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Performativity and interactivity: Pre-paradigmatic performance

Ian Stevenson

Introduction

Tertiary music technology education is characterised by a great diversity of pedagogical methods, from theory-first approaches, to creativity and composition-led; from the rapidly disappearing one-on-one, to collaborative, group-based and student-centred models (Brown & Nelson 2014). As an arts practice discipline, music has also been caught up in sector-wide trends towards reduced funding and standards-based assessment practices (Tregear 2014; Morgan 2004) all of which have caused those teaching in music technology to adapt and reflect on our strategies to deliver relevant and future-focused learning experiences.

This chapter outlines attempts to develop an integrated conceptual and pedagogical framework for learning and making electronic music in an undergraduate music program. It maps practical responses to the problems that have arisen during the development and delivery of a second-year undergraduate subject in music technology entitled *Machine Musicianship*. It also addresses the notion of digital literacy as relevant to electronic music performance. The problems that define such an undertaking include but are not limited to the following: how to select appropriate pedagogical methods relevant to engaging "digital native" learners; how to orient students towards an experimental approach to music making where the lines between performer, composer and instrument builder are blurred; how to assess diverse musical outcomes and approaches where the results may not conform to conventional musical paradigms; how to encourage risk taking but value skills exploited in presenting work of quality; how to encourage concept driven work that develops the artist's independent voice; how to express a set of explicit and inclusive musical values that avoids invoking the musical prejudices of assessors and that are not opaque to students.

A response, in part, to these questions in the context of the *Machine Musicianship* subject is encapsulated in the problematic of performativity and interactivity, a pair or series of pre-paradigmatic concepts that are explored, developed and evaluated in the design of the subject's content, delivery and assessment. The notion of the series as a concept or signifier in a chain of reference or sense is developed by Gilles Deleuze in the book Logic of Sense (2004, 36-41). This tool of thought, linked to the idea of the problematic, is used to encourage students to explore the concepts of performativity and interactivity in the understanding that the terms lack fixed definitions and require them to introduce and extend their

own knowledge, within the learning context, towards a creative solution. In this sense the terms are pre-paradigmatic, not yet locked into a disciplinary or expressive paradigm. These problematic[1] concepts are taken up as assessment criteria that are explored in student-centred group learning activities that are intended to provide a demonstrable link between the learning outcomes for the subject, the content of the subject, in particular as stimulus for creative strategies and technical designs, and linked into an assessment framework.

A curriculum for making computer music

The subject under discussion is the fourth in a sub-major sequence in sound technologies delivered as part of the Bachelor of Music at Western Sydney University (formerly UWS). Over three successive semesters students are introduced to a range of potentially challenging electroacoustic repertoire from the twentieth and twenty-first centuries. These exemplars are intended to challenge their listening assumptions, open a discussion on the nature of contemporary music and introduce them to canonical works that enable them to engage in an informed way with the discourse of electronic music. This repertoire also provides them with examples of how the practical topics in music technology that they are being introduced to relate to the practice of composers and performers.

The practical techniques covered in the first two semesters include conventional methods in stereo recording, MIDI sequencing, sound synthesis, and approaches to composition. These techniques are assessed in the context of practical projects framed by mainstream creative tasks such as performance documentation and production, sound design for sonic branding, and production music composition. These musical ideas are accessible to most musicians entering an undergraduate program. However, in what is probably a fairly standard approach to university-based music technology training, during the second semester, students are stretched by being forced through assessment task requirements to engage creatively with the everyday sound environment as a source for musical material that they must select, collect and with which they must compose.

The third semester offers an introduction to conventional multi-track studio techniques that allows students to develop skills that many identify as being important to them at the time of enrolment for higher education. Studio production skills also facilitate the development and presentation of their work in composition and performance subjects and enable them to produce a portfolio of recorded work that may be useful in establishing their professional careers. Interestingly, many students choose in this context to develop the more experimental approaches to the use of a broad range of sound material that they have been introduced to in their first year. These approaches could loosely be characterised as soundscape and acousmatic composition.

[1] The term problematic is borrowed from Gilles Deleuze's reading of Kant in which problematic Ideas provide a "systematic unity" to an enquiry without expecting solutions or answers (Deleuze 1994: 168–169).

Throughout this process several forms of scaffolding (Sawyer 2006: 11) or staging (Collins 2006: 52) are taking place. Firstly, techniques, terminology and listening strategies advance hand-in-hand, each building on the other and enabling greater technical facility and access to effective methods of discourse and creativity. Secondly, the criteria that are offered to assist students to target their effort and by which students are assessed are introduced in stages in order to set standards and expectations that progress throughout the subjects. Criteria are aligned explicitly with assessment task descriptions and learning outcomes for the subjects. At first year level students are introduced to simple objective measures of audio production quality and the listening skills associated with their aural identification and description; the need for organised and systematic presentation of materials; academic referencing standards to encourage reading, listening and attribution; the development and expression of coherent conceptual frameworks for creative work; and a concern for musical form. These criteria and associated standards descriptions start with simple values and build and integrate as students progress through the curriculum.

This approach is not novel and has become best practice in higher education (Morgan 2004; O'Donovan, Price & Rust 2004). The criterion and standards based assessment approach described above has been evaluated in earlier work (Blom, Stevenson & Encarnacao 2015). As noted in that evaluation, many students use this scaffolding to target their efforts but many choose to ignore the institutional context of their learning. Many students aim just *to get through* while balancing the demands of earning an income and maintaining themselves and their families. These contrasts can be attributed to varying aspects of internal and external student motivation (Biggs 1985). One of the objectives of developing conceptual assessment criteria is encourage students to reflect on their motivation by bringing into question the role of the assessment apparatus.

Subverting the assessment framework in the fourth semester

In an effort to achieve some of the pedagogical objectives outlined earlier the criterion and standards-based approach is somewhat subverted at the point when students reach the fourth semester. In this subject we move outside of conventional pedagogical paradigms in order to encourage an experimental approach to music making, blur the lines between performer, composer and instrument builder, encourage risk taking, and develop the artist's independent voice. To achieve these objectives the learning environment is designed to develop what is known in the educational literature as *a community of practice* (Collins, 2006: 51). This community shares a common set of goals including passing the subject and making music. Learning activities are structured so that students are thrown together to share and facilitate each other's learning. Social media is employed to stimulate an authentic sense of community and the normalisation of the learning experience. In the years 2015 and 2016 98% of students enrolled were active users of Facebook, whereas usage of the University's learning

management system as a communication tool was limited. Despite fluctuations in engagement with Facebook in preference for other platforms, students are encouraged to think of social media channels from the perspective of professional producers not 'prosumers'.

The software tools employed in the subject present a problem and a challenge to this community. The media-programming environment *Max/MSP* (now simply *Max 7*, Zicarelli & Puckette 2014) is alien, in some ways archaic and is difficult to learn. *Max* is a computer program for musicians and media artists that adopts a graphical patching metaphor and a dataflow programming model. Dataflow programming is particularly useful for event-based, real-time processes typical of musical and other interactive applications. This model attempts to make programming accessible to musicians thereby opening up the musical possibilities offered by computational approaches to music making. Despite its aims, *Max* harks back to a time when computer musicians had to build their own tools, when the term *computer music* had a distinct meaning that did not reflect the norm. This software does however encourage music making outside of the conventional musical paradigms. It challenges and encourages students to adopt some of the pioneering spirit of early computer music in which the computer was seem as a tool that freed composers and musical experimenters from the constraints of conventional musical practice. The computer enabled musicians to imagine new compositional forms and procedures and new types of instruments. In truth, new tools often appearing on tablet computing platforms are rapidly subverting the conventional paradigms by offering new and interesting ways to control the production of electronic music for example, by avoiding the piano keyboard control interface. However, as Messerschmitt and Szyperski (2003) point out these software tools continue to embed the representations of musical knowledge and processes adopted by their authors. The strengths and weaknesses of emerging tablet-based music software for teaching music performance are considered elsewhere in this book (see Chapter 5 Stevenson & Blom). However, one of the values embedded in the design of *Max* is its openness to new forms of musical expression. In addition to allowing students to participate at some level in this creative and exploratory subversion of musical norms, the use of a patching environment is intended to develop some form of digital literacy (Jenkins 2009) without the need to write code. To this end it encourages systematic and programmatic logic, and a non-linear approach to music production. These aspects of digital literacy are considered in more detail below.

A difficult and unaccommodating software environment is not the only problem that binds this community of practice. In addition to giving an "introduction to music programming in a patcher environment", the subject aims to "provide a conceptual understanding of interactive or responsive sound works, a practical understanding of performance interfaces for digital instruments and an ability to design, plan, realise and assess substantial creative projects"[2]. In this context, practical problems and

[2] This text is taken from the subject description published in the University handbook and subject learning guide.

learning challenges proliferate and become a normalised part of work with music technology. This is in stark contrast to the 'frictionless' nature of modern software interfaces that have been posited as the bedrock of the digital natives' expectations (Prensky 2001). In facing the questions and challenges posed by this process we hope that deeper forms of learning may result. Just as in conventional musical practice, examples of rich musical experiences form the impetus for continued perseverance; in teaching this subject, examples of engaging technology-enabled works are used to inspire students to develop the necessary skills to take the first steps in this direction. In addition to the practical problems a conceptual problematic defined by two key concepts is embedded at the heart of the subject and expressed within the assessment rubric through which students must attempt to gauge their own progress and by which their assessors must evaluate their achievement. The two concepts of *performativity* and *interactivity* are explored throughout the subject and are tested for their ability to stimulate and produce new and interesting solutions in the form of creative works and performances and positive learning outcomes.

What is performativity?

The concept of performativity comes from the philosophy of language (Austin 1962; Searle 1979) and has since been adopted in a range of critical and cultural theory (Butler 1997). In the philosophy of language, a performative utterance is one that brings a state of affairs into existence. This usually relies on an institutional context. Examples include the recitation of marriage vows and a proclamation by an authorized celebrant that produce a marriage in the act of speaking. Performativity links performance with creation, a concept not unknown to the world of music, particularly in improvised performance. An improvisation is a unique instance of a musical work. Even in scored music a performance can be considered as an ontologically distinct token of a particular musical type that is brought into existence by its rendition in performance (Wollheim 1980; Wetzel 2011).

How then does performativity become a problem in electronic music performance? Electronic sound reproduction replaces the necessity for performance in the presentation of music. This challenge to the status of electronic concert music was realized by its pioneers in the middle of the twentieth century who sought a means to integrate some element of performance in the presentation of their otherwise pre-recorded compositions (Manning 2003). One solution adopted by early practitioners such as Pierre Schaeffer and Karlheinz Stockhausen was the use of multi-speaker playback systems that allowed sounds to be projected into the auditorium and required a performer to *diffuse* the sound live during the concert. An aspect of musical authenticity is related to the production of sounds in real-time and this issue affects audience reaction to the performances of DJs as much as it does those engaged in experimental electronic music (Auslander 2008; Moore 2002; Emmerson 2007). One of the aims of research into new musical interfaces is to enable expressive and visually engaging musical

performances (Paine 2015) that retain some of the embodied aspects of traditional instrumental performance.

Each compositional or performance strategy might be situated somewhere along a continuum of performativity where at one end is located the playback of fixed works and at the other are located works generated by real-time sound synthesis with continuous parametric control over the production of sound. An analysis of performativity in electronic music would likely reveal a great variety of approaches that would not sit easily on a single dimension. For example, real-time synthesis can be expressive and nuanced on a micro-scale, whereas interaction can produce variable structures on a larger scale. Highly engaging and successful musical works can easily combine more-or-less fixed sequences of material that are augmented by dynamic and expressive performance gestures on a limited range of vocal, instrumental or other ornamental resources. There are no simple rules for performativity, however it is an easily understood value linked to the concept of authenticity and a useful way of problematizing electroacoustic music performance and stimulating creative design responses to the development of performance interfaces and sound generation algorithms.

The following guidance is offered to students in the learning guide:

> Performativity: a term used in this unit to describe the way in which sound is created or structured in performance. It borrows and develops the concept of speech acts introduced by philosopher of language J. L. Austin who described the way certain parts of speech bring things into being. A highly performative work with technology is one in which the performer or participant, unlike pressing play on a CD player, effects the creation of the sound or its low-level structures moment-by-moment. In traditional instrumental performance, this might be considered an expressive or nuanced performance. The concept of performativity is problematised by the notion of machine agency. With generative or artificially intelligent systems, the machine or algorithm may become more of an active agent in the performance of the work. In this case a highly complex algorithm may be constructed so that some analogue of decision-making or other forms of complex behaviour are exhibited without human intervention. This might also be considered performative.

Performativity is expressed as an evaluative criterion within the subject documentation with the use of descriptive text associated with standards of achievement. This text includes the following elements from poor performance to outstanding:

- Does not engage with the patcher environment as a performance or composition tool
- Mainly pre-recorded material and playback.
- Relies heavily on preproduction, or, comprises large blocks of pre-made material.
- Good balance between preproduction and real-time structuring on macro and micro scale.

- Most sound material or structures created in performance, strong link between performance gestures and sonic material.
- Highly nuanced technique and expressive performance.
- Unique realization created in the moment.

What is Interactivity?

Interactivity describes a situation where two elements within a system respond to each other in more-or-less predictable ways. Artist and academic Garth Paine (2002) surveys a number of models of interactivity relevant to experimental musical practice. He initially discounts merely responsive systems such as CD player which responds to a button press. Citing Todd Winkler he describes a three level model of interactivity:

- The conductor model in which a central musical intelligence commands a group of responsive performers coordinated by a score.
- The quartet model in which each player responds to the others, moment to moment with a form of organised but distributed musical intelligence that is coordinated by a score. Control can be subtly shifted from one player to another.
- The improvisation model in which the musical structure can be modified within an agreed framework and control is deliberately passed from one member to another.

Another model is that of the conversation in which each party responds to the less predictable contributions of the other with more-or-less spontaneous, novel and engaging results. As we can see interactivity and performativity are closely related concepts. They are both tied up with agency and novelty. Interactivity may be associated with stochastic algorithmic processes, with aspects of artificial intelligence, or with physical interfaces that present a wide range of control possibilities.

The following guidance is offered to students in the subject learning guide:

> In the simplest terms, interactivity can be mapped onto a continuum between the play button of a CD player at one end and an ensemble free-improvisation at the other. There are several dimensions however, for example granularity of control, which might be placed on a continuum from high level (e.g. a few parameters control a complex algorithm that evolves by itself); note event control (e.g. piano); to low level timbral control (e.g. human voice, low level synthesis). Another continuum might be in terms of predictability of response; for example a piano is relatively highly constrained and predictable in terms of its output for a given input, the violin a little less so, an improvising partner less predictable again. The concept of interactivity is also problematised by the notion of machine agency. With artificially intelligent systems and machine listening, the machine may become more of an interactive partner and so interaction becomes less about control and more about complex responses initiated by behaviours on the part of the system.

Interactivity is expressed as an evaluative criterion within the subject documentation with the use of descriptive text associated with its own standards of achievement. This text includes the following elements from poor performance to outstanding:

- "Press to start" where no machine agency is present.
- Simple control systems inhibit expressive potential or variation in performance or limited machine agency.
- Adequate control and interaction or well developed algorithmic complexity.
- Effective interaction with performance system or sophisticated algorithmic material.
- Novel performance interface, interaction with sonic material or audience.
- Outstanding integration of acoustic and electronic elements and development and exploitation of performance interface.
- Advanced and expressive performance system.

Digital literacies and constraints on creativity

The subject fulfils one further role within the degree by engaging with the discourse around digital literacy. Digital literacy as a learning outcome is a contested and evolving term having moved from a simple notion of computer literacy (an ability to operate standard computer software) to something less clearly defined and more diffuse. In their 2008 survey of digital literacies Colin Lankshear and Michele Knobel present a "web of literacies of the digital" including ICT/computer literacy, information literacy, technological literacy, media literacy, communication literacy, visual literacy, network literacy, e-literacy, digital competence, digital *Bildung*, web literacy and game literacy, amongst others (4).

An interesting parallel or inversion of the evolution of digital literacy can be seen in the transformation in the teaching of English in Australian schools. Fehring and Nyland (2012) identify a focus on "language and language proficiency" (8) in English teaching in Australian schools in the 1980s "reflecting the multicultural and pluralist perspective of the period" (8) and an absence of the term "literacy" implying knowledge of the rules of English grammar "associated with ideas of social class and power" (10). In contrast, more recent developments particularly in the roll-out of the National curriculum (ACARA 2015) have seen a renewed focus on the elements of English grammar. To highlight the parallel with digital literacy, we might compare the approaches to English literacy of the 1970s and 80s (those experienced by this author) that aimed to teach students how to *use* the language with more recent approaches that attempt to highlight the way that the language *works*. Similarly, in the transition from computer literacy to digital literacy we have seen a shift from training on the use of software to a focus on how digital and networked media work as sources of information.

A further recent development (itself a throw-back to the use of high-level computer languages such as BASIC and LOGO during the adoption of early microprocessor-based computers in schools in the 1980s) is the inclusion of "coding and computational thinking across the curriculum" in primary and secondary schools in New South Wales and elsewhere (BOSTES 2017). Citing Jeanette M. Wing, the NSW Education Standards Authority adopts the following definition of computational thinking:

> Computational thinking is the thought processes involved in formulating a problem and expressing its solution(s) in such a way that a computer – human or machine – can effectively carry out…. computational thinking is not just about problem solving, but also about problem formulation.

In this aspect of digital literacy once again we can see a parallel with an extension of English literacy from reading and writing, to forms of critical media literacy. In the case of digital literacy, we see an extension of computer literacy from reading and writing computer code to systematic or critical problem formulation on the other. The hope of this pedagogic enterprise is that experience and understanding of the fundamental formulation of algorithms can foster creative and innovative approaches to a range of problems in the area of interest of students rather than merely reproducing or enacting existing strategies. In accordance with this hope, the approach to digital literacy in *Machine Musicianship* extends beyond information literacy to a notion of systems literacy in order to develop a critical understanding of the affordances and constraints offered by new and existing digital music technologies. It also embraces the evolving nature of such literacies by embedding problematic concepts such as performativity and interactivity as defining criteria that encourage and empower students to enact and perform their own creative solutions to their unique musical and creative problems. At a more basic level we hope that students will learn not just how to *use* software but how software *works*.

The limitations of computer systems in creative endeavours is highlighted by musician-researcher Andrew Hugill and computer scientist Hongji Yang in their formulation of the emerging field of *creative computing.* Hugill and Yang point out that: "although human beings increasingly turn to computers as aids to creativity, the way the software is engineered frequently enforces compromise or, worse, inhibits creativity through unwelcome constraints" (Hugill & Yang 2013: 5). As Messerschmitt and Szyperski (2003) assert, software embeds a representation of social or technical processes and an assumed understanding of the needs and wants of users, as modelled or imagined by the software designers. The awareness of these constraints or assumed models of creative process is a primary motivation in the design of the software environment chosen for the subject: Max/MSP. As its author Miller Puckette states: "The design of Max goes to great lengths to avoid imposing a stylistic bias on the musician's output" (Puckette 2002: 39). Unlike other music software that carry with them the conventions of a musically literate culture, "On starting Max, the user sees nothing but a blank page—no staves, time, or key signatures—not even a notion of 'note,' and certainly none of instrumental

'voice' or 'sequence'" (39). This approach assumes that these conventions of a musical culture embody both pre-defined solutions to and statements of musical problems, whereas algorithmic and computation thinking demand a reformulation of the musical problems themselves that must be engaged with performatively by the musician as they develop their creative work. This creative work must engage at a fundamental level with the notions of instrument (Schaeffer 2017: 31), composition and performance. As can be imagined, this approach defies the imposition of stable and clearly delineated assessment criteria that might determine predictable forms of musical expression.

By choosing a software tool such as this rather than some more accessible and up-to-date software such as *Ableton Live* (Ableton 2017), we trust that students are able to rise to the challenge of formulating their own musical problems rather than adopting existing solutions to problems that encapsulate the creativity of artists who have gone before. Rather than expressing a prejudice against musical conventions we hope that this approach can empower students to become independent learners and creators. Learning to learn software and to imagine and adapt to new forms of creative process will be a necessary skill in the rapidly changing future of their professional and creative lives after university. By imagining musical creation through the lens of performative acts whether as instrumentalists or through machine agency, and by focusing on performance as a field of interaction with musical systems and structures such as ensembles, audiences and instruments, students are hopefully empowered to produce alternative paths to musicianship that may help them to find and produce the niches that will enable them to flourish in an uncertain musical ecosystem. Similarly, by subverting the assessment framework we attempt to challenge students not to rely on the formulaic strictures of institutions but to think and act for themselves and to devise unique solutions that build their creative strength and individuality.

Evaluation

The concepts of interactivity and performativity are debated by students and found to be unstable and problematic. They challenge students as composers, performers and scholars, and stimulate creative responses to the challenge of developing novel musical responses in the context of exploring new software. Situating these concepts within the assessment framework opens the possibility or necessity of negotiation or demonstrating a claim for the validity of their own solutions to the assessment task requirements. This potentially shifts the authority from the assessor to the student and enhances their agency in their own learning and creativity.

Of course, many students prefer to ignore the institutional context and focus on their personal interests and needs, or find the notion of unresolved problems unsettling. In formal, written student feedback some students question the relevance of the subject content to their own musical aspirations and many find the prospect of mastering such a completely new paradigm in the available time unrealistic. While

students do mention aspects of the assessment task descriptions in their feedback, the assessment criteria themselves are never addressed. However, the impact of a conceptual approach in a practical subject is regularly commented on by students. For some the challenge of new tools and new concepts is highly productive. Some students regard the experience as "challenging, new and innovative" enabling them to "discover something [they] didn't know before". Students noted the value of "expanding the idea of what is possible in creating new instruments" and found this approach "interesting and thought provoking". Students also responded positively to being "thrown in at the deep end" with music programming and "discovering new ways of performing". Students have consistently reflected on the subject's demand for "critical and logical thinking". The subject results in them "getting out of [their] comfort zone and they respond positively to the range of "new musical possibilities" and the resultant encouragement of "new levels of creativity". Comments such as these attest to the capacity of this approach to produce a space for creativity and empowered learning.

Conclusion

The use of the problematic concepts of performativity and interactivity embedded in the assessment design for the unit aims to signal to students that they are operating in a different paradigm to the one usually signaled by clear actionable assessment criteria with explicit standards of performance. The goals of the unit are linked to this "pre-paradigmatic" mode of music creation in their aim to orient students towards experimental music making where the lines between performer, composer and instrument builder are blurred by the software tools they are learning. They aim to encourage a diversity of musical outcomes and to provide an assessment framework to accommodate these. The unit encourages risk taking and expects students to defend and argue for their choices. Above all the aim is to nurture student musicians as artists with a developing independent creative voice.

References

Ableton. (2017). *Live 10* [software]. Berlin: Ableton

ACARA. (2010). Australian Curriculum Assessment and Reporting Authority. Retrieved from http://www.acara.edu.au/curriculum, accessed 24 January 2018.

Auslander, P. (2008) *Liveness: Performance in a mediatized culture* (2nd ed.). London and New York: Routledge.

Austin, J. L. (1962). *How to do things with words*. Oxford: Clarendon Press.

Biggs, J. B. (1985). The role of meta-learning in study process. *British Journal of Educational Psychology*, 55, 185-212.

Blom, D., Stevenson, I. and Encarnacao, J. (2015). Assessing music performance process and outcome through a rubric: Ways and means, in D. Lebler, G. Carey and S. D. Harrison, eds. *Assessment in Music Education: from Policy to Practice*. New York: Springer, 125-139.

Brown, A. and Nelson, J. (2014). Digital music and media creativities, in P. Burnard, ed. *Developing*

Creativities in Higher Music Education. Abingdon: Routledge.

Butler, J. (1997). *Excitable speech: A politics of the performative*. New York: Routledge.

Collins, A. (2006). Cognitive apprenticeship, in K. Sawyer, ed. *The Cambridge Handbook of the learning sciences*. Cambridge, U.K.: Cambridge University Press, 47-60.

Deleuze, G. (994). *Difference and Repetition*. (P. Patton, Trans.). London: Athlone Press.

Deleuze, G. (2004). *The logic of sense*. (M. Lester, C. V. Boundas and C. J. Stivale, Trans.). London: Continuum.

Emmerson, S. (2007). *Living Electronic Music*. Farnham: Ashgate.

Fehring, H., & Nyland, B. (2012). Curriculum directions in Australia: has the new focus on literacy (English) and assessment narrowed the education agenda? *Literacy Learning: The Middle Years*, 20.

Hugill, A., & Yang, H. (2013). The creative turn: new challenges for computing. *International Journal of Creative Computing*, 1 (1), 4-19.

Jenkins, H. (2009). Confronting the challenges of participatory culture: Media education for the 21st century, in *The John D. and Catherine T. MacArthur Foundation reports on digital media and Learning*. Cambridge, MA: MIT Press.

Lankshear, C. and Knobel, M. (2008). *Digital literacies: concepts, policies and practices*. New York: Peter Lang.

Manning, P. (2013). *Electronic and computer music*. New York: Oxford University Press.

Messerschmitt, D. and Szyperski, C. (2003). *Software ecosystem: Understanding an indispensable technology and industry*. Cambridge MA: MIT Press.

Moore, A. (2002). Authenticity as Authentication. *Popular Music*, 21 (2), 209-223.

Morgan, C. (2004). *The student assessment handbook: new directions in traditional and online assessment*, New York: Routledge.

NSW Education Standards Authority (NESA) (n.d.). *Coding across the curriculum, digital technologies and ICT resources*. http://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/learning-areas/technologies/coding-across-the-curriculum , accessed 24 January 2018.

O'Donovan, B., Price, M. & Rust, C. (2004). Know what I mean? Enhancing student understanding of assessment standards and criteria. *Teaching in Higher Education*, 9 (3), 325-335.

Paine, G. (2002). Interactivity, where to from here? *Organised Sound* 7 (3), 295-304.

Paine, G. (2015). Interaction as material: The techno-somatic dimension. *Organised Sound*, 20 (1), 82-89.

Prensky, M (2001). Digital natives, digital immigrants. *On the Horizon*, 9 (5), 1–6.

Puckette, M. (2002). Max at seventeen. *Computer Music Journal*, 26 (4), 31-43.

Sawyer, K. (2006). Introduction: The new science oflLearning, in K. Sawyer, ed. *The Cambridge Handbook of the Learning Sciences*. Cambridge, U.K.: Cambridge University Press, 1-16.

Schaeffer, P. (2017). *Treatise on musical objects: An essay across disciplines* (C. North and J. Dack,

Trans.). Berkeley: University of California Press.

Searle, J. (1979). *Expression and meaning: Studies in the theory of speech acts*. Cambridge, U.K.: Cambridge University Press.

Tregear, P. (2014). Enlightenment or entitlement? Rethinking tertiary music Education. *Platform Papers*. Vol. 38, Sydney: Currency House.

Wetzel, L. (2014). Types and tokens, in E. N. Zalta, ed. *The Stanford encyclopedia of philosophy*. plato.stanford.edu/archives/spr2014/entries/types-tokens/, accessed October 2015.

Wollheim, R. (1980). *Art and its objects*. Cambridge, U.K.: Cambridge University Press.

Zicarelli, D. and Puckette, M. (2014). *Max* (Version 7.0) [software]. San Francisco: Cycling 74.