Music Technology and Computational Thinking: Young People displaying Competence

Nicholas Reynolds, Andrew Swainston, Faye Bendrups
Melbourne Graduate School of Education
The University of Melbourne, Australia
{nreyn, swaa}@unimelb.edu.au, fayebendrups@hotmail.com

Abstract: A project involving the composition of a number of pieces of music by public participants revealed levels of engagement with and mastery of complex music technologies by a number of secondary student volunteers. This paper reports briefly on some initial findings of that project and seeks to illuminate an understanding of computational thinking across the curriculum.

Keywords: Computational Thinking, Music Technology, ICT Competence, Young People

1 Introduction

This paper reports a project that was part of a one day birthday event in Melbourne. The activity, entitled Sound Escape, involved the creation of a 'crowd-composed' piece (or pieces) of music. This paper presents very early findings from the project and introduces two young people and presents their involvement with technology. It provides an opportunity to describe computational thinking in practice and to highlight the possible connection between computational thinking, music technology, artistic and creative pursuits, and young people. In a time when there is much concern about young people's ICT competency, their capacity for computational and critical thinking, their reported inability to engage for prolonged periods of time and, amongst other things, their role as ICT consumers rather than producers, this paper reports that in certain circumstances it is very apparent that young people (certainly those in this project) have the necessary skills and competencies of 21st Century citizens.

In the structuring of the event it was decided that while there was room for the ‘traditional’ approaches of compositional software and a piano keyboard, a range of music making sources that didn’t require specific musical technical skill would provide a richer and more inclusive experience. Consequently, a suite of products that included laptops with piano keyboards, DJ equipment, midi drum pad/patch controllers, and a large collection of loops (pre-recorded short excerpts of music (single instrument) or drum rhythms) was developed. The final list of equipment comprised:

- 10 Mac laptops (microphones included) with Garageband and Logic ProX software installed
- 4 Mixtrack Pro2 DJ controllers (with Serato multitrack software)
- 2 Maschine Mikro drum pad and midi controllers (with Maschine software)
- 10 headphones
- 10 midi keyboards

A consequence of using modern approaches and technologies was that these technologies were unfamiliar to both facilitators; they each understood the function and purpose of the technologies but had no real practical experience using them. In particular this applied to the Maschine and to the Mixcraft Pro. These technologies were chosen not only because they were state of the art but also because they are relatively inexpensive, a consideration when working to a strict budget. As it happened the student volunteers were also unfamiliar with some of the technologies. All had used GarageBand but only a few had used Logic Pro, three of the seven had used Mixcraft but none had used Maschine.

2 Computational Thinking and Computer Use

As long ago as 1980 Seymour Papert envisioned a world in which computers were the carriers “of cultural ‘germs’ or ‘seeds’ whose intellectual products will not need technological support once they take root in an actively growing mind” (Papert, 1993, p. 9). It is interesting in this case to note that the technological support had become part of the creative process and the intellectual product rather than just, as Papert thought, a way of supporting active minds. Perhaps this is a reflection of the development of technologies beyond even Seymour’s vision. Papert’s notion of technology as “objects to think with” (p. 11) is very much apparent in the use of technologies present at the Sound Escape event. While he was talking specifically about Logo Turtles as these objects, the parallels with modern technologies are clear.

In what might be seen as contradictory statements Wing (2006) defines computational thinking as "a way that humans, not computers think" yet calls for university subjects entitled "Ways to Think Like a Computer" (p. 35). In 2008, she clarifies this by talking about "mental tools" and "metal tools" (computers), where "the power of our 'mental' tools is amplified through the power of our 'metal' tools" (Wing, 2008, p. 3718) but here it is stressed that is the ability to think computationally (a human quality) is paramount in achieving outcomes not achievable without those metal tools. She does describe computational thinking as "a universally applicable attitude and skill set everyone, not just computer scientists, would be willing to learn and use" (Wing, 2006, p. 33).

We return to Papert now for more sage advice, which echoes (if it is possible to echo from the past) Wing's notion of universal application. He uses the term "think like a computer" quite freely but qualifies the term so that it does not mean to only or always think like a computer, rather as "a powerful addition to a person's stock of mental tools" (Papert, 1993, p. 155). When Papert asks himself to think like a computer, he does so knowing that "it does not close of other epistemologies. It simply opens new ways for approaching thinking" (p. 155).

Using descriptions of computational thinking by Wing and the National Research Council (*Report of a Workshop on The Scope and Nature of Computational Thinking*, 2010), Woltz et al. define computational thinking as "a mode of problem solving that emphasizes the processes necessary to express a computing-intensive solution in a structured, dynamic way" (Wolz, Stone, Pearson, Monisha Pulimood, Switzer, 2011). The NRC's definition is a little broader and reflects Wing's definition, saying that "computational thinking is a fundamental analytical skill that everyone, not just computer scientists, can use to help solve problems, design systems, and understand human behaviour" (*Report of a Workshop on The Scope and Nature of Computational Thinking*, pp. viii-ix).

In its most basic, but possibly its most universally accepted form, computational thinking requires a mindset or thinking approach that applies an understanding of the way computers work (think, act, function, are programmed) in order to solve complex contemporary problems. The actions and approaches of the young people in this study are real world examples of this kind of computational thinking; actions that occurred not in the world of computer science or programming but in the artistic and creative world of musical composition.

Music education has been challenged by researchers such as Lucy Green (Green, 2002, 2008) who through the investigation of the ways in which popular musicians learnt their craft proposed a way of learning she termed ‘informal learning’. This is hardly a revolutionary term and it exists in many disciplines. What is relevant to this paper is the way Green describes some of the attributes of informal learning and the ways in which these expert musicians perceive their own skill development.

She talks about how knowledge is often ‘discovered’ rather than learnt through theory instruction. In one example she uses popular musicians’ knowledge of chords and their harmonic properties. Quoting one of her colleagues she states:

> You discover A-augmented-6 because you want to play a Stevie Wonder song; you discover A-augmented-9 because you want to play a Jimi Hendrix song; you discover A-major triad over a B bass-note because you want to play a Carole King song (Charlie Ford in Green, 2008, p. 207).

This development of an understanding of complex harmonic structure without formal instruction can be seen as a way of thinking that fits with the ways in which the young people presented in this paper interacted with the complexities of the technologies and their ways of working musically and creatively.

3 Method

Data in the form of observational notes were collected throughout the day and analysed to produce a narrative of events. A photographic record of the day was kept and all computer files saved on the day were collected and stored safely on separate disks. More than 150 people participated in the activity. Many of those were parents who watched or assisted their children. The youngest participant was aged three with the oldest admitting to being “in her seventies”.

In this paper observational field notes are used to present actions of the young people in context.

4 Complex Music Technology

Maschine is described by its manufacturer as a “compact groove production system”, designed to allow the creation and editing of “grooves” (drum patterns and feels) that can be used in live performance or to enrich recorded performances. The software has the capacity to record live audio, called ‘sampling, which can also be used in groove production. One typical use is to record a phrase or even a word and to splice it up so that segments of words can be treated rhythmically. For example the word ‘yes might be represented as ‘ye, ye, ye, yes’. The hardware itself consists of 16 touch pads that can be assigned a series of controls through controller buttons and knobs. It also contains an LCD multifunction screen and standard transport buttons for play, record and so on. The way that pads are linked to controls creates a complex set of multifunction possibilities.

This complexity is increased through its interaction with its software. The software offers a complex and complete set of tools for the editing, recording and mixing of sound. It can be driven by the Maschine hardware or by the computer.

As the feature set and possible combinations of pad to controller and software function increase, the complexity of the task at hand becomes apparent. The requirement for significant operator skill appears to be a given.

> J and T arrive together; they are early and ready to get started. They look around the space a little uncertain and are introduced to Author 1 and Author 3. It is clear that they are very interested in the Mixtrack and the Maschine. Author 1 asks about their expertise with this equipment (it is new to him and he has little idea of how it all actually works). The boys respond that they haven’t worked with this gear and haven’t seen the Maschine software before but that it shouldn’t be a problem. They sit down and start working.

The approach they both used (they were working at different workstations located next to each other) was to click and see. They had familiarity with an earlier version of Mixtrack so that created very few problems but the Maschine hardware and software was completely new to them. First they attempted to work out what its primary purpose was. This was a purpose according to their needs not necessarily what the manufacturer stated. They decided that its primary purpose would be to work as a drum generator but were intrigued by its capacity to work with and create samples.

> J looks at the maschine with interest, he starts pressing buttons and moving knobs. These actions do not appear to be random, they have purpose. He has the software open on his screen and shifts his attention there. Author 1 interrupts him to ask how it is going on. He replies that

> it is really interesting how each of the pad buttons appear to be able to be assigned completely different functions.

The actions above occurred over a very short time period. In that time J had made an appraisal of the hardware and had correctly identified the complexities of the interface. This complexity did not daunt him, rather it excited him. He was keen to keep learning.

> While Author 1 is talking to J, he (J) discovers the sample recording capacity of the equipment. He records a brief section of the conversation between him and Author 1. He shows Author 1 what he has done and then proceeds, through the use of the hardware, to play with the sample, rubbing over sections to produce the broken speech described earlier. He is very excited about this. He is not immediately sure exactly how the recording took place – through the Maschine hardware or through the computer microphone – but he will work that out very quickly.

The serendipitous discovery of the ability to record samples was very interesting to J. He had no idea that the software would do that but as soon as he had realised that this was the case he commenced editing the recorded track. The question of 'how' appeared somewhat irrelevant to him. The software performed a function. That function made perfect sense to him and afforded him an opportunity for increased artistic flexibility.

> T is working next to J, he has not said much but has focused on working with samples that he has found. He has not asked any of the authors for advice or assistance. There are brief discussions between him and J as they show each other what they've done (these are not audible), but most of the focus is on independent exploration.

The rapid mastery of a highly complex and multifaceted piece of software and hardware is apparent in the actions of these two boys. This mastery is demonstrated when participants begin expressing interest in the technologies. A number of young children want to press the buttons and make sounds. They are also very attracted to the Mixcraft DJ devices. The two boys, J and T, became confident and competent users of this technology in a very short period of time. They achieved such mastery that they could also confidently and competently provide guidance and support for those participants who wished to compose on those technologies.

5 Conclusion

This short paper can only begin to report on the project. It is presented here as a way of highlighting the ways in which young people can, when interested, when presented with authentic tasks, and when left on their own to learn what they feel is necessary to learn, can demonstrate high levels of competence in dealing with complex and unseen technologies. Here we have examples (brief as they are) of young people deeply engaged in critical and creative thinking, who are solving problems and applying 21st Century skills in order to solve them.