highlights the use of computers in only a very simplistic way which is CAI.

Around the early to mid-1980s, various initiatives in Australian music software indicated a support in music education for CAI programs. Rosanne Gare developed *Sing – Creating your own tunes* for Apple II as part of the Queensland Education Department's Computer Education Curriculum Project in 1982. *The Treble Clef* and *The Bass Clef* were two instructional programs developed for use on the Commodore VIC-20 microcomputer by Victorians Philip O'Carroll and Christine Vincent and published by Contronics. An educational software development group from the Education Department of Western Australia developed *Music*, a set of five programs in aural training and music notation for use on the BBC microcomputer. Robert Cook produced three music instruction programs for the Apple e// called *Harmony*, *Ear Games* and *Key Signatures and Scale Builders* published by Medleys Music

34. Stevens, 15.

House.³⁵ Given the types of programs being developed for educational use and those that were available, it is understandable why music teachers would have primarily utilised CAI in their teaching practice. During that particular time, it was also arguably the only practical use for available technology. Southcott places this over emphasis of CAI in perspective, "CAL was always there, but problematic. It was a question of size. One synthesiser to thirty-five students! Until computer and keyboard laboratories and laptops it was always going to be a problem".³⁶ The limited music education resources were hindering the quality of teaching and learning.

Incremental, funding and resources have slowly increased throughout the years. The government's commitment to Programmed Logic for Automatic Teaching Operations (PLATO) in the mid 1980s is evidence to this. PLATO was a comprehensive computerised learning system originally conceived at the University of Illinois in 1959.³⁷ The University of Western Australia had officially joined a network of seventy-two centres across twelve countries in May 1985, utilising PLATO. The Computer Aided Learning Service (CAL) under the direction of the Systems Research Institute of Australia was to oversee the implementation of PLATO within Western Australia and assist in future developments in other states. In June 1985, the Micro PLATO computer became fully operational and students were using the aural training lessons from the GUIDO³⁸ programs.³⁹ This example of

Government funding invested in technology, already presumes expectations for its future in education at the outset. The underlying issue that remains constant is that music education not be overlooked for funding in the secondary school curriculum.

Stevens asked how may microcomputer technology be used in music teaching and learning? In response, two principle applications for the use of computers in music education were alluded to – as a form of educational media and as a personal tool for music teachers and music students.⁴⁰ The first application is a form of CAI. As mentioned previously this encourages a highly structured classroom setting where teaching methods are expository and teacher-centred and students are passive recipients of information. Computing programs such as drill-and practice, instructional games and tutorials with testing capabilities are employed in this situation. The second application was to use the computer as a personal tool for music teachers and music students. This tended towards a CAL approach. Stevens subdivided this into four categories:

1. Digital music synthesis.
2. Multi-track digital recording/sequencing.
3. Music transcription, editing and printing.
4. Data-based applications that include music library catalogue and musical instrument inventory.⁴¹

Steven's connects this second application for the computer to educational media that was termed a 'microcomputer-based learning environment' that was analogous to an open classroom setting. Such a setting was to encourage heuristically based learning that supported to a degree, an unstructured learning environment. For example, this approach would:

Allow students access to one of the many "music composer" programs...to directly manipulate the elements of music (pitch, duration, tempo, dynamic, timbre, etc.) within a microcomputing

35. Stevens, 9-25.

36. Southcott.

37. G. McPherson, "Computer-Based Instruction in Musicianship Courses at the University of Western Australia: The GUIDO System". Stevens, R. S. (Ed.). *Computer Technology and Music Education: The Australian Beginning*. (Victoria: Deakin University Press, 1987): 69-77.

38. Since 1974, under the direction of Professor Fred T. Hofstetter, the University of Delaware has been developing the GUIDO system for aural training. Guido D'Arezzo is the name of the eleventh century monk who invented sofeoggio syllables and music staff. His name is now a registered trademark of the University of Delaware and as an acronym for graded units for Interactive Dictation Operations. Ibid., 69-77.

39. Ibid., 69-77.

40. Ibid., 9-25.

41. Ibid., 9-25.

environment where they assume the roles of the composer, performer and listener, they should acquire a working knowledge of (i) the elements of music, (ii) the ways in which these elements interrelate, and (iii) the ways in which these elements are notated, as well as acquiring an appreciation of the various possibilities for musical expression and creativity.⁴²

In this example, using the computer as a personal tool is similar to the application used for creativity or the more compositional approach to music education taken by the United Kingdom during this time that supported the notion of CAL.

During this time, it was recognised by Stevens that Australian education should utilise various aspects from both CAI and CAL approaches.⁴³ It is important to make the point that music technology is referred to as a 'tool'. The definition of the term 'tool' when referring to 'music technology' is conflicting to its current definition. Many people often refer to technology⁴⁴ as a tool. Brown suggested that the term 'tool' is a limiting metaphor and that people perceive technology in multiple ways, not merely as a 'tool'.⁴⁵ Dillon elaborates that in education, technology is often referred to as a 'tool':

Teachers who are often unfamiliar users of technology use the word in this manner. Those in technology related studies also perceive the human machine interaction as a user and tool metaphor. Historically, artists have a different kind of relationship with technology. This kind of creative rather than reactionary relationship is of interest here. The response from composers was

to compose music that stretched the aesthetic boundaries of those instruments and of music itself.⁴⁶

Thus the important focus was on the composition itself rather than the technical brilliance of the tool. Further, in 1980 Papert⁴⁷ suggested that the computer and/or synthesiser was a cognitive amplifier and not just a 'tool'. Therefore, term 'technology' has come to describe a range of ideas and practices:

- the creative processes used to develop products,
- the products created through these processes,
- the 'know-how' related to these processes and products,
- the tools and equipment used.⁴⁸

The term 'tool' is certainly appropriate when considered in this context. The primary role society perceived for computers and technology in the 1980s was as a tool. The term was used by a society with an industrial understanding, which in turn was also reflected in education. Such a shift in understanding is prominent in the advent of the Internet and online technologies.

Recent developments

In the more recent past, the distinction between Computer-Aided Instruction and Computer-Aided Learning approaches has become blurred. CAI is now considered a knowledge based approach that utilises technology for role-playing and simulated learning.⁴⁹ While creativity and composition still appear to be the motivators for CAL. Each approach is no longer ascribable to a specific country. The advances of technology

42. Ibid., 18.

43. Ibid., 18.

44. 'Technology' is defined as the: "scientific study of industrial and mechanical arts; practical arts collectively" G. E. Turner, (Ed.) *The Australian Pocket Oxford Dictionary*. Revised Edition. First Published 1924, F. G. Fowler & H. W. Fowler. (Melbourne: Oxford University Press, 1989), 725.

45. A. R. Brown, "Changing Technologies, Changing Minds: Taking account of music technologies in the curriculum". Gifford, Brown and Thomas (Eds). *Conference Proceedings of the ASME XI National Conference*. (Brisbane: Australian Society for Music Education, 1997). A. R. Brown, "Music, Media and Making: Humanising digital media in music education". *International Journal of Music Education*. International society for Music Education. No. 33, (1999): 3-9.

46. S. Dillon, "Making Computer Music Meaningful in Schools". *La Trobe Database*. (2004) [Online] <http://farben.latrobe.edu.au/mikropol/volume6/dillon_s/dillon_s.html> (Accessed: 26/05/04).

47. Seymour Papert is the designer of the LOGO computing language developed in 1968 at the Massachusetts Institute of Technology.

48. Queensland Studies Authority, *Technology: Years 1 to 10 Syllabus*. (2003):1 [Online] <<http://www.qsa.qld.edu.au/years1to10/kla/technology/docs/syllabus/rationale.pdf>> (Accessed: 20/07/05).

49. Peter Webster, "Historical Perspectives on Technology and Music". *Music Educator's Journal*. Vol. 89, No. 1 (2002).

have combined CAI and CAL, moving toward a more holistic understanding that encompasses strong points from both approaches. Thus the innovation and potential of various music programs and music technology became realised.⁵⁰ MIDI technology had cemented its place in the music industry and the classroom. The significance of technology in education became important for its capability rather than the emphasis being placed on a 'whiz bang' new 'tool' that is used in a traditional pedagogy. It is useful to consider Australia's position in this shift in thinking. If the expectations placed on technology in Australian education in general are implemented in the music classroom it will further cement the status of music in the school curriculum.

Increased pressure on teachers since the 1990s, to use technology in their practice was coupled with the pervasive impact of online⁵¹ technologies in society. This expanded the limits of integrating technology in education and proposed to change the way people thought of technology, it was becoming the 'norm'. General Australian syllabi are encouraging teachers to facilitate the incorporation of technology in education due to the outcome of positive academic results, but neglect to provide any guidance.⁵² For example:

50. Some notable music programs are Metasynth, Music Mania, Band-in-a-Box, Rock Rap 'n' Roll, Music Ace, Making Music, Sound Edit 1.6, Finale, Sibelius, Digital Performer, GarageBand and Studio Vision Pro.

51. The beginnings of online technologies can be traced back to the 1960s and more specifically J.C.R. Licklider who first proposed a global network of computers in 1962 to transfer research information across the scientific and military fields. It was not until between 1990 and 1994 that a succession of stable services emerged in Australia for what we now refer to as the Internet. R. Clark 'A Brief history of the Internet in Australia.' (The Australian National University, 1998) [Online] <<http://www.anu.edu.au/people/Roger.Clark/II/OzIHist.html>> (Accessed: 21/10/07). W. Howe 'A Brief History of the Internet' (2007) [Online] <<http://www.walthowe.com/navnet/history.html>> (Accessed: 21/10/07).

52. SOCCI, *Market Research Report, October 2001*. (Brisbane: Queensland University of Technology, Faculty of Education, 2001):7, [Online] <http://www.thelearningfederation.edu.au/tif2/sitefiles/images/brochures/background/market_research/mkt_ch2.pdf> (Accessed: 12/07/05).

Queensland School Curriculum Council (2000) cited students' use of technology as important in helping them to become life-long learners, complex thinkers, active investigators, creative persons, effective communicators, and reflective and self-directed learners. This encouragement is also present in other Australian syllabus documents, although there is little explicit guidance to teachers on how they might fulfil these objectives using online resources.⁵³

Unfortunately, the issue of appropriate support and resources for teachers is to an extent, still unresolved.

The Australian Computers in Education Conference in Adelaide, in July 1998 produced a significant revelation that displayed a shift from the 'technology' to the 'pedagogy'. Anderson asserted a commonly held view that the mere placement of computers in classrooms will not affect student learning outcomes:

*Educators are now more concerned with the learning process and how we can design more effective delivery strategies so that we can help students to engage in meaningful, authentic activities that make use of today's tools. These tools should not be used in the classroom to merely replace existing tools. Word processors can replace the pencil or biro, paint programs can replace the drawing pad and crayon and drill and practice booklets can be replaced by on screen versions. In doing this we're merely taking a small step sideways and ignoring the true potential of emerging technologies.*⁵³

Technology has evolved to meet the requirements of a multidimensional society and education needs to reflect this. The true value of this technology will not be apparent unless the practice in which it is used changes accordingly.

Online technology is another landmark in highlighting a way that innovation is changing

53. N. Anderson, "Computers in the Schools – Taking small steps in the right direction", *Education Review*. July, (1998) [Online] <<http://www.schools.ash.org.au/litweb/steps.html>> (Accessed: 22/07/04)

processes in education by expanding possibilities and moving away from the simplistic idea of technology as a 'tool'. This can essentially change the nature of classroom content and processes. There is considerable support for online technologies, especially as an Educational Data Source (EDS):

The use of online technologies as EDS has been systemic in most Australian states with each state establishing complex websites to disseminate curriculum materials including past test papers, projects, teaching resources, and links to numerous alternative educational sites.⁵⁴

An element of authenticity is added when online tasks and materials are accessed by teachers. Many such sites reflect real world situations, thus they contain 'authentic data.' "While little research has been conducted on the effects of this increase in the availability of 'authentic data those studies that have been carried out suggest significant improvements in student affect"⁵⁵ This is thought to be partly due to the increased potential for meaningful interaction which occurs when the outside world is brought into the classroom via the internet: "Allowing learners to have virtual experiences they could not have or may feel unfit to have in real life."⁵⁶ This adds an entirely different dimension to real life learning and the wide range of possibilities for educational processes that can be enhanced by technology. Online technology has not only enhanced the ability to research music, but created access to music forums, global conferencing, messaging networks and e-mail that can put music students in direct contact with artists, composers and a network to the music industry.

The term 'School 2.0'⁵⁷ is being used to describe the shift in thinking about what schools will look

like in the future. There appear to be three major factors at the core of this discussion which are also identified by Tangient LLC:

1. New collaborative computer technologies which include distance learning, free and open source software, videoconferencing and read/write web.
2. A changing economy that has transitioned from the industrial age through the information age to the current digital age, where employers value and require people to have a different skill set.
3. New technologies giving birth to a culture that is transparent, multidimensional and collaborative allowing open discussion about many aspects of society, particularly education.⁵⁸

The Web has shifted from just being a medium in which information is transmitted and consumed, to a platform where content is created, shared, remixed and repurposed. People are no longer merely using the Web for reading books, listening to the radio or watching television, but are having conversations consisting of a visual and multimedia vocabulary. Web 2.0 does not only look like a network, but behaves like a one. By definition, 'Web 2.0' is used to describe "applications that distinguish themselves from previous generations of software by a number of principles. These new, Web 2.0, applications take full advantage of the network nature of the Web."⁵⁹ This change from a read-web medium to a platform for read-write-web fulfils Berners-Lee's original vision of the Web stated in 1999.⁶⁰

54 SOCCI, 9.

55 Ibid., 9.

56 Ibid., 9.

57 Tangient LLC host over 1,300,000 wikis for over 3,400,000 people and have products designed for the smallest classroom and the world's largest corporations and institutions. The team at Tangient explains the use of now common terms such as 'School 2.0,' 'Web 2.0' and 'Classroom 2.0' (2010).

58 Tangient LLC, 'School 2.0 Wiki'; (2010) [Online] San Francisco. <http://school20.wikispaces.com/>

(Accessed: 20/05/10).

59 C. Ullrich, K. Borau, H. Luo, T. Xiaohong, S. Liping & S. Ruimin, S. 'Why Web 2.0 is Good for Learning and for Research: Principles and Prototypes'. Proceedings of the 17th international conference on World Wide Web. Beijing: International World Wide Web Conference, (2008): 705.

60 T. Berners-Lee, T. *Weaving the Web*. (London: Orion Business Books, 1999).

In responding to this shift in thinking and finding a practical way to enhance music education and performance experiences for young people, there are an increasing number of high quality online resources and applications available. A notable resource is 'themusicpage.com', a company who is dedicated to the proposition that the world's best performances and the world's best teachers should be available to anyone, anywhere at any time. The founder and managing director explain that their mission is simply, "To change the musical world by connecting musicians and educators to a global audience"⁶¹ They use the web to stream both live and archived performances and can also connect students and teachers over the internet using both simplex (one-way) and duplex (two-way) communication technology. This innovative use of technology is continually evolving.

Current curricula inclusions for computers and technology in education are pronounced as important for the future of Australia at a national level. The *National Goals for Schooling in the Twenty-first Century*⁶² are common and agreed goals for Australian schooling. This establishes a foundation for action among various government and non-government agencies responsible for schooling. While each of these goals can directly

involve technology and the environments enhanced when such technologies are utilised, the following are specifically dedicated to it:

Schooling should develop fully the talents and capacities of all students. In particular, when students leave school, they should:

- 1.1 have the capacity for, and skills in, analysis and problem solving and the ability to communicate ideas and information, to plan and organise activities, and to collaborate with others...
- 1.5 have employment related skills and an understanding of the work environment, career options and pathways as a foundation for, and positive attitudes towards, vocational education and training, further education, employment and life-long learning.
- 1.6 be confident, creative and productive users of new technologies, particularly information and communication technologies, and understand the impact of those technologies on society.⁶³

The requirements and expectations outlined by the government and educational authorities are encouraging that technology be used for authentic and practical experience. This places Australia within a societal and global context. It is hoped that these national goals will:

Provide a basis for investment in schooling to enable all young people to engage effectively with an increasingly complex world... characterised by advances in information and communication technologies, population diversity arising from international mobility and migration, and complex environmental and social challenges.⁶⁴

At a national level it is intended that a dynamic and adaptable school system will be initiated, that is responsive to students needs and is central to Australia's economic, social and

61. G. Collinson, G "What is The Music Page?" themusicpage.com. (2012) [Online] <http://www.themusicpage.com/mtvText.php?file=about> (Accessed: 29/03/12).

62. In Adelaide on 22-23 April, 1999, the state, territory and Australian Government Ministers of Education met as the 10th Ministerial Council on Education, Employment, Training and Youth Affairs, chaired by the Minister for Education, Children's Services and Training in South Australia, the Hon Malcolm Buckby MP. Conscious that the schooling of Australia's young is the foundation on which to build the nations future, Council agreed to act jointly in assisting Australian schools in meeting the challenges presented in current society. In reaching agreement to address various areas of common concern, the State, Territory and Australian Government Ministers of Education made a historic commitment to improving Australian Schooling within a framework of national collaboration. Department of Education, Science and Training, (2005b) "The Adelaide Declaration on National Goals for Schooling in the Twenty-first Century". *DEST Policy, Initiatives & Reviews*. (2005b) [Online] <http://www.dest.gov.au/sectors/school_education/policy_initiatives_reviews/national_goals_for_schooling_in_the_twenty_first_century.htm> (Accessed: 12/07/05).

63. Ibid.

64. Ibid.

cultural development. It is the Commonwealth's philosophy that: "all individuals should have the opportunity early in life to acquire knowledge, skills, values and understandings necessary for lifelong learning, employment and full participation in society".⁶⁵ The Commonwealth's position includes:

- Identifying national standards and priorities for students.
- Reporting of nationally comparable data on student achievement and other outcomes of schooling.
- Improving accountability of education providers to parents, guardians and the wider Australian community.
- Providing significant funding to enhance the learning outcomes of all school students.

Further, the Commonwealth has two pertinent priorities for financial support:

- Improving the quality of teaching and the learning outcomes for students.
- Encouraging and supporting effective partnerships between school and industry to enable young Australians to acquire vocational, enterprise and career education, knowledge and experience before they leave school.⁶⁶

The MCEETYA ICT in Schools Taskforce (ICTSF)⁶⁷ is responsible for providing strategic advice to all Australian Education Ministers on issues relating to the use of ICT meeting the National Goals of Schooling. They describe the current educational climate:

Huge forces are driving through industry and society to create the information economy and the knowledge society. The ICT in Schools Taskforce provides advice on innovation

*and emerging opportunities within this fast, multi-dimensional, complex and changing environment.*⁶⁸

MCEETYA 2001 endorsed priority areas of work and initiatives for the Taskforce:

- Implementation of *Learning in an Online World*: the school action plan for the information economy;
- Support for The Le@rning Federation (the Schools Online Curriculum Content Initiative);
- Support for joint action across the educational sector (schools, VET and higher education);
- Development work in respect of the use of research in ICT in teaching and learning;⁶⁹
- Support for the development of EdNA Online; and
- Advocacy and policy development in other matters, including regulation, that influence the adoption of ICT in schools.⁷⁰

Several initiatives are in place in support of technology in education with an understanding that we are living in a constantly changing environment that is regarded as inherently multidimensional. This complexity that is embraced by the younger generation in society and regarded as the driving force of the future needs of the nation are required to filter through to education to ensure relevance. This not only extends to music education in the use of ICT, but applies to maintaining student interest and engagement with music through the interactive use of technology. Our students are a generation of people that cannot conceive of a world without technology.

65 Ibid.

66 Department of Education, Science and Training, 2003.

67 The MCEETYA ICT in Schools Taskforce is chaired by Dr Martyn Forrest, Secretary, Department of Education in Tasmania. The Taskforce draws members from all jurisdictions including New Zealand, and the Catholic and Independent sectors.

68 Ministerial Council on Education, Employment, Training and Youth Affairs, "About MCEETYA ICT in Schools Taskforce". *MCEETYA Commonwealth of Australia*. (2005) [Online] <<http://icttaskforce.edna.edu.au/about/index.html>> (Accessed: 21/07/05).

69 The Taskforce works with the Australian ICT in Education Committee (AICTEC) on issues relating to information and communication technologies on teaching and learning. Ibid.

70 Ibid.

The governments of Australia and New Zealand funded The Learning Federation (TLF)⁷¹ for the period of 2001-2006. This was part of the Australian Government's 'Backing Australia's Ability: Innovation Action Plan', an initiative designed to create online curriculum content and infrastructure to enhance teaching and learning using technology.⁷² Such content would consist of a collection of interactive multimedia learning resources and tools that would enable students in years P-10 to engage in learning experiences that enhance their skills on an innovative, creative and entrepreneurial level:

The digital resources support the arts and technology curriculum and also explore opportunity, entrepreneurship and vocational learning. The general educational intent, however, is that these learning objects can be used as transdisciplinary resources. Students are compelled to explore, take risks, analyse and synthesise information, think critically, solve problems and make decisions.⁷³

It is apparent that technology in education has shifted focus toward the idea of vocational education and part of gaining the skills required to be active participants in society. This has been adopted by the Australian government in their advocacy for science, technology and innovation. It is important that music education follow in this direction to ensure its relevancy and secure its place in the school curriculum.

71. The Learning Federation is an initiative on behalf of the Australian Education Systems Officials Committee (AESOC) by a joint venture of the Curriculum Corporation and education.au.limited.

72. The Learning Federation, "About TLF". *An Australian Government Initiative: Backing Australia's Ability*. (2003a) [Online] <<http://www.thelearningfederation.edu.au/tlf2/showMe.asp?md=p&nodeID=>> (Accessed: 12/07/05).

73. The Learning Federation, "Innovation, Enterprise and Creativity". *An Australian Government Initiative: Backing Australia's Ability*. (2003b) [Online] <<http://www.thelearningfederation.edu.au/tlf2/showMe.asp?nodeID=79>> (Accessed: 12/07/05).

Discussion

Since the push from the former Prime Minister John Howard, in 'Backing Australia's Ability - Building Our Future through Science and Innovation', importance has been placed on the ability to: "develop new industries and to find solutions to contemporary and emerging problems".⁷⁴ The \$3 billion dollar investment in the Australian innovation strategy was originally announced in 2001 and to be implemented over five years. The Australian Government has invested a further \$5.3 billion dollars in 2004 for an additional five year commitment. The following statements highlight the Governments goal:

The Australian Government's goal is for Australia to build a world-class innovation system. This ambitious agenda depends on effective partnerships between governments at all levels, researchers and business, to share the substantial financial investment necessary to ensure that ideas move smoothly from generation to end use.⁷⁵

To relate this back to music education is to engage where possible, innovative technologies to uphold the values deemed important in society.

Subsequently, the Australian Government has allocated funding for schools over a four year period. This legislation from 2005-2008 provides \$33 billion dollars for schools, a \$9.5 billion dollar increase over the previous quadrennium.⁷⁶ While not all of this will go towards technology, it is apparent from the various policies and initiatives in place that a substantial amount will be used

74. J. Howard (MP), "Prime Minister's Message". *DEST, Backing Australia's Ability Building Our Future through Science and Innovation 2005*. (2005) [Online] <http://backingaus.innovation.gov.au/pm_message.htm> (Accessed: 23/07/05).

75. Ibid.

76. Department of Education, Science and Training, "School Education Summary". *DEST School Education*, (2005d) [Online] <http://www.dest.gov.au/sectors/school_education/School_education_summary2.htm> (Accessed: 12/07/05).

for this purpose. Further, the current federal government's 'Digital Education Revolution' (DER) aims to contribute "sustainable and meaningful change to teaching and learning in Australian schools that will prepare students for further education, training and to live and work in a digital world".⁷⁷ In this context, the Australian Government is investing over \$2.1 billion to support the effective integration of ICT in Australian schools in line with the Government's broader education initiatives, including the Australian Curriculum.⁷⁸ Part of this is the implementation of the National Broadband Network (NBN) to deliver high speed broadband connections to individual schools, homes and workplaces. The premise for the NBN is to ensure Australian school students access to similar bandwidth capabilities at home and at school, regardless of the location or time.

Continuing higher levels of funding and support from both federal and state governments since the early 1980s have established computers and technological innovation in many Australian schools and educational institutions. Many of the initiatives outlined in the above section indicate a firm commitment by the Australian Government to endorse technology in education. Much of their reasoning hinges on social, cultural and economic growth in Australia and the recognition of Australia within a global context.

A deeper understanding of the purpose of technology and its impact on society has necessitated the inclusion of its use in all classroom settings including music. Governments at both state and federal level advocate its importance through not only Government funded initiatives, but also the compulsory incorporation of technology in school curricula. The Queensland Studies Authority explains the

importance of technology in the broader sense in their Rationale for their 'Technology Syllabus' for years 1 to 10:

Technology involves envisioning and developing products to meet human needs and wants, capitalise on opportunities and extend human capabilities. Products of technology include artefacts, processes, systems, services and environments. These products make up the designed world. Products of technology have impacts and consequences on individuals, local and global communities and environments.⁷⁹

The greatest challenge is monitoring how technology is being used in educational environments.

In terms of music technology, there is an increased awareness of the importance of electronic music and subsequently its place in music education. While electronic music and other forms of contemporary music in the Western art music tradition have established credibility in society, it still does not present a huge array of professional composers and musicians. In response to this, it has still not fully established its place in Australian music education curricula. However, teachers are realising that the discipline of music incorporates a breadth of styles, genres and methods of working with sound. For example, synthesisers and drum machines are utilised in many musical genres. Such instruments have expanded the possibilities for students to work with sound rather than within the restriction of standard Westernised music notation. Electronic music has certainly made its mark globally and it has reached the shores of Australia. In context, electronic music has impacted the music industry, synthesisers are utilised as a cost effective measure in replacing string sections and at times complete orchestras for recording and producing film music.⁸⁰

77. Commonwealth of Australia, "Digital Education Revolution". Department of Education, Employment and Workplace Relations, (DEEWR) (2011) [Online] <<http://www.deewr.gov.au/Schooling/DigitalEducationRevolution/Pages/default.aspx>> (Accessed: 26/11/12).

78. Ibid.

79. Queensland Studies Authority, 1.

80. R. M. Prendergast, *Film Music: A Neglected Art*. 2nd Edition. (New York, London: W. W. Norton & Company, 1992).

Conclusion

It is appropriate to suggest that to some degree, technology redefines the culture that creates it. By no means is this a new idea, but on a simplistic level, one just needs to look at the way we now communicate and interact to understand its impact. The music industry and the evolution of electronic music is a notable example. Compact discs will soon find their place on museum shelves next to vinyl records and tapes. The necessity of incorporating technologies into the classroom continues to be apparent. This is governed by social values within both national and global contexts. The challenge that is upon educators and educational authorities is to ensure technology is being used to enact these values. The Australian Government is monitoring ICT in education by conducting regular reviews:

ICT is rapidly changing the way we look at and participate in education and training. To make sure Australia is positioned to obtain the benefits of education technology, DEST is conducting a review into Australia's Future Using Education Technology. The review will look at the current uses and providers of education technology as well as examining potential and emerging applications. Innovative educational approaches will be explored as well as the infrastructure and expertise required for Australia to effectively use ICT in delivering education and training in the future.⁸¹

Technology has been identified as a precursor to the success and growth of Australia's future. It is understandable then that society should view ICT as a priority for education. The question educators are currently challenged with is: how effective such technology will be in schools where many teachers still practice in a

largely nineteenth century model of teaching? It would be contradictory to use traditional teaching practices with technology that presents interactive multidimensionality. The development of a holistic teaching and learning approach that effectively uses the powerful technological platforms available is necessary. We have already seen two main foci (CAI and CAL) being developed that reflects the values considered important in their societies. The importance now is to develop an approach to using technology in music education that reflects contemporary times.

Crawford (2005) identified that, to improve the quality of teaching and the learning outcomes for students partaking in music education, an understanding of authentic learning practice is essential. This requires that a holistic view of the ways young people interact in their multifaceted or multidimensional everyday lives be introduced in the way teaching and learning is approached.⁸² This includes encouraging an interchangeable environment for experiential learning. Creating authentic learning situations for students to gain vocational experience and knowledge before leaving school aligns with this principle. In the music classroom one of the ways of achieving such a goal is to tie school music to professional music practice via technology and music technology. The idea of authenticity was first introduced in medical education for an improved interface between theoretical academic learning and clinical practical learning.⁸³ Since, it has been referred to in other areas including music philosophy, education, art, writing, assessment and motivation.⁸⁴

81. Department of Education, Science and Training, "Australia's Future Using Education Technology". *DEST Policy, Initiatives & Reviews*. (2005c) [Online] <http://www.dest.gov.au/sectors/school_education/policy_initiatives_reviews/reviews/au> (Accessed: 12/07/05).

82. R. M. Crawford, "Educational Blueprint: Technology as valued knowledge in music education". A Celebration of Voices. Proceedings of the XV National Conference for the Australian Society for Music Education. (Melbourne: ASME, 2005): 63-68.

83. H. Barrows, "A taxonomy of problem-based learning methods". *Medical Education*. Vol. 20, (1986): 481-486.

84. T. Marra, *Authentic Learning*. (Michigan: University of Michigan, 2004) [Online] <<http://www-personal.umich.edu/~tmarra/authenticity/authtn.html>> (Accessed: 1 July, 2005).

The National Review of School Music Education (NRSME) has stated clearly that:

*While there are examples of excellent music education in schools, many Australian students miss out on effective music education because of the lack of equity of access; lack of quality of provision; and, the poor status of music in many schools.*⁸⁵

With the increasing pressure from government and education authorities on teachers to use ICT in education, it is important that music is not overlooked. Further, for teachers to extract the most from what technology is available, it is important not to use it in a past model of music teaching and learning. Therefore, the teacher's role becomes particularly significant, "Teachers are vital to the quality of music education for all students and need to take pro-active roles in ensuring the quality and status of music

in schools through developing their own professional expertise, learning and values"⁸⁶

This paper has outlined various landmark points in time since the 1960s where technology has impacted on education in a significant way. Further, it has been outlined that ICT, like many of the priorities on educational agendas are a response to government strategies. As the demands of society have increased and technology has evolved, it has progressed further up the priority list. In fact, advances in music technology demonstrate how the discipline of music is a pioneer in such an area. The more we push the boundaries of the musical dimensions and elements, the more elaborate and intelligent the innovations that are invented. Within the context of education, it is important that our discipline not get left behind in contemporary times.

85. Department of Education, Science and Training *National Review of School Music Education*. (ACT: Australian Government, 2005): v

86. *Ibid.*, vi-vii.

Dr Renée Crawford is a music educator who has published both nationally and internationally in her field. She is currently a lecturer in the Faculty of Education at Monash University and a Research and Evaluation Consultant for organisations such as the Starlight Children's Foundation. Her musical interests are in composition, film music, minimalism, the analysis of contemporary Australian music and the use of digital technology in music. As an advocate for the effective use of technology in education, her PhD research completed at Monash University was based on the philosophy of authentic learning and technology in music teaching and learning practices.