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# Digital Technology and the Study of Music

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## Abstract

This paper examines three functions of music technology in the study of music. Firstly as a tool, secondly as an instrument and lastly as a medium for thinking. As our societies become increasingly embroiled in digital media for representation and communication, our philosophies of music education need to adapt to integrate these developments while maintaining the essence of music. The foundation of music technology in the 1990s is the digital representation of sound. It is this fundamental shift to a new medium with which to represent sound that carries with it the challenge to address digital technology and its multiple effects on music creation and presentation. In this paper I suggest that music institutions should take a broad and integrated approach to the place of music technology in their courses, based on the understanding of digital representation of sound and these three functions it can serve. Educators should reconsider digital technologies such as synthesizers and computers as music instruments and cognitive amplifiers, not simply as efficient tools.

## Autobiographical Note

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## Introduction

When assessing the impact of digital technology in the study of music it becomes apparent that there is a need for an integrated policy recognising that technology has three main functions in music. Firstly, that digital technology is used as a tool for assisting in menial tasks such as word and music processing, assembling and viewing statistics and audio examples, and for lecture delivery. Secondly, it functions as a musical instrument used for compositions, performances and other expressions of music. Thirdly, digital technology can be a medium for thinking, providing a mirror and window for students of music to reflect upon and view their work, or the work of others. Each of these functions need to be integrated in order for the full value of music technology in the study of music to be realised.

Contemporary digital technology in the 1990's is based, in the main, on microprocessor controlled devices. Digital computers are devices which are most recognisably microprocessor controlled. Computers are extensively used in every academic discipline including the study of music. But computer



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controlled audio devices are having a greater impact on music studies than is immediately obvious through computer usage. For example, microprocessors are at the heart of Compact Disc players, modern audio recording equipment, music synthesizers, electronic tuners, metronomes, printers and photocopiers. The foundation of such music technology is the digital representation of sound. Modern music synthesizers are digital instruments that are becoming established for both utilitarian and virtuosic performances, they are fundamental to popular and contemporary music of our time and are being used in an increasingly wide range of performance styles and situations outside of popular music.

Roos (Roos, 1989) is one of many questioning the degree to which contemporary technology's potential is being fully utilised by musicians, when he asks;

> with respect to all uses of technology in music today.
> 1. Are you using sequences to get around having to do worthwhile, though arduous work?
> 2. Is the quality of your music brought to a higher level, or is it just made easier and more convenient to execute?
> 3. By employing certain techniques are you able to realise musical alternatives that would not be possible any other way?
> 4. Are you in any way missing out on developing some skill that is necessary to building a strong musical foundation?
> No single answer to questions like these is quantitatively better than another. Often circumstances dictate your response. How you use technology in your music is a personal issue. It is, however, something that deserves serious consideration. (p. 104)

This paper intends to lay a foundation from which answers to questions about the comprehensive use of contemporary technology in the study of music can be answered, and from which new questions and directions can be articulated.

This paper will now examine each of the three main ways digital technology should support the study of music.

## Digital Technology as a Tool

Musicians, musicologists and others involved in the study of music have used a variety of technological tools for keeping chronicles of musical compositions, musical performances and musical ideas. Historically this has been via the medium of print, either as musical notation or textual descriptions and reviews on paper. Industrial, and subsequently electronic, technologies allowed for audio recordings of music to be made. Audio recording technology has been an invaluable tool for the student of music through much of the twentieth century. There have been a number of other tools used to a greater or lesser extent by musicians such as metronomes and tuning devices.



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Contemporary technology, in particular digital (computer based) programs are the tools of the late twentieth century. The computer's ability to be programmed allows it to serve the function of any of the tools previously mentioned. It can act as paper, pen, tape recorder, metronome, tuner and more. Most significantly, digital computers can integrate these programmed tools into new hybrid tools whose usefulness is more than the sum of their parts. Friend et. al. allude to this through observation of its effects when they state 'Composition and performance have been fused into one act, through the use of electronic music synthesizers and sophisticated recording techniques.'. (1974: 187) For example, a music notation program can be likened to an integration between paper and tape recorder in that it can both display musical notation but also record and playback performances. Its ability to transcribe those performances into notation takes it beyond the sum of the previous technologies and a little way into the possibilities offered through integration of these digital representations of sound.

The development and use of such musical tools (programs and devices) are the foundation of industries in themselves. There is much that users of these tools (musicians and music students) can contribute to their development. Thus it is common for many music departments in tertiary institutions to have courses devoted to such development. It is also common for commercial providers of such tools to employ these graduates who have a strong musical understanding combined with technical and human-factors training. Therefore, it is suggested that schools of music should seriously consider the fostering of music technology research on a par with other more common music studies such as composition, performance, music education, music therapy and musicology.

As with any profession it is necessary for musicians and others working in the music field to be proficient with the tools of their trade. A musical instrument is the main tool of trade for performers of music but contemporary technological tools such as computer based notation programs, sequencers, music synthesizers, audio recorders and more are the tools of trade for most music professionals of the late twentieth century.

The piano is widely used as a tool by musicians. It has long been considered that a basic skill on piano is useful to any student of music. The piano allows for polyphonic parts to be realised, it is an instrument which aids conceptual understanding of harmony and theory through its physical layout, and is accessible due to the ease of sound production across its entire register. As a result pianos are now commonly found in music learning environments.

I propose that some form of digital instrument is well suited to the position of common music study workhorse now occupied by the acoustic piano. Therefore, synthesizer/computer skills should be considered fundamental to the music education of any music-related discipline, for similar reasons that piano skill is considered desirable. The next section of this paper will deal with this proposition in more detail.

The introduction of digital tools into music studies is taking place progressively. The first step was the use of electronic tuners and metronomes,



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the next step will be the replacement of acoustic pianos with digital pianos for non-performance roles, as the skills and knowledge required for acoustic or digital pianos are identical, excluding some extended performances techniques. These digital keyboards will form the basis of a computer-based work environment that will be common place and invaluable to the music student of the twenty first century. The third stage will be the wider use of digital sequencers, recorders and other tools in conjunction with these keyboards. The fourth stage will be the development of portable digital workstations which will allow all the capabilities of the computer-based workstations to be carried with the musician with similar ease that he/she might now carry, and use, a 'walkman' tape recorder. Such portable tools will require musical user interfaces, yet to be fully developed, rather than language or graphic interfaces.

## Digital Technology as an Instrument

The major area of technological development throughout the history of music has been in the improvement of musical instruments. It is through musical instruments that musicians externalise their musical ideas. Wood and animal products were used for early instruments, followed by brass and other metals, which were not only used as materials for instruments but to make tools with which to build better wooden instruments. Keyboard instruments from harpsichords to pianos relied on technological advances for improvements. The pipe organ was often a technological as well as instrumental masterpiece. Instrument development has not slowed, in particular orchestral instruments have been improved through use of computer technology which is incorporated in the refining of shape and structure through computer modelling and computer aided manufacture. Microprocessor controlled instruments have gained great usage in popular music and electroacoustic music and their development is no less rapid than previous instruments, driven by the desire of performers and composers to realise their music.

The synthesizer is the foremost instrument of contemporary music technology. The synthesizer has some thirty years of history across a variety of musical styles, and has spanned various electronic technologies. Like all new instruments its shape and functions are constantly evolving.

The synthesizer of the 1990s is generally a digital computer with gesture controller, commonly a keyboard. Its ability to manipulate sound is potentially more complex than any previous musical instrument (Semegen 1989), but the skills required to achieve virtuosic control of this are only just becoming recognised and consolidated. The synthesizers similarity to other instruments in performance requirements is outlined in Brown (1992) and Moore (1990) who provide a view of performance inclusive of contemporary and traditional instruments.

> Performing music, as we have defined it, is the task of transferring symbolic representations of musical thought into the physical actions necessary to operate a musical instrument so that the specified musical thoughts are realised in sound. (p. 13)



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Once digital technology is considered as a musical instrument the effective use of such technology in the study of music becomes clear. The place of musical instruments in music study is well understood. Instruments based on contemporary technology, in particular the synthesizer, need to be provided with similar opportunities to other instruments and can be used in familiar ways.

The development of digital technology as musical instrument should occur within centres of music study, so that a musical perspective can at all times be maintained. Anthony Kemp (1986) makes the point clearly when he states;

> Some music teachers question whether items of electronic apparatus can be considered musical instruments, maintaining that there is a fundamental difference between machines and acoustic instruments. Clearly all instruments are capable of being played unmusically and no instrument is of itself musical. It is the capacity of the player to engage in musically sensitive and imaginative movements which transfers an innate object into a speaking and living thing. All instruments have their limitations and it is the ability of the player to operate within these in a musically productive fashion which is important. That is not however to deny the fact that we should be developing electronic instruments which possess the capability of responding to high levels of nuance and human sensitivity in performance.

## Digital Technology as a Medium for Thought

Perhaps the greatest influence of digital technology on music studies is its ability to allow us to think about music in new and enhanced ways. As a result it can change the way we understand music and provide new insights for the people who create and research it. This has been so for technological developments throughout history as Mumford (1934) says, 'behind all the great material inventions of the last century and a half [there] was not merely a long internal development of technics: there was also a change of mind.' (p.3). Digital technologies are providing one of the more significant changes in medium of modern time the influences of which we are only beginning to see, as Gassée (1990) put it, 'Computers are simulation engines - powerful tools for mental-model building. We are only beginning to see them as such'. (p.226) Use of digital technology can lead, if effectively studied and implemented, to new ways of learning and understanding music as an art form and sound as a science.

This concept can be less confronting if we look at digital technology as a new representation of reality. It, like all mediums before it, can reshape our view of the world (McLuhan 1964), and consequently our view of music and its place in the world. It is interesting to observe the changes to music and musical thinking as a result of significant media evolutions; for example, the rise of music notation on paper shaped the music world by allowing communication and storage of music which overcame distance and time to a large degree. Further, the advent of audio recording as a medium influenced



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the music community by allowing the communication of music to reach new heights, challenged the role of musicians and live performance in society, and allow music to be stored and organised as sound rather than notation or language (Jones 1992). Electronic broadcasting technologies of radio and television introduced both opportunities and challenges for the musician, musicologist and music audiences alike.

The advent of digital representation of music via microprocessor-based technology will similarly challenge and inspire the way we think about music and its place in society. The concepts of musicianship, musical instrument definitions, fundamental musical skills, the role of the performer, the composers control over final realisation (Friend et. al. 1974), physical relationships between performers and with their audiences, authenticity of style, recent history of musical instrument development (Boulez 1986), intellectual copyright, distribution of music product, adherence to current tonalities and forms (Deutsch 1976), relationship between score and performer (Matthews and Abbot 1980), positioning in space of sound objects, psychoacoustics (Carterette 1989) are some of the issues confronting the academic music community as a result of digital representation of sound. Digital technology is indeed a vehicle for addressing both eternal and novel questions on the nature of music.

## Conclusion

The place of digital technology should be fundamental to the working with, the expression of, and thinking about, the study of music. The student of music, no matter what their speciality, should have instruction in, and access to, digital technology which will allow them to engage in music according to their needs and desires.

The influence of digital technology on the study of music should take place on three levels. Firstly, it should be used as a tool, as it is when used for creating rehearsal accompaniments, transcribing and typesetting music notation or assembling and viewing data of both written and audio forms from a musicological field trip. Secondly, digital technology in the form of a synthesizer, should be a recognised instrument which can be studied, written for and performed on as are other instruments. Thirdly, digital technology should be a medium for expressing and describing sound in a new way which challenges and extends our knowledge of music and ourselves. This may include it being a research metaphor, compositional assistant or a performance partner, allowing us to experience music in a new light.

The possibilities are vast for those institutions which have the vision to enhance their music studies with these technologies. Composer Pierre Boulez (1986) goes further;

> In the end, musical innovation will have somehow to learn the language of technology, and even to appropriate it. The full arsenal of technology will elude the musician, admittedly; it exceeds, often by a big margin, his ability to specialise; yet he is in a position to assimilate its fundamental procedures, to see how it functions and according to which conceptual



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> schemes - how far, in fact, it might or might not coincide with the workings of musical creation and how it could reinforce them. (pp. 9 - 10)

It is important that institutions involved with music are able to include digital technology in their courses in all three ways already described. It is equally important that a considered opinion about the place of digital technology in music be lead by *music* institutions. Digital technology plays a large role in music making and presenting in the commercial music industry. If there is not an academic perspective provided on this important aspect of music making and presenting then it will be left entirely to market/popular forces to develop and control.

It would appear from the views presented in this paper that digital technology has a significant place in the study of music and will be a valuable asset to those who use it wisely and to its full advantage.

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