# The evolution of technology-based approaches to music teaching and learning in Australia: A personal journey

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## Abstract

The use of Information and Communication Technology (ICT) as a tool for teaching and learning both in Australia and overseas is now very much taken for granted across all areas of learning and at all levels of education. But how did this addition to the range of pedagogical means and methods employed in music education come about?

This article is written from a dual perspective – as a music education historian and as an early adopter and promoter of technology-based approaches to music education in Australia. The first part of the article is largely autobiographical as I recount my experiences as a tertiary academic with reference to developments in technology infrastructure (hardware and software) and associated pedagogies.

In the second part, I refer to recent scholarly opinion on technology in music education and then reflect on future directions and possibilities. Although curricula produced by education authorities advocate the embedding of technology in all learning areas, the inclusion of ICT in curriculum guidelines has been described as 'an afterthought'. It is argued that adoption of technology-based approaches to music learning is reliant on two factors – adequate opportunities for ICT in teacher education, and individual teacher motivation and commitment.

**Key words:** music education; information and communication technology; Australia; teacher education; computer-assisted instruction, online instrumental music tuition

## Introduction

The use of Information and Communication Technology (ICT) as a tool for teaching and learning both in Australia and overseas is now very much taken for granted across all areas of learning, including music, and at all levels of education (Baskin & Williams, 2006; Sarkar, 2012; Savage, 2010; Wastiau et al., 2013; Whelan, 2008). Indeed, the inclusion of ICT was specifically recommended in the Report of the National Review of School Music Education (Australian Government Department of Education, Science and Training, 2005) and is now at least nominally required by Federal, State and Territory authorities in school curriculum guidelines. But how did the addition of technology-based approaches to the range of pedagogical means and methods employed in music education come about in Australia?

My approach to the writing of this article is as a music education historian and as an early adopter and promoter of technology-based approaches to music education in Australia. In the first part of the article, I recount my experiences as a tertiary academic at Deakin University (1977-2008) where I was able to utilise a range of technology-based applications in my teaching of music and music education. I have drawn principally on my own published articles and conference papers as well as other contemporaneous materials to document and explain the development of technology-based approaches to music education in Australia generally and more particularly in Victoria. The first part of the article is therefore largely autobiographical and aims to document the evolution of technology-based approaches to music education in Australia with reference to developments in technology infrastructure (hardware and software) and associated pedagogies.

The second part of this article draws on some recent articles to further document the developments associated with this pedagogical approach to music teaching and learning and to reflect on future directions and possibilities. Several writers have documented the evolution of technology as it has been applied to music education, chief among whom is Crawford (2009) who looked specifically at the adoption of technology in secondary music education. The approach adopted for the present article is essentially a personal narrative – the journey – together with discussion of current views expressed in a representative sample of scholarly literature.

## The journey

### PLATO and Music CAI

Like other pedagogical approaches such as Orff, Kodály, Dalcroze and Musical Futures, the development in Australia of what may be termed the technology-based approach to music teaching and learning was the result of overseas influences and its evolution was then determined by local adaptations and enhancements. My introduction to computer applications in music education came as the result of an outside studies program (sabbatical leave) experience at the University of Illinois at Urbana-Champaign in 1980. The objective of the sabbatical leave project was to investigate innovations in music teacher education with a view to their possible introduction to Australia. I soon discovered that the only substantial innovation in terms of the means and methods of delivering music learning to teacher education students at that time was the use of Computer-Assisted Instruction (CAI). A mainframe computer system known as PLATO (Programmed Logic for Automatic Teaching Operations) had been developed as a joint venture between the Computer-based Education Research Laboratory (CERL) at the University of Illinois – the team there headed by Don Bitzer – and the Control Data Corporation from the early 1960s (Hook & Stevens, 1982). PLATO relied on hard-wired (mostly telephone) connections between the computer mainframe located at the University of Illinois and terminals located not only at Illinois but also at several other major United States universities and colleges. A precursor of our present-day computers and of the internet, PLATO terminals had text display (albeit monochrome), static and animated graphics, music notation graphics, keyset input as well as a touch-sensitive screen, a speech synthesizer, a music production peripheral (the Gooch Synthetic Woodwind), a music keyboard and many features of the internet including email and what is the equivalent of present-day blogs (Stevens, 1982). PLATO was designed to deliver 'courseware' covering a wide range of subject areas though various forms of computer-based education including CAI – drill-and-practice routines, tutorial programs, simulation experiences and gaming – and Computer-Managed Instruction (CMI) – student testing, recording of student progress and prescribing of learning materials (Hook & Stevens, 1982). Essentially the pedagogical approach taken in many PLATO courseware programs was computer-based programmed learning.

While at the University of Illinois, I had the opportunity to develop several music programs using PLATO's authoring language (TUTOR) including a tutorial on 'Simple and Compound Meter'. Back in Australia in 1981, I had the opportunity to work with a university colleague in adapting United States courseware to the Australian context for Control Data Australia (the company that marketed PLATO in Australia) in several subject areas that was an in-kind exchange for the installation of PLATO terminals at Deakin University. I was able to utilise courseware for my students to supplement their music learning until the mid-1980s when the PLATO system closed in Australia. By that time, stand-alone computers (Apple II, Commodore 64, Atari and BBC computers) were being introduced to schools and tertiary institutions and I had the opportunity to transfer my use of technology for teaching to these 'microcomputers' as they were now known.

## Microcomputers as a creative tool

The advent of microcomputers enabled a wider range of technology-based applications to be utilised for music education. Computer-based music synthesis and sequencing software enabled students involved in creative music to shift from studio-based equipment such as a multi-track tape recorder and analogue synthesizer combination to a stand-alone computer-based environment able to provide a more readily accessible and empowering set of compositional tools. With the advent later of MIDI (Musical Instrument Digital Interface) for both real-time and step-time music input, students were able, not only to create music, but to instantaneously playback the results of their compositional ideas.

Aside from utilising computers in my university teaching, I had the opportunity to promote computer applications to music education through teacher professional development presentations in several states and to produce articles advocating the use of technology for music education in schools. As well, I established the Australian Computers in Music Education Group (ACIMEG) through which I produced a series of newsletters (Stevens, 1983-86) and a collection of public-domain music software programs (Stevens, 1984). I also had the opportunity to organise sessions at two major conferences. The first was at the 1985 ANZAAS (Australian and New Zealand Association for the Advancement of Science) Festival of Science (Stevens, 1987) and the second was at the XVIII$^{th}$ ISME (International Society for Music Education) Biennial Conference at the School of Music, Australian National University in July 1988 (Cooper & Elliot, 1988, pp. 55-57). The range of presentations at these conferences included sessions on computer-based creative music making in schools, musical analysis, ear training and music composition in the primary school, a university course in music technology for music educators, computer-based aural training at the Defence Force School of Music, a PLATO-based musicianship course, and music learning through Logo.

## Terrapin logo and its music mode

The latter application – Terrapin Logo – was a child-centered software program developed during the early 1970s by a team including Seymour Papert at the Artificial Intelligence Laboratory, Massachusetts Institute of Technology that enabled children to program a cybernetic turtle robot to move around a computer screen leaving a trail of light and creating geometric figures (spirals and other shapes) (for a more detailed description of Logo Music, see Stevens, 1988, pp. 45-56). Logo was widely utilised at primary and lower secondary school levels for developing spatial concepts, programming skills and logical processing. Essentially, Logo was promoted by its developers as a 'language for learning', an active and self-directed learning style as opposed to the passive learning approach inherent in computer-assisted instruction (Papert, 1982). There was also a Logo Music Mode that enabled students to 'teach' the turtle to 'sing' melodies. This was developed by Jeanne Bamberger as part of her research work into musical intelligence and musical perception. The Music Mode of Logo was promoted for use in Australian schools by Carl Stevens and myself during the 1980s (see Stevens & Stevens, 1987). Music Logo was emulated by several other creative music programs utilising dedicated music cards slotted into computer motherboards, thereby enabling polyphonic music production; for example, the software programs *Musicland* and *Melodyland* developed by the New Zealander, Martin Lamb, enabled children to experiment with the elements of music in a compositional setting promoting not only musical creativity but also conceptual learning (Upitis, 1983, p. 41). During the 1980s, several Australian music educators were involved in music software development with creativity programs such as *Sing – Creating your own melodies* by Rosanne Gare, and CAI programs such as *The Treble Clef* and *The Bass Clef* by Phillip O'Carroll and Christine Vincent, and *Harmony, Ear Games* and *Key Signatures and Scale Builders* by Robert Cook (Crawford, 2009, pp. 154-155).

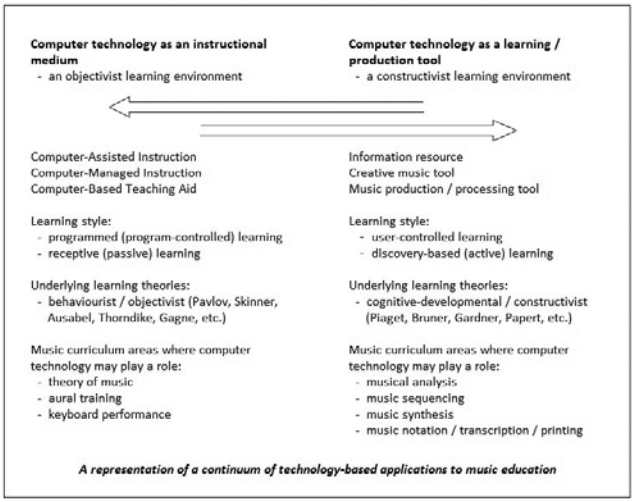
During 1986-87, I had a further sabbatical leave at

the Microtechnology Unit in the Music Education Centre at the University of Reading. At this stage, the emphasis in technology-based music education in the United Kingdom was very much on group music making and collective decision-making utilising advanced music sequencing and notation software, MIDI keyboard synthesizers and multi-timbral MIDI sound modules. This approach had the advantage of enabling students to have a ready means of externalising their musical ideas by obtaining instant auditory and visual feedback in response to their compositional 'hypotheses'. A similar focus on creative music making using a range of Computer Musical Instruments (CMIs) including an expanding range of MIDI peripheral devices was also taking place in Australia with teachers being encouraged to invest in appropriate equipment for classroom use (Brown, Stevens, & Wallace, 1992).

## HyperCard and music learning

By the early 1990s, music software developers in the United States were making use of a software application called HyperCard which had been developed for Apple Macintosh and Apple IIGS computers. HyperCard – as its name suggests – enabled the bringing together of several forms of hypermedia – text, animation, pre-recorded music, speech and video content (through audio CDs and DVDs) and MIDI sound production – in a variable sequence of 'cards' (screen displays). Commercially-produced music learning programs – both drill-and-practice programs such as *Listen* (Resonate) that focused on developing aural perception skills (interval and chord recognition, etc.) and 'music appreciation' programs such as *Ludwig van Beethoven Symphony No. 9* (The Voyager Company) that allowed students to explore the history and literature of music by accessing music tracks from pre-recorded audio CDs – utilised a similar format and similar media resources as HyperCard. Through a series of Apple University Development Fund Grants, I was able to develop HyperCard programs on music notation and musical styles (Stevens & Brown, 1991a, 1991b) which formed part of university course materials for both on-campus and off-campus (distance education) students (Stevens, 1992). Also during the 1990s, Melbourne software developers Peter Lee, Malcolm Haylock and Tim Wilson utilised CAI and CMI principles in their aural training and music theory programs *Auralia* and *Musition* (Rising Software), both of which achieved considerable success and are now marketed locally and internationally.

The internet became available in Australia from 1989 and by 1992 there were two commercial dial-up Internet Service Providers (ISPs) in capital cities. Three years later there were more than one hundred ISPs providing internet access to businesses, educational institutions and the general public (AARNET, 1989-2010). Australian universities were early adopters of technology for both teaching and research and there was also recognition by school education authorities of the potential for utilising the internet for both student learning and teacher professional development. My university was then in the process of embracing technology for teaching distance education students and over the next few years I had the opportunity to develop not only off-campus materials for courses on ICT applications to education but also elective study units for students interested in technology and music teaching and learning (Stevens, 1988, 1994). I also promoted what I termed 'an eclectic approach' to the application of technology to music education – technology as an instructional medium and technology as a music production tool (Stevens, 1991). As the internet became more widely available, I added a third application – that of technology as an information environment/resource – that was incorporated on the right-hand side of what I conceived of as a 'Continuum of Technology-based Applications to Music Education'. Using more contemporary terminology, the two opposite, although hopefully, complementary sides of this continuum may be thought of as an 'objectivist learning environment' and a 'contructivist learning environment' respectively (Bond, 2002, p. 13).




**Source: adapted from Stevens, 1994, p. 49**

## The Art-E-Mus course

In 1995, I was part of a team awarded a National Professional Development Program Grant to develop a project entitled 'Teaching with Converging Technologies: A Professional Development Course for Teachers with Responsibility for Music and Visual Art (P-8)'. Subsequently developed as the *Art-E-Mus Technology Education Course,* it aimed to provide professional development for teachers in the use of technology in their teaching and, in the spirit of 'practising what you preach', the course was delivered entirely through technology-based media (Stevens, 1997). The course content included both visual arts and music, and was designed for both generalist and specialist teachers.

Course participants needed to have a computer together with access to the Internet (either in their own schools, at a cluster group base school or in their own homes). The 'hub' of the course delivery system was an extensive World Wide Web site that included course information, study materials, downloadable readings, cluster group activities, self-directed activities, and weekly postings to a bulletin board. Aside from general course information pages, the site included a page for each week of the course – the site was progressively updated with the next week's page of study guide material and learning activities. Participants were also encouraged to use email, not only to make contact with the course team, but also to communicate with each other as well as with teachers outside the course. This, it was hoped, would facilitate the development of an electronic network of professional support and collegiality.

Another important course delivery medium was the Interactive Television (ITV) programs produced by the Art-E-Mus course team and a commercial production company. These programs were broadcast from the Victorian Department of Education's 'SOFNet' television studios in Melbourne and received by schools across Victoria equipped with narrow-band television reception facilities – a satellite dish, receiver/decoder and television monitor. The standard ITV program included about 30 minutes of interviews and demonstrations, followed by questions for discussion during a 30 minute 'interval', and then a return to the ITV

program with additional interviews, demonstrations as well as responses by a panel of experts and/or members of the course development team to the questions that had been phoned in by course participants. Most programs concluded with several 'Hot Tips' – ideas on the use of technology in music and/or art classrooms for immediate implementation by participants in their schools.

The other main course delivery medium was teleconferencing. Ideally participants met in a 'cluster group' of fellow participants for this activity – although several teachers participated in the course as individuals. The teleconference sessions required a VoicePoint or other 'hands-free' telephone to enable full cluster group participation; otherwise, an ordinary telephone could be used by individual participants. In addition to weekly Self-Directed Activities (which included the keeping of a course journal, reviewing of web sites, reading of downloadable text materials), the course involved participants working in a cluster group through a series of school-based practicum activities which focussed on utilising computers, peripheral devices and the Internet in their own classrooms.

One of the objectives of the Art-E-Mus Course was to 'develop a research base on the [uses of] converging communication and information technologies in education ...' (Blackmore, 1997, p. 2). Within the process of developing and implementing the Art-E-Mus Course, the course development team utilised an action research approach as its *modus operandi*. There were several positive findings from the formal evaluation of the project. Participants reported that they were motivated to develop their own websites, that the ITV programs were an ideal medium for communicating course content, and that the cluster group meetings where the ITV programs were viewed overcame any feelings of isolation. Participants also reported that the course developed and extended their computer skills and confidence, extended their knowledge of the discipline areas, provided creative ideas for classroom application, provided information about internet resources and software, led to submissions for developing technology in the respective discipline areas, and demonstrated the application of technology across disciplinary boundaries (Blackmore, 1997, p. 32).

Although schools had been provided with funding for the purchase of the necessary infrastructure for internet access, some participants found computers and particularly dial-up modems were not yet available in their schools and this restricted their access to the full range of Art-E-Mus Course materials and activities. Reflecting this all-too-common situation during the first semester of presenting the course (the first half of 1996), the report of the project was appropriately titled *Evaluating the Art-E-Mus Course: 'A Year before it's Time'* (Blackmore, 1997).

Having acquired website authoring skills, I was able to develop university distance education courses in music and arts education that utilised a variety of technology-based media. Allowing for the fact that not all of our students had internet access at the time, study materials were supplied in CD-ROM format which facilitated asynchronous learning and included links to off-line web pages as well as to video presentations, PowerPoint tutorials, PDF readings, software programs and assignment tasks, all of which were included on the CD-ROM (Stevens, 2007; Stevens, Raphael, Grenfell, & Dressens, 2007). This delivery format provided students with a greater variety of learning experiences than print media (study guides and readers) and audio-visual materials (audio cassettes and VHS tapes) that had been utilised a decade earlier.

## Synchronous online music learning: The iMCM Project

In 2012, I was invited to give a report on 'The Australian Experience' as part of a Keynote Presentation at a Technology Pre-Conference Workshop entitled 'Teaching Music with Distance Learning Resources' at The College Music Society's Fifty-Fifth National Conference at the University of San Diego. Together with other remotely-located presenters, my report was delivered through an online teleconferencing system –

Cisco TelePresence MOVI client software – from my home office in Melbourne to San Diego in California (Stevens, 2012). This foreshadowed a project that I had an involvement with at the Melbourne Conservatorium of Music, The University of Melbourne that trialled the online delivery of instrumental music tuition.

One of the problems, widely acknowledged for students living in regional and remote areas, is the lack of proper access to music learning opportunities, particularly specialist instrumental tuition, which may significantly limit their musical development (McPherson, Davidson, & Faulkner, 2012). Given the availability of broadband connectivity in many regional areas (albeit, not without limitations at times) and the rollout of the National Broadband Network throughout Australia, utilising one-to-one and small group online instrumental tuition presented itself as one possibility for overcoming 'the tyranny of distance'. One of the justifications for the investment in and progressive roll-out of the NBN has focused on a more cost-effective means of providing education through online learning (Arnold et al., 2014). However, one of the major limitations identified through overseas experience is the problem of signal latency – that is, the time delay in video and audio transmission between two remote locations. Videoconferencing platforms such as web-based systems – *Skype*, *VSee*, *Zoom* – and hardware-based systems – Cisco, Centra, MediaLinks – are adequate for business meetings and the like, but instrumental music lessons need to involve synchronous interaction between teacher and student – for example, a teacher and student playing a duet – together with much higher quality audio (full frequency range) and video quality (multiple camera and zoom capability) to approximate face-to-face teaching. At the international level, there are several major overseas research institutions that are both utilising and researching videoconferencing and other ICT systems to facilitate music learning. These include the Manhattan School of Music, New York (Duffy et al., 2012), Sibelius Academy, Finland (Ruippo, 2003), Royal Danish Academy of Music (Duffy et al., 2012), Conservatorio di musica G. Tartini and the Italian Research and Academic Network, Pisa, Italy (Allochio, Buso, & Drioli, 2012). However, all research studies have highlighted the problem of latency as being the major inhibiting factor. Up until now, research undertaken into online music learning in Australia has been fairly limited and so a pilot program – referred to as the *iMCM Project* – was developed at the Melbourne Conservatorium of Music with funding from the Melbourne Networked-Society Institute at The University of Melbourne.

This project involved providing students at a regional school (Ballarat Clarendon College) who were learning oboe, drums and singing with online lessons given by specialist instrumental teachers located at the Conservatorium in Parkville (Stevens, McPherson, & Moore, 2015). The research underpinning the project focussed on two aspects – technical and pedagogical. The technical aspect involved laboratory- and field-testing of various videoconferencing systems and, where possible, modifying coding and de-coding protocols to minimize signal latency and maximize audio and video quality. The second aspect involved action research into student-teacher interaction in the online environment, identifying the advantages and disadvantages of online tuition experienced by both students and teachers, and the development of pedagogical methods and techniques specifically for online instrumental teaching.

The outcomes from this project which concluded in 2014 were, from the technical perspective, the development of digital codecs (coding that compresses data to enable faster transmission and decompresses received data) which improved signal latency and audio quality, and identification of optimal hardware and software for use in online instrumental music tuition (Moore, Stevens, & McPherson, 2015). From the pedagogical perspective, the project confirmed the efficacy of videoconferencing as a means of accessing specialist tuition in regional and remote areas on a regular basis. In addition, the teachers developed specific pedagogical techniques for optimising the online/videoconference learning experience and

both students and teachers developed valuable technology skills that were transferable to other areas of learning and teaching (Stevens et al., 2015).

## Where to next? Some observations and recommendations

My active involvement with technology and music education effectively came to an end in 2017 after assisting with grant applications in support an extension of the iMCM project to establish a National Online Music Learning Hub. Regrettably funding for this larger project was not forthcoming. In the meantime, of course, technological innovation has continued at an ever-increasing pace and has permeated all areas of society and so there is little doubt that opportunities for music learning and music making will continue to be enhanced by the application of new technologies. Aside from the widespread use of tablets and smartphones by students, teachers and society as a whole and the ever-increasing sophistication of hardware and software applications, the social landscape resulting from the use of social media platforms will further encourage the development of technology-facilitated 'communities of learning'. Internet media now include social networks that connect people (*Facebook, Twitter, Weibo*), media sharing networks (*Instagram, Snapchat, Flickr, YouTube, Vimeo*), discussion forums/blogs (*Quora, Digg, Reddit, Timbir*), and bookmarking and content curation networks (*Pinterest, Flipboard*), all of which have created a new pedagogical culture which today's music educators and music students can utilise. In this context, the point made by Crawford (2009) is particularly apt: 'New technology redefines the culture that creates it. One just needs to look at the way we now communicate and interact to understand the impact of technology' (p. 165).

Despite recognition in the wider educational community of the benefits of technology-based approaches for student learning, Crawford and Southcott (2017) point out that there is a disconnect between music and technology in recently-produced Australian school curricula. This disconnect, they assert, is due to curriculum guidelines being 'both vague and limiting'. There is certainly mention in the *Australian Curriculum* that, as one of the seven general capabilities to be specifically promoted, ICT should be embedded within all learning areas including music (ACARA, 2015). But, as Crawford and Southcott (2017) also draw our attention to in relation to the curriculum guidelines for Music and the Arts at the lower secondary level, 'Given the potential of technology to enhance music teaching and learning at all levels, its comparative omission in Years 7 and 8 seems incomprehensible. When ICT is mentioned, it appears to be an afterthought' (p. 362). The inclusion of music technology in the school curriculum has long been advocated in a succession of school music education reviews. The recommended actions in R.10 'Support Services for Music Education: Music teaching and technology' from the National Review of School Music Education not only pointed to the need for technology to be embedded in the school music curriculum and for the provision of technology-based equipment in schools, but also the embedding of music technology in pre-service teacher education courses and professional development programs (Australian Government Department of Education, Science and Training, 2005, p. xxii).

However, as with all pedagogical approaches to music teaching and learning, the use by teachers of particular teaching methods and techniques is dependent not so much on recommendations or prescriptions by educational authorities, but on individual teacher competencies, preferences and motivation. Accordingly, realisation of the recommendation to teachers for the 'embedding of ICT within all learning areas' is conditional on practising teachers and teacher education students being aware of and competent in using of technology-based approaches to music education through their pre-service training and then continuing professional development.

## Upskilling and motivating music teachers

Southcott and Crawford (2011) among others have quite reasonably asserted that 'few [teachers] have enough time to pursue professional development in the use of ICTs in music' (Crawford & Southcott, 2017, p. 348). Nevertheless, given the 'embedding of ICT within all learning areas' statement in the *Australian Curriculum*, it is assumed (or at least may be hoped) that pre-service courses for generalist primary teachers have covered the various applications of technology to teaching and learning across all learning areas sufficiently well for early-career teachers to apply their technology competencies to their teaching of music. In a national audit of pre-service teacher primary teacher education courses undertaken by Hocking (2009), the average percentage of the pedagogical foci within the surveyed compulsory arts/music courses (n=51) allotted to a technology-based approach, as opposed to other approaches such as Kodály, Orff and Dalcroze, was 6.3% (pp. 94-95). This represents a reasonable proportion of the attention to technology as a pedagogical approach to music but does not account for the exposure to what Finger, Jamieson-Practor and Albion (2010) refer to as Technological Pedagogical Content Knowledge (TPAK) – that is, generic skills and knowledge applicable across all curriculum areas – which might also contribute to the technological competencies of graduating primary teachers.

The situation for specialist music teachers at the secondary level may not always be taken for granted in the same way. Although now somewhat dated, a study by Leong reported that novice music teachers in Australia (59 beginning teachers and 102 final year music education undergraduates) – it may be assumed that the majority of these specialist were secondary teachers – stated that 'they were not provided with the resources and opportunities to employ and apply newly acquired skills such as the use of music technology' (Leong, 1999, p. 30). An informal review of masters level teacher education courses in Victoria revealed that, of the four institutions offering secondary music curriculum subjects, only one made specific reference to 'knowledge of the role of ICT music teaching and learning' in subject descriptions (The University of Melbourne, 2018).

The Victorian *Inquiry into the Extent, Benefits and Potential of Music Education in Victorian Schools* (Education and Training Committee, 2013) reported that 'Teachers in rural and regional areas can find it difficult to access professional learning activities. More needs to be done to make music professional learning opportunities more accessible to these teachers, including the increased use of technology' (p.87). This call applies not only to teachers in regional and rural areas but across the board. Teacher professional associations such as aMuse (Association of Music Educators [Victoria]) and particularly the Soundhouse Alliance in Victoria provide opportunities for teacher professional development in music technology. At least one professional development provider, Katie Wardrobe (Midnight Music), has done much to up-skill local music educators in this regard and has produced an invaluable music technology resources guide (Wardrobe, 2018) that includes lists of music software programs/apps, online articles, lesson plans and podcasts.

Given the growth of digital technology generally and of music applications in particular, technology-based approaches to music education should be recognised as equally-legitimate pedagogical method to more traditional approaches such as Orff and Kodály, and as such, should be incorporated as an essential component in teacher education courses and teacher professional development.

Motivation is also an important factor, but this is conditional on teachers recognising the pedagogical benefits of utilising technology in their teaching and being personally inspired by the possibilities afforded by ICTs for enhancing their students' learning. As I recommended in an article almost thirty years ago and which I believe is no less applicable today: '… music educators … should be encouraged to adopt an eclectic approach to the applications of computer technology to music education in order to avail themselves and their students of the best of both the worlds [computer-

assisted instruction and open-ended compositional environments] offered by this exciting innovation in music education' (Stevens, 1991, p. 34).

## References


AARNET (1989-2010). History [of the Australian Academic and Research Network]. Retrieved from https://web.archive.org/web/20101220175608/http://www.aarnet.edu.au/about-us/history.aspx

Allochio, C., Buso, N., & Drioli, C. (2012). An inside and hands-on look to a distance musical performance and education A/V streaming system. Retrieved from http://www.conts.it/artistica/lola-project/introducing-lola-workshop/opuscolo-progressivo-rid.pdf

Arnold, M., Bellamy, C., Coker, B., Gibbs, M., Hill, P., Nansen, B., & Wilken, R. (2014). *Framing the NBN: Public perceptions and media representations*. Parkville: Institute for a Broadband Enabled Society, The University of Melbourne.

Australian Curriculum, Assessment and Reporting Authority (ACARA) (2015*). Australian Curriculum: Introduction–Foundation to Year 10 overview.* Retrieved from http://www.australiancurriculum.edu.au/Curriculum/Overview

Australian Government Department of Education, Science and Training (2005). *National Review of School Music Education: Augmenting the Diminished*. Canberra, ACT: Australian Government.

Baskin, C., & Williams, M. (2006). ICT integration in schools: Where are we now and what comes next? *Australian Journal of Educational Technology, 22*(4), 455-473.

Blackmore, J. (1997). *Evaluating the Art-E-Mus Project: 'A Year Before it's Time'*. Geelong: Deakin Centre for Education and Change.

Bond, A. (2002). *Learning music online: An accessible learning program for isolated students*. Kensington Park, South Australia: Australian National Training Authority.

Brown, A., Stevens, R. S., & Wallace, N. (1992). Music Technology Systems: Recommended Purchasing Guidelines. *Victorian Journal of Music Education, 1992*(2), 20-27.

Cooper, B., & Elliot, R. (Eds.). (1988). *ISME [XVIII Biennial] Conference Program Guide, 17-23 July 1988, Canberra, Australia*. Canberra: International Society for Music Education.

Crawford, R. (2009). An Australian Perspective: Technology in Secondary School Music. *Journal of Historical Research in Music Education, 30*(2), 147-167.

Crawford, R., & Southcott, J. E. (2017). Curriculum stasis: The disconnect between music and technology in the Australian curriculum. *Technology, Pedagogy and Education, 26*(3), 347-366.

Duffy, S., Williams, D., Stevens, T., Kegel, I., Jansen, J., Cesar, P., & Healey, P. G. T. (2012). *Remote Music Tuition*. Paper presented at the Ninth Sound and Music Computing Conference.

Education and Training Committee, Parliament of Victoria (2013). *Inquiry into the Extent, Benefits and Potential of Music Education in Victorian Schools*. Retrieved from https://www.parliament.vic.gov.au/file_uploads/Music_Education_Final_041113_FJWsJhBy.pdf

Finger, G., Jamieson-Practor, R., & Albion, P. (2010). *Beyond Pedagogical Content Knowledge: The Importance of TPACK for Informing Preservice Teacher Education in Australia.* Paper presented at the Key Competencies in the Knowledge Society. KCKS 2010. IFIP Advances in Information and Communication Technology.

Hocking, R. (2009). National Audit of Music Discipline and Music Education Mandatory Content within Pre-Service Generalist Primary Teacher Education: A Report. Sydney: Music Council of Australia.

Hook, C. M., & Stevens, R. S. (1982). *Computers in Education: The Advent of PLATO in Australia*. Paper presented at the 52nd ANZAAS [Australina and New Zealand Association for the Advancement of Science] Congress, Macquarie University, Sydney.

Leong, S. (1999). The plight of novice music teachers in Australia: Initial preparation and workplace expectations. *Issues in Educational Research, 9*(1), 23-31.

McPherson, G. E., Davidson, J., & Faulkner, R. (2012). *Music in our lives: Rethinking musical ability, development and identity*. Oxford: Oxford University Press.

Moore, G. A., Stevens, R. S., & McPherson, G. E. (2015). *Videoconferencing for teaching and learning using highly interactive pedagogy.* Paper presented at the 26th Annual Conference of the Australasian Association of Engineering Education (AAEE), Deakin University, Geelong.

Papert, S. (1982). *Mindstorms: Children, Computers and Powerful Ideas.*: The Harvester Press.

Ruippo, M. (2003). Music Education Online. *Sibelius Academy*(2), 1-8.

Sarkar, S. (2012). The Role of Information and Communication Technology (ICT) in Higher Education for the 21st Century. *The Science Probe, 1*(1), 30-41.

Savage, J. (2010). A Survey of ICT Usage Across English Secondary Schools. *Music Education Research*(12), 89-104.

Southcott, J., & Crawford, R. (2011). The intersections of curriculum development: Music, ICT and Australian music education. *Australasian Journal of Educational Technology*(27), 122-136.

Stevens, R. S. (1982). Computers in Music Education: Future Directions and Opportunities for Australia. *The Australian Journal of Music Education*(31), 5-15.

Stevens, R. S. (Ed.) (1983-86). *ACIMEG Newsletter*. Geelong: Australian Computers In Music Education Group & Deakin University.

Stevens, R. S. (1984). ACIMEG Music Software Disk (Version Version 1.0, January 1984). Frenchs Forest, NSW: Apple Computer Australia Pty. Ltd.

Stevens, R. S. (Ed.) (1987). *Computer Technology and Music Education: The Australian Beginning (Proceedings of a Symposium entitled "Utilising Computer Technology of Music Teaching and Learning held as part of the ANZAAS Festival of Science – 1985)*. Geelong: Deakin University Press.

Stevens, R. S. (1988). *My Computer Sings! A Study of Educational Computing in Music Education* (ECRG Monograph No. 13). Geelong: Deakin University.

Stevens, R. S. (1991). The Best of Both Worlds: An eclectic approach to the use of computer technology in music education. *International Journal of Music Education*(1), 24-36.

Stevens, R. S. (1992). *HyperCard as a Medium for Off-Campus Teaching of Music: Implications for Future Music Education Practice*. Paper presented at the Association of Music Education Lecturers Annual Conference 1992, Sydney.

Stevens, R. S. (1994). *Technology and Music Teaching and Learning*. Geelong: Deakin University Press.

Stevens, R. S. (1997). *Practising What You Preach – A Report on the Use of New Communications and Information Technologies for the Delivery of a Teacher professional Development Course on Computer-Based Music Education*. Paper presented at the First Asia-Pacific Symposium on Music Education Research, Seoul, Korea.

Stevens, R. S. (2007). ECA551 Primary Arts Education – Music (Study materials). Geelong: Faculty of Arts and Education, Deakin University.

Stevens, R. S. (2012). *'The Australian Experience', a contribution (delivered online from Melbourne via Cisco TelePresence MOVI system) to a Keynote Presentation 'Distance Education in and Production in Music: Past, Present and Future' coordinated by F.J. Rees, Technology Pre-Conference Workshop: Teaching Music with Distance Learning Resources.* The College Music Society Fifty-Fifth National Conference. University of San Diego.

Stevens, R. S., & Brown, A. (1991a). Introduction to Musical Styles (Version 1.1 [January 1991]). Geelong: Deakin University Press.

Stevens, R. S., & Brown, A. (1991b). Introduction to Music Notation (Version 1.1 [January 199]). Geelong: Deakin University Press.

Stevens, R. S., McPherson, G. E., & Moore, G. A. (2015). *Report on The iMCM Project – Creating musical futures via the NBN through iMCM for students in rural and remote communities*.

Stevens, R. S., Raphael, J., Grenfell, J., & Dressens, J. (2007). EMA200 – The Arts in Education (Study materials). Geelong: Faculty of Arts and Education, Deakin University.

Stevens, R. S., & Stevens, C. J. (1987). Music Microworlds: The Development of a LOGO-Based Music Tool Kit. In R. S. Stevens (Ed.), *Computer Technology and Music Education: The Australian Beginning (Proceedings of a Symposium entitled "Utilising Computer Technology ofr Music Teaching and Learning held as part of the ANZAAS Festival of Science – 1985)* (pp. 51-58). Geelong: Deakin University Press.

The University of Melbourne (2018). Learning Area Music A 1 (EDUC90463) [Subject Description]. Retrieved from The University of Melbourne Handbook https://handbook.unimelb.edu.au/subjects/educ90463

Upitis, R. (1983). Milestones in computer music instruction. *Music Educators Journal, 69*(5), 40-42.

Wardrobe, K. (2018). *Ultimate Free Music Tech Resources Guide 2018-19*. Melbourne: Midnight Music.

Wastiau, P., Blamire, R., Kearney, C., Quittre, V., Van de Gaer, E., & Monseur, C. (2013). The Use of ICT in Education: A survey of schools in Europe. *European Journal of Education: Research, Development and Policy, 48*(1), 11-27.

Whelan, R. (2008). Use of ICT in education in the South Pacific: Findings of the Pacific eLearning Observatory. *Distance Education, 29*(1), 53-70.

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