CreateWorld 2011

Pre-publication Proceedings

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Griffith University, Brisbane
Queensland
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Editors
Michael Docherty :: Queensland University of Technology
Matt Hitchcock :: Griffith University, Qld Conservatorium

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Pre-Publication

Proceedings of the CreateWorld11 Conference

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Proceedings of the CreateWorld10 Conference
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CreateWorld Conference paper 2011

Zoomusicology, Live Performance and DAW

Robert Burrell
Queensland Conservatorium, Griffith University

Keywords
Live Performance, Zoo-musicology, Composition, Birdsong, Live Electronic Performance, Digital Signal Processing (DSP), Digital Audio Workstation (DAW).

Abstract
Title: Zoo-musicology, live Performance and the Digital Audio Workstation

The field of practice-led research in music is diverse, encompassing creation, performance, and production. In my case, it forms part of my PhD research at Griffith University, Queensland Conservatorium of Music. This project attempts to bring together traditional notated music composition practice with electro-acoustic techniques. In this project I attempt to create an interaction between the motifs of a particular bird's call and the responses of a live performer. Recordings collected in the field are applied through various computer programs to create a sound file against which the performer interacts in imitation and polyphony as well as in a metaphysical and abstract metamorphosis. The process contains field recordings, music transcriptions, audio manipulation and Digital Signal Processing (DSP) within a Digital Audio Workstation (DAW), new music compositions and a series of works for solo performers and electronics. This project address the notions of composition across multiple media and the effect that technological workflow can have on the compositional process. This paper positions the research and responds reflectively on the progress to date.

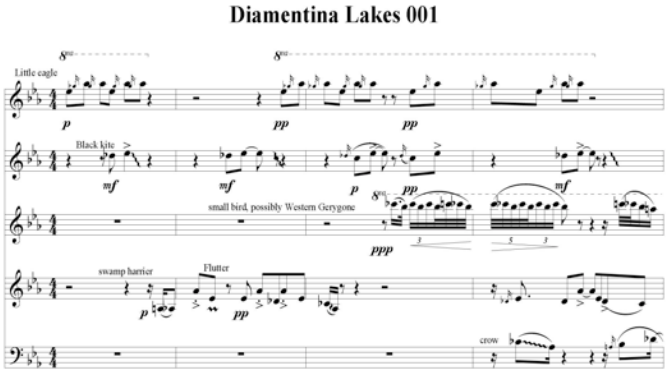
Introduction to the Research

This paper documents an evolving project of composition with birdsong. It describes a development of styles and techniques and evaluates the composers' response to these processes. As part of my auto-ethnographical research towards a PhD at the Queensland Conservatorium of Music, I have been crafting a series of works that derive their motifs from Birdsong. In much of Australia the Pied Butcherbird (*Cracticus Nigrogularis)* is known for a distinctive 'beautiful, flute like song' (Day, 1993). It is one of the three Australian birds included in the *National Audubon Society and Cornell Laboratory of Ornithology's* record *Beautiful Bird Songs of the World.* (Pollock, 1979) Sometimes this species will sing in duet or antiphony with others, one bird's call being complimented and added to by another, often without a break or even overlapping, resulting in harmonies and counterpoints. Andrew Skeoch has written in his 'Listening Earth' blog, "*Pied Butcherbirds have the most sublime song; a series of fluted musical tones, woven into a repertoire of short melodic phrases that are often sung in duet"* (Andrew, 1996 - 2011).

Photo courtesy (Unknown, 2011)

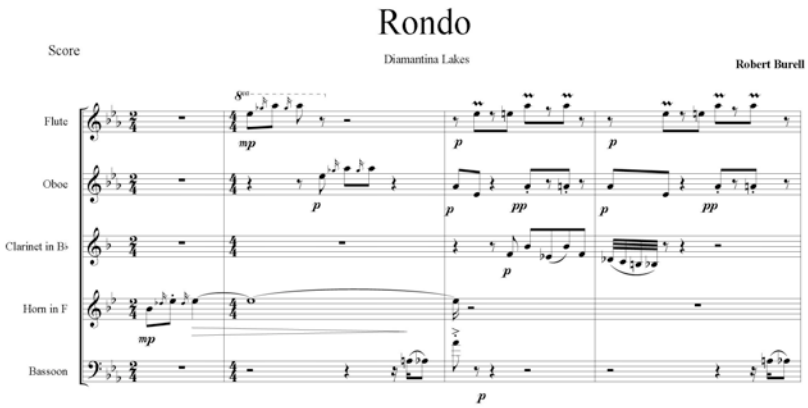
I would be more comfortable with the birdsong being the subject instead of you but leave it for now. I am using birdsong as a stimulus to extend myself to create new works, which are greater in scope than my previous works. I began by recording birdsong and transcribing it into traditional music notation, analyzing the recordings for their motivic, harmonic, rhythmical and structural elements as well as any implied or apparent compositional devices such as motivic development, ornamentation, and repetition with variation. I then selected motifs, rhythms and compositional devices for reinterpretation, which were then realized as traditional works with western common practice notation. In this process I have created a number of multiple movement works for various woodwind and brass quintets and string orchestra.

Example 1. Transcription of various birdcalls collected at Diamantina Lakes National Park, far western Queensland, Australia.



These transcriptions were used in the work for WW Quintet.

Example 2. Copy of score for Wood Wind Quintet which incorporates the motifs notated in example 1.



The results have been gratifying; the melodic material in the birdsong has created music with depth and implied form with the impression of going beyond anything that I have previously composed. However, in my desire to explore the possibilities of birdsong in composition, I am also endeavoring to combine the recordings made in the field with traditional compositional methods involving notation (and all the myriad of ideas that come from composing through the written medium –see A, B, C, D, pg 6). This project will result in creation of a mix of electronic and acoustic live performance works, with the electronic component being derived from Digital Signal Processing (DSP) within a Digital Audio Workstation (DAW).

Auto-Ethnography, the Self and Research

In the paper ***Music, Recording and the Art of Interpretation***, Professor Paul Draper and Dr Stephen Emmerson report that:

> *"the Queensland Conservatorium Research Centre (QCRC)hosts a number of research areas and corresponding academic clusters. Perhaps the most ephemeral and misunderstood of these is the* ***Artistic Practice as Research*** *theme, its somewhat contentious nature residing in the use of the adverb 'as'.* (Paul, 2008)
>
> This methodology has been selected as the primary mode of exploration for this project. It allows the work of art, the music itself to occupy a central point in the research, with the associated new knowledge that comes from the project subject to interpretation and critical investigation.

Although most research and its financial support is driven by empirical evidence and reasoning communicated through written text, graphs and statistics writers such Gina Wisker makes a telling point in favor of these methods:

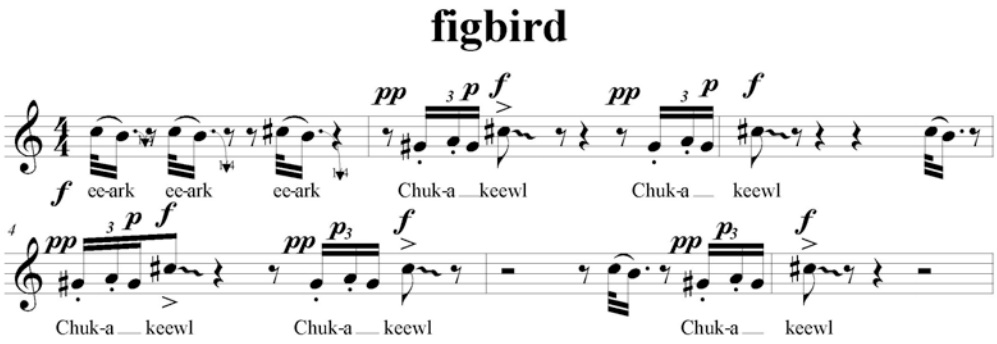
> *"Much creative work takes place in the intersection of critical perspectives, cultural contexts and the personal. Its main difference from the standard arts and humanities research is in the inclusion of the creative work as a part of the research object explored by the theories and critical perspectives….and the involvement of the self is a vehicle for the creative work"* (Wisker. Gina, 2008)

I am privileged to be at the QCRC where the validity of my creative research is supported and acknowledged, and this project is part of a larger push within QCGU to foster critical artistic enterprise.

The Source Material and Repertoire

The ambient sounds and birdsong recordings used in this research comprise new field recordings. These are the first part of the source material and data. They range from general 'all inclusive' recordings, (referred to in this paper as 'soundscapes') made at numerous locations along the Eastern Rim of Australia as well as in the Far West of Queensland and the Simpson Desert; to specific species recordings, which were collected in both remote locations and the urban environment of Brisbane.

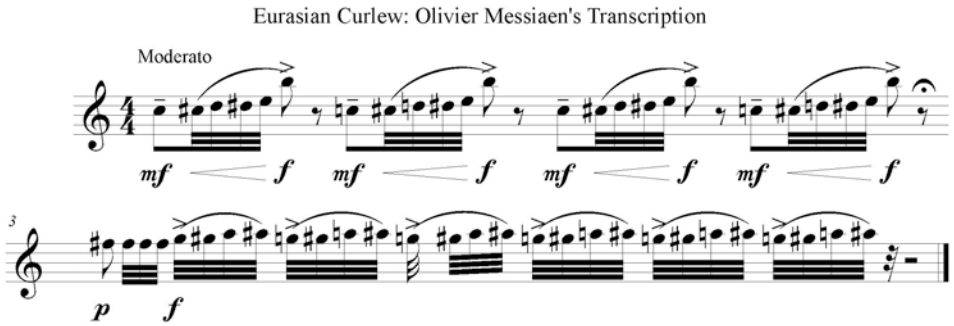
The second source of material that contributes to the repertoire is the transcripts made of the specific targeted birds and their calls.
Example 3. A copy of a transcription of the calls of a Figbird. Note the inclusion of text to assist in the performance characteristic.



These transcripts are 'attempts' to render the calls -complete with their non-human, non-western music performance characteristics- into traditional music notation. This task creates a filtering component that ranges from the notation's inability to document all the data, to the transcriber's own personal interpretation of the events heard. Areas in which notation can be deficient include pitch, scale tuning and metre. Dr Hollis Taylor in her paper 'Composers Appropriation of Pied Butcherbird Song' translates Olivier Messiaen's own words in which we detect a hint of doubt about the transcription process:

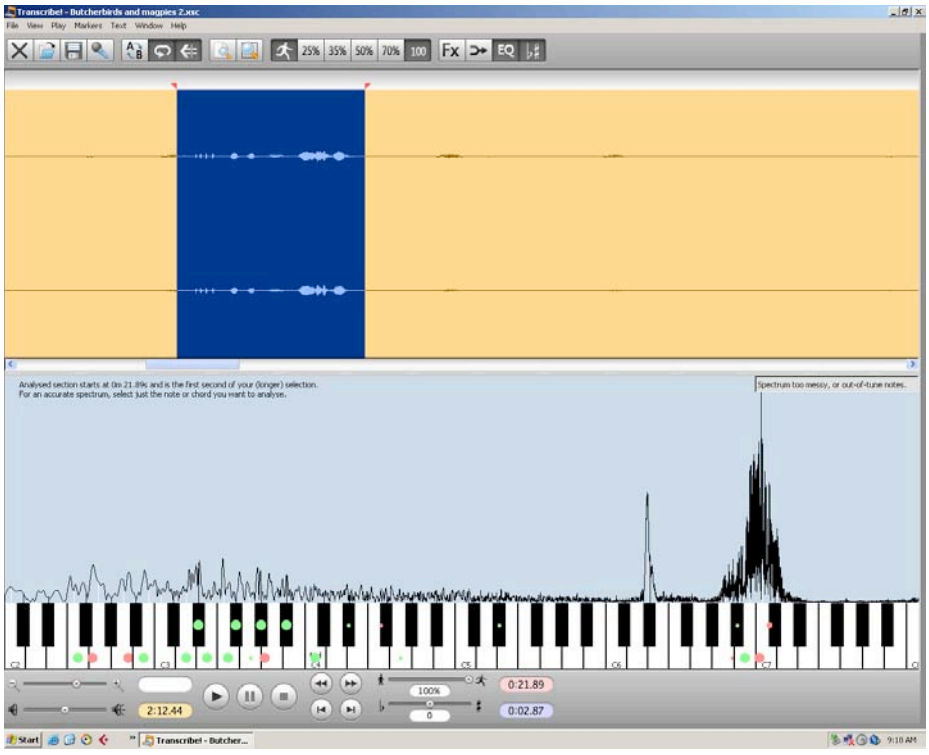
"*I listened at length to the Australian bird songs and even tried to notate them"* (Taylor, 2010)

Example 4. The following is of Olivier Messiaen's attempts at documenting the Eurasian Curlew. (Rothenberg. David, 2005)



To help diminish the influence of the transcribers own interpretation and imagination, the recordings of this project have been placed in a computer program that highlights the actual pitch of all notes present (including whether the pitch is a 'true' note or a 'flat' or 'sharp' tone) and any harmonic partials that may be present as well. The program 'transcribe' was selected for its ease of use and flexibility in pinpointing pitch data as also for the fact that it does not give a written transcription, but shows the information required, and leaves the rest to the scribe.

Example 5: Screen Shot of the program 'Transcribe', motif of Pied Butcherbird.



Rather than simplifying the task, this method of transcription complicates the decision making process of transcription as the transcriber has multiple notes to choose from. The final transcription may need to include the primary melodic note as well as its fundamental, because, the note in question, alone, does not give the 'most complete' realization of the timbre present in the call. Example 5 illustrates the complexity of the call. The green notes are the dominant notes present in the recording. The orange ones are those present (or are these approximate pitches within a quarter tone?), but either sharp or flat, and the small

notes both green and orange are heard, but of lesser importance. From this melee of notes a choice as been made to best represent the call.

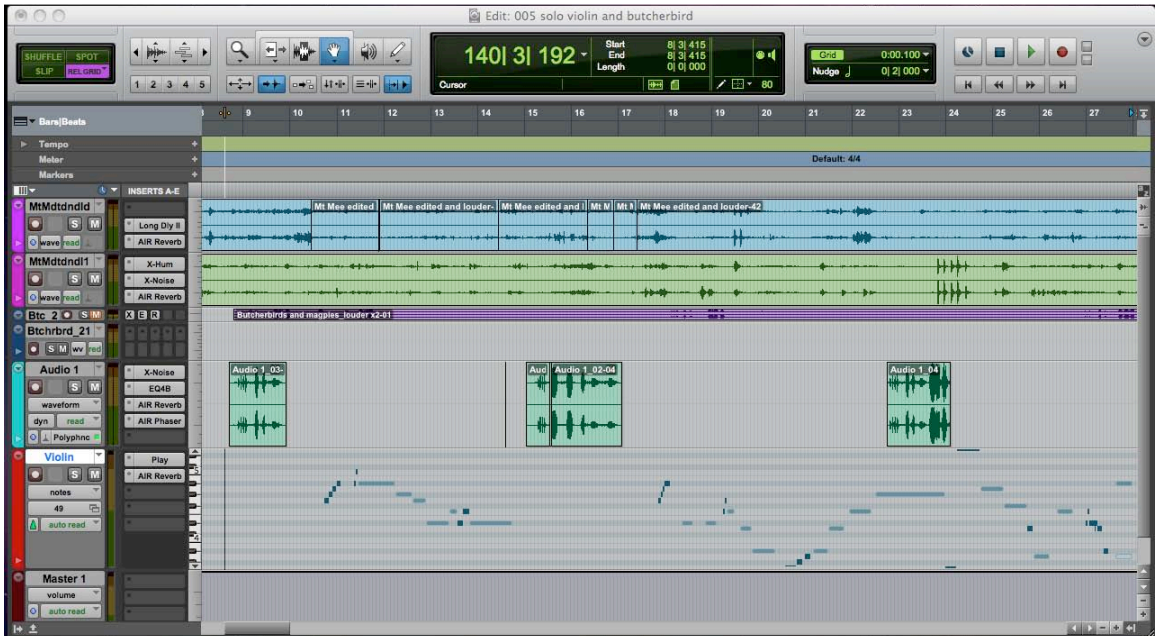
The third musical source in this project is the composer's use of the transcripts to create music for the live musician to realize, utilizing compositional devices from Western art music alongside implied and actual forms in the transcriptions. This can be seen in Example 2.

The fourth source is the function and process of writing with a Digital Audio Workstation and a series of Digital Signal Processors.

Research Design and Technical Methodology
Analysis and Dialogue

The intent of this research is to develop interplay between birdsong and the live performer. The research begins with the collection of the birdcalls and then the process of selecting the most suitable. In this I am listening for a distinct call or series of calls which evidence development and variation as the call motifs are delivered. This is then transcribed as in Example 3.
The birdcall is placed in a DAW and is then enhanced and edited with DSP to assist the audience to focus on the call and not be distracted by any other 'unwanted' data. Typically this involes a process of filtering to remove unwaned environmental or electronic data.

Example 6. DAW. Tracks 1and 2 Soundscape of twittering forest birds.
Track 3 Butcherbird reference track from which excerpts are taken.
Track 4 and 5 birdcall motifs
Track 6 midi track of solo violin



To accompany the birdcall a 'soundscape' is selected; placed in the DAW and enhanced by DSP (tracks 1 and 2). Soundscapes in this case refer to a general non-specific recording of sounds such as running water or an indistinctive heterophony of forest birds.
After this the birdcall is transcribed; a time consuming, questioning and analytical process of taking a transient event, and rendering it into another dialogue, a written notation, or graphical representation. At times I have written words under the notes (see example3) and motifs to associate a subtle language styled intonation that I cannot capture in music notation and the combination of the notes and words have assisted the interpretation of featured birdcalls.

Once transcribed, the next task is the realization of a musical response to the motifs and elements within the call, to create a musical composition that will actively interact with the recording.

It is at this juncture that several problems occur:

a) How literal to make the primary notation of the birdsong. Questions that arise include: How much literalness to employ (exact imitation? Lowering the pitch to accommodate the human ear? Setting the motif within a usual musical meter)

b) How much metaphysical evolution and derivation to allow (inversion, retrograde and retrograde inversion, intervallic and rhythmical diminutions and augmentations, sequences, countermelodies and other western art music compositional devices)

c) How much abstract and purely artistic license to employ (superimposing tonality and/or modes and scales, superimposing perceptions and emotional responses as subjective artistic expressions) and finally

d) How much of a farrago, a medley and synthesis of the elements and techniques of A, B and C is appropriate.

It is difficult to summarize this aspect of the research. It embodies the search for a suitable dialogue or process that incorporates the birdcall into the composition as well as allowing it to be interpreted as a source. There are aspects of *musique concrete* as well as the metamorphosis of what grows from it; a living in symbiosis.

Running alongside this is the effect of the 'duet' and how the musical structure is unfolding. This struggle is apparent in my journal, a summary of which is:
The one cannot be created outside of the context of the other. The written response must be placed beside the initial call and the two compared. Is it right? Does it make musical sense? Do I like it? Is it idiosyncratic to the instrument? Is a particular birdcall ornament best represented with a trill or a mordent? Are those quick notes best realized as spiccato? That melancholic intervallic motif; how many times can I repeat it and exploit it before the human ear tires of hearing it? This is one of the more taxing areas of the research where much testing and experimentation, writing and listening, discarding and re-writing is undertaken.

The audio recording of the birdcall itself can be very complex, as Australian composer David Lumsdaine has observed:

> "*The Pied Butcherbird is a virtuoso of composition and improvisation: the song develops…..through varied repetition….it articulates the harmonic course of its song with microtonal inflexions, or places of cadence with a bird's equivalent of tremolandi and flutter-tonguing."* (Lumsdaine. David, 1996)

Once again the research process is entered into:

a) How much literalness to employ (exact quoting)

b) How much metaphysical evolution and derivation to allow.

c) How much abstract and purely artistic license to employ (superimposing tonality and/or modes and scales, superimposing perceptions and emotional responses as subjective artistic expressions) and finally

d) How much of a farrago, a medley and synthesis of the elements and techniques in A, B and C.

What about all the DSP? The filters, equalizers, noise reduction, stereo imaging, audio stretch/warping, reverb (what type of reverb), stuttering and so on.
Another layer of complexity, which does not come after the first two have been completed, but must be considered, included and polished along side the other elements.

To recapitulate; it begins with collecting the hard data, the birdcall. It is then transcribed into music notation (another form of hard data). It is then placed in a DAW along with an accompanying 'soundscape' and the new compositional material (more hard data) resultant from the research of the transcription and the recording. These are then played/performed to assess their interaction and they are further refined and manipulated. Simultaneously and running alongside all this, and influencing the research is the resultant

effects and new research data of the DSP which has not only to be accommodated but it must be 'at one' with the whole, a supportive voice amongst the many, which make the whole. Always remembering; that any non-musician, untrained ear, can listen to the end result and know and identify an error. Be it in structure, melody, rhythm or timbre.

Artistic Rational and Conclusions

The Pied Butcherbird has been quoted and used as source material by many western composers, -Olivier Messiaen (Taylor, 2010) being the most famous. Australian composers who have employed the song of this species include Don Kay, Michael Hannan, John Rodgers, and Hollis Taylor. It is one of the more distinctive songs used in the 'Australian Soundscapes' series of David Lumsdaine (Lumsdaine. David, 1996). Even the folk songwriter John Williamson quotes the bird in his song of 1989 'Rip, rip, woodchip' (Thompson, 2005). One of the factors contributing to this is, the specie's 'clear flute like' (Pollock, 1979) timbre and its tendency towards musical intervals that the western ear is comfortable with.

Good results often come when built on the foundation of others. Ultimately I wish to capture and render the multiplicity of a heterophonic texture and using this to create new knowledge, but at this stage, I am not yet able to do that area any service of credit and so I am starting with this simpler project. It is complex enough for now and is a logical step from the instrumental works that I have been bringing into the realm of new knowledge (creating) up to this point in my research.

Recording, DAW and DSP Medium

A ProTools 9 program on a MacBook Pro
A Zoom N4
Finalé 2010
Garriton Instruments
EastWest Platinum Plus Orchestral Instruments
Cubase Studio 4
Transcribe
GoldWave
Digirack EQ3 4-Band
Waves Post Production WNS Noise Suppressor
Air reverb
Air Phaser
X hum
X Noise
Long Delay II

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The Digital Cinematography Revolution & 35mm Sensors: Arriflex Alexa, Sony PMW-F3, Panasonic AF100, Sony HDCAM HDW-750 and the Cannon 5D DSLR.

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Abstract

This paper compares several of the latest professional digital video cameras from a range of manufacturers with a sensor that is similar in size to a standard 35mm film frame. Only a handful of companies were once making 'full sensor' digital cameras that were solely the domain of the high-end market sector. Since the DSLR revolution of the past few years, the technology is now more readily accessible. This paper analyses the strengths and weaknesses of a range of the latest mid-priced cameras examining their native recording format, image resolution, sensitivity to light and progressive frame recording. Furthermore, it will consider the implications of the availability of such technology on the teaching of screen production in Australian Universities.

Keywords

35mm sensor, CMOS, depth of field, resolution, compression, moiré, high-definition (HD), digital single-lens reflex (DSLR), ISO, latitude and rolling shutter.

Introduction: Background and Context

This paper reports on a series of camera test conducted in April 2011 at the Griffith Film School (GFS), which is a faculty of Griffith University, located at the South Bank Parklands in Brisbane, Australia. GFS was created in 2005 as a specialist arm of Queensland College of Art (QCA), that amalgamated with Griffith University in the late 1980s as part of the Australia-wide tertiary education reforms.

When GFS was established in 2005 it continued its proud history of teaching students how to shoot film, although the writing was on the wall that it was increasingly under threat from advancements in video recording technology with an increasing number of films being shot on high definition cameras such Michael Man's *Collateral* (2004) Sony CineAlta HDW-F900, Thomson VIPER FilmStream and Robert Altman's *A Prairie Home Companion* (2006) HDCAM SR to name but a few (Wheeler, 2009). GFS acquired a range of its own HD cameras including the Sony XDCAM PDW-F330 and F350 as well as the Sony HDCAM HDW-750 coupled with a variety of HD zoom and cine lenses to keep current with the video technology advances.

For the most part, these formats serviced the needs of the students aesthetically and from a teaching perspective endorsed them on professional cameras that were also readily used out in the industry. Once students reach their final undergraduate year and undertake their last short film, the reins are loosened and they get to choose their preferred format whether it be film or video.

In 2009 the first digital single-lens reflex (DSLR) project was pitched to staff. The rationale was that the script was set at night and required a camera that was sensitive to low light conditions and had a ISO rating fast enough to maximize the available light. Film wasn't an option as the budget didn't allow for it, the GFS HDCAM HDW-750 did not have a fast enough ISO and although it was relatively new to the marketplace, the Canon 5D Mark 1 DSLR met all the demands the group required. The final tipping point was that the Canon 5D had a sensor that was the same size as a Super 35mm frame which gave the image a shallow depth of field which was an aesthetic look to the image the students found appealing. Despite concerns about image quality, the rolling shutter effect of CMOS sensors and high level of compression, *Quiet: You'll Wake Up The War* turned out to be a very professional looking short film and screened at the Cannes Short Film Corner and the Beijing Film Academy as well as numerous other local and international film festivals.

In 2010, eight of the thirteen graduate films were shot on DSLRs, specifically Canon 5D and 7D which was a 300% increase from 2009 but this time around results were mixed. The trend toward DSLR as the preferred acquisition format was obvious, but the projects did not have the same low light demands as *Quiet: You'll Wake Up The War* so there had to be another reason for the shift. Students owning the cameras appears to be a significant factor as it gave them the confidence they knew the 'in and outs' of

the equipment. Twenty-four hour accessibility gave them the option to test and tinker. The other significant contributor to the shift was a desire for the projects to have a 35mm 'look.' Even though the image was digitally acquired, the depth of field from DSLRs is similar to that of 35mm film and students obviously liked the shallow depth of field look.

Although it had never been raised in the past or even seemed like an issue, as a result of the shift towards DSLR cameras, it became apparent GFS was caught in a league of two-thirds inch or 16mm depth of field. Smaller gauges or chip sizes inherently have a greater depth of field and although students had the knowledge that it could be manipulated by light and lens choice. Now there was a camera with 35mm depth of field as an option, production teams immediately started gravitating towards it. They were all aware of the deficiencies when using a camera for motion picture acquisition that's primarily designed for shooting still photographs, but the shallow depth of field look outweighed the operational and other negatives associated when shooting on a DSLR. Initially GFS looked to embrace the format and purchase equipment that would provide students with all the functionality they were accustomed to when working with professional video cameras such as provision for a director's monitor and sync sound. However as the cost of building an infrastructure around a stills camera so it could be functional for filmmakers slowly crept higher and higher, GFS questioned the practicality and longevity of the format, particularly when several video camera manufacturers were about to release products designed to compete with the burgeoning DSLR market.

Early 2011 saw the release of the Panasonic AF100 with its micro-four-thirds inch chip and the Sony PMW-F3 with a full super 35mm sensor. These two cameras were in a price range that made them a relatively affordable purchase for GFS but before a decision could be made as to which camera, it was decided to test them against a reputable high-end camera as a benchmark. The Alexa manufactured by Arriflex and introduced to the market in 2010 is designed for use in high budget feature film and television production. Similar high-end cameras such as the Red One and Sony F35 would have been equally appropriate, however at the time of the test, the Alexa was chosen simply because it was easily accessible and had an existing reputation for quality and film like imagery. It was also decided to include the Canon 5D Mark 2 in the mix to see how the it fared against the new cameras as well as the Sony HDCAM HDW-750 to find out if it could still hold its own in a marketplace now dominated by tapeless formats.

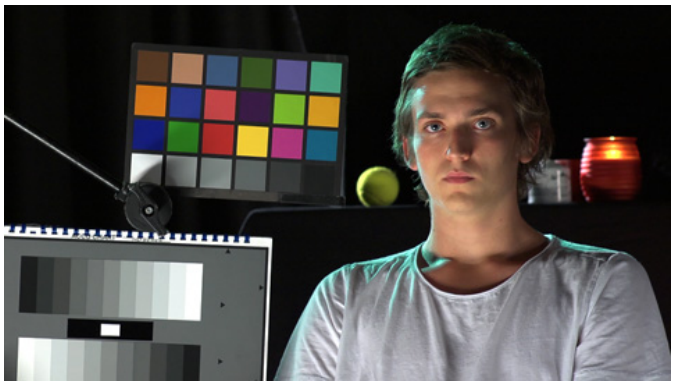
GFS cinematography student lining up the cameras for the latitude test.

The tests conducted were intended to provide GFS with an informed decision about choosing the right camera and curbing the use of DSLR cameras when shooting graduate films. It wasn't that GFS disapproved the use of DSLRs; the images they produced at times were impressive. It was simply we felt that important aspects of production such as a directors monitor, sync sound recording options, proper follow focus and cine lenses were being forsaken because the cameras were not setup for motion picture acquisition as its primary function. Cinematographer Tony O'Loughlan who had recently shot the TV series K9 supervised the test and our main areas of investigation included resolution, aliasing, skin tone, exposure, motion and colour fidelity. When it allowed, the same lenses were used across all cameras to ensure equity in the comparison, while other times various lenses were attached to each model due to the limitations of available equipment and time. The main thing we wanted to investigate was the quality of the image and for this reason it would not just be a test of resolution and exposure charts, but rather various environments and conditions in available light that most students would encounter.

Behind the scenes image from the exposure tests.

Test 1: Latitude, Exposure and ISO

This test was conducted in the GFS sound stage under tungsten lighting conditions featuring a Caucasian face, printed 11 stop grayscale latitude test chart and printed colour test chart. Each camera was tested individually using the same Zeiss compact prime lenses for all cameras that could accept a PL lens mount. The cameras were all set to the same ISO rating, given a base exposure and then bracketed through a variety of exposures ranging from two stops under, correct exposure, through to two stops over. The ISO rating on each camera was then increased to examine any noise or grain in the picture and the bracket exposure test repeated.



A frame from the Panasonic AF100 recorded during the latitude test. The AF100 handled highlights better than most of the other cameras. A clear delineation can be seen between every bar even in the whites on the grayscale chart in the bottom left corner of frame.

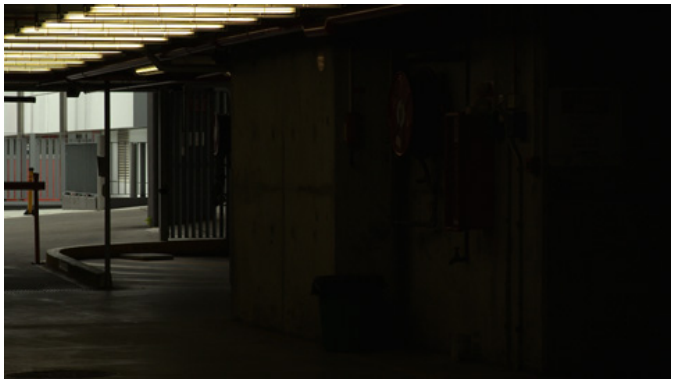
Test 2: Candlelight and Skin Tone

The simplest of tests, the subject held a candle in a darkened studio environment and randomly moved it closer or further away from their face at various distances to see how each format handled skin tone, highlights and shadows in high contrast conditions. Once again, each camera was given a base ISO and exposure and then slowly bracketed through different exposure and ISO ratings. Unlike test one, the same lenses could not be used across all cameras because in this instance all the cameras were pointing at the subject at the same time.

A frame from the Sony F3 recorded during Test 2 in the XDCAM EX format. There was minimal grain in the blacks even when pushed to a higher ISO. However it did not always perform so well with highlights where channel bleeding was visible sometimes in the skin tones.

Test 3: Mixed Lighting Conditions

For this test we placed the cameras in an undercover car park that had a mix of unbalanced fluorescent light and daylight. The intention behind this test was to see how each format handled skin tones in mixed light and a location that was heavily backlit by daylight. The fluorescent lights were protected by metal surrounds and their fine lines and close proximity to the light made for perfect territory to test the cameras ability to see detail in highlights and the moiré effect.



Sony F3 in mixed colour temperature lighting conditions. The metal shields for the fluorescent lights in the top left of frame held their detail and did not blow-out.

Test 4: Daylight, Colour and Rolling Shutter

The main purpose of this test was to examine the replication and authenticity of colour and also check for any CMOS sensor artifacts, or what is commonly referred to as rolling shutter. In overcast daylight conditions several outdoor elements were recorded and then rerecorded with movement to test for any smear, skew or wobble which are common characteristics of a rolling shutter. The important thing to note is that in the rolling shutter effect is not caused by an actual physical moving shutter like in a film camera. Rather different portions of the frame are charged or exposed at different times than other portions. If the subject or the camera were to move during the exposure, the result would be reflected in the frame as a smear, skew or wobble artifact. Most of the new cameras use CMOS sensors and the manner in which the sensor goes about capturing the shot has significant impact on the image.

An exterior image from the HDCAM HDW-750. With enough available light the camera still performs well against its modern contemporaries.

Results

What's really impressive with all of the cameras benchmarked against the Alexa is that although the Alexa is clearly the superior camera with greater latitude, zero image distortion, rolling shutter and moire, it is also significantly more expensive. The Canon 5D is less than a tenth of the cost of an Alexa but its images are certainly not a tenth of the quality and the same can be said for the AF100 and F3 as well.

Sony PMW-F3

Out of the bunch, there is no doubt the Sony F3 performs great in low light, even when pushed to 1600 or 3200 ISO where signal noise or grain was surprisingly minimal. Unfortunately the same cannot be said for the manner in which it handles highlights and overexposure where there was some noticeable clipping and channel bleeding in bright highlights. We were using default, out of the box settings and apparently this issue can be remedied using cine gamma presets and as any DOP will attest, if you know the weaknesses of a format you can compensate and adjust the shot accordingly. The results from recording on the SxS cards were impressive, the only noticeable compression was during the candlelight test where at times the skin tones looked slightly blocky. That said, the expandability of the F3 to dual stream 4:4:4 and recording in Sony's S-Log format could certainly remedy this problem. S-Log is Sony's version of a Raw image format which protects the details in highlights and shadow areas for grading later (Zacuto: The Great Camera Shootout Episode One, 2011). Although this feature is not standard and won't matter to a lot of users, it is very attractive for those who intend to use the camera in high-end environments. Furthermore, the dual-link HD-SDI upgrade delivers full quality 4:4:4 uncompressed video which is a feature that is usually reserved for top of the line high-end cameras such as the Sony F35 (Zacuto: The Great Camera Shootout Episode One, 2011). Sony's decision to provide a PL lens mount as standard makes it immediately acceptable into the existing film-based world. The camera can also come with a set of entry-level prime lenses for those not wanting additional expenditure on a kit of lenses. Finally, it makes the large-sensor style camera a contender in various production environments that would never have previously considered working with such a format.

Panasonic AF100

The Panasonic AF100 is roughly a third the price of the F3 and that needs to be taken into account in this comparison. The AF100 is a good camera and is certainly adequate handling most tasks. It performed well in most of the tests but when pushed out of its comfort zone, unlike the F3 there was a significant deterioration in the image quality. There was a considerable amount of grain, particularly sections with high detail when the ISO was pushed. Unlike the F3 CMOS chip that was specifically designed from scratch, the AF100 utilizes a high-megapixel sensor derived from a stills camera (Zacuto: The Great Camera Shootout Episode Three, 2011). Even though the sensor has been optimised for video and delivers a much cleaner image than any of its DSLR competitors, the rolling shutter was significantly more obvious than the F3. Panasonic's micro four-thirds sensor also limits the choice of suitable lenses because they don't offer any cine-style lenses and neither does anyone else for the micro four-thirds mount. Instead, Panasonic are relying on third-party adapters and the utilisation of stills lenses that can be problematic for focus in a motion picture environment and were part of the reason GFS wanted to move away from DSLRs in the first place.

Canon 5D

Standalone, the images from the 5D look impressive, but once stacked against cameras with similar sensor sizes that are designed for video use, there are significant issues with the format. One of the most noticeable in our series of tests was the manner in which the 5D replicated colours and dealt with angles. On the whole, the images from the 5D were more saturated than those of the F3, Alexa or AF100. This is not a major issue until a scene is recorded that contains a large amount of colour and there is a risk of peaking, which in-turn causes chroma bleeding. Our main worry with the 5D was the manner in which it handled straight lines, particularly those that are on a slight angle. It was very obvious on the colour chart that stepping had occurred in the black lines that separated the colour squares. Aliasing and moire are a symptom of shortcuts that have been taken to get video frame-rates from large sensors, as well as the fact the sensors aren't optimised for video (Zacuto: The Great Camera Shootout Episode One, 2011). The 5D reduces its video image to 1920×1080 so while the larger sensor gives the cinematographer a shallower depth of field, the technical down res-ing produces some really unwelcome artefacts (Zacuto: The Great Camera Shootout Episode Two, 2011). So once again, go in knowing the weakness of the format and adjust your composition accordingly.

A frame from the Canon 5D. If you look closely, particularly at the black horizontal line between the greyscale bottom row and the colour row above it, you can see the artefacts that appear as steps in the angled line.

Sony HDCAM HDW-750

Like a beautiful slow reversal filmstock, the HDCAM loves light and unlike its contemporaries, performs best at its relatively slow rating of 320 ISO. However, like CPU technology, sensor technology for cameras is moving so rapidly that the newer CMOS chips simply out perform those manufactured only six years ago. The HDCAM doesn't have the latitude of the other cameras, highlights blow-out quite easily, the 3:1:1 sub-sample rate made the colours look dull and overall, when pushed in low light with the introduction of gain, the image became extremely grainy. Like its predecessors such as Betacam SP and Betacam SX, HDCAM served the industry well for a period of time but struggles to compete with the more recent advances of the tapeless recording formats.

Conclusion

Red One set the trend with modular cameras that can be scaled according to budget and this appears to be the new direction for other manufacturers as well. DSLRs can also be included in this mix because these days they can be accessorised to operate in a similar fashion to a camera designed purely for motion picture acquisition. All of the cameras have their own strengths, while there is a significant commonality in the target market, it's clear that Sony is aiming for slightly higher-end buyers than Panasonic or even Canon for that matter. Like when the Red One was first released, the F3 is going to be a player in the choice for independent features over the next few years. With features like Dual-Link SDI and S-Log colour, there is no doubt it has the capability. In the race between the AF100 and F3, like most things it all comes down to price. Future usage and the cameras application is an important consideration when making a decision about which to buy. For individuals, the AF100 is an affordable option that produces excellent results however you must keep in mind the lens factor. A camera is useless without them and this may prove a difficult stumbling block for the AF100 to overcome. For

those who don't have existing lenses, to purchase a basic kit would be a significant additional cost. Although its more expensive, the Sony F3 with its option to come bundled with a basic lens kit and its upgradeability may be a better out of the box solution. It really comes down to what was said earlier, the cameras intended application how far you want to take it.

At about an eighth of the cost of the F3, and half that of the AF100, the 5D manages to produce quality shots when you work within its limits. For a camera that's primary function is still photography, the 5D certainly punches above its weight when recording motion pictures. However, the results from the GFS test clearly show the F3 and AF100 have considerably less rolling shutter and line skipping. The 5D has a high-resolution sensor but it reduces its video image to standard HD 1920×1080 and while the larger sensor gives the cinematographer a shallower depth of field, there are some really unwelcome artefacts that come with that. HDCAM is showing its age, it was simply outperformed by the other cameras that were more sensitive to light; have less signal noise and more colour depth. Including the HDCAM in this test was like trying to compare the latest CPU technology against a chip that was manufactured six years ago - there has simply been far too much technological advancement for it to compete.

At GFS, once it was announced the F3 would be added to the mix of formats for the third year production slate, ninety percent of the 5D projects switched. This to a degree confirmed that the students were chasing a camera that gave them the '35mm depth of field look.' Principal photography for all third year undergrad projects was completed in July 2011 and overall, the F3 produced excellent results even when recording to the SxS cards with the XDCAM EX codec. That said, every camera has its purpose and we still had one 5D project that looks fantastic because the DOP understood the weaknesses of the format and accounted for them. The Canon 5D was the most suitable camera for this film because the script demanded something that could fit into tight places. We also still had one HDCAM project because the look it produced was the aesthetic the DOP wanted. Interestingly, when the budget allows, students still gravitate towards 16mm film and there's no denying the aesthetic qualities of film will continue to for many years to come.

From a teaching and education perspective, the positive aspect of these rapid leaps ahead in sensor technology and camera formats are that film schools can now access equipment that was once cost prohibitive because not only were the cameras expensive, so was the accompanying post-production equipment. The shift to tapeless formats is invariably democratising the industry and as manufacturers continue to release cameras and equipment that performs close to its high-end counterparts at a tenth of the price, it will only increase the quality of the imagery and standard of work produced. The priority now is to understand the new directions the technology is taking because things are moving so fast; equipment becomes obsolete in a much shorter timeframe. Modular cameras allow for incremental expandability and perhaps this can help the longevity of ones investment. It certainly seems to be the direction several manufactures like Red and Sony are now taking. The main principle we must always keep in mind is that the camera is only a tool in the filmmaking process, but perhaps if the stories we tell can match the quality of the imagery these new cameras deliver, we're in for exciting times ahead.

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ISHQ: A collaborative film and music project – art music and image as an installation, joint art as boundary crossing.

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Abstract

This paper is a reflective response to the process of creating a new installation art music partnership at Griffith University in 2011. The key collaborators were Dr Kim Cunio from the Queensland Conservatorium, Griffith University (QCGU), and Dr Louise Harvey from the Griffith Film School (GFS). Both participants are early career academics and established practitioners in their fields, giving the project currency in both the academy and the creative arts. The paper responds to the aesthetics of working collaboratively on a themed installation as well as defining the significance of new artistic collaborations between the participants and their host institutions, the QCGU and GFS. This project follows on from the AUC Crossing Boundaries paper of 2010 (Hitchcock, Cunio, Harvey, Chircop), which documented student led collaborations, and recommended increasing staff collaboration as between key academics.

Keywords

Music, film, Islamic art, animation, 3D, installation, moving image, collaboration.

Part 1: Introduction:

This project follows on from an existing music research project undertaken in 2007. In early 2007 Kim Cunio was approached by the Art Gallery of NSW (AGNSW) who were bringing the Khalili collection of Islamic Art to Australia. This collection is seen as one of the leading collections in the world, remarkable for two reasons. The first is that it constitutes a private holding that is on par with many of the government collections of Islamic countries, the second is that it is held by a Persian (Iranian) Jew, and as such constitutes a living example of cultural tolerance and shared value.

To accompany the collection a series of new musical works were commissioned to illustrate the magnitude of the holdings. They were to respond to the landscape of the desert, a central feature of early Islamic culture, the teachings of Islam contained in a magnificent collection of Q'urans, as well as cultural collections, including the Mongol 'Chronicles of the World' and the Persian 'Shahnama', one of the world's great epic stories. Five pieces of music were installed to accompany the exhibition and a larger CD was produced and manufactured for distribution in both Australia and parts of the Arabic world.

By and large the response to the music was generous. ABC Radio National broadcast the concert launch to the disc and exhibition, something that presenter Geoff Wood described as taking Cunio's work to another level:

> *Tonight a cracking concert for you from the Persian and Arabic traditions… Much of the music you'll hear tonight was composed, or arranged, by Sydney-born Kim Cunio who is really in a class of his own when it comes to historically-based musical composition.* (Wood, 2009: 1).

John Shand praised *ISHQ* in The Sydney Morning Herald, and David Khalili insisted on buying his own promotional stock as a momento. (Cunio: 2007). The disk also sold very well during the exhibition and a series of public performances were both well attended and critically enjoyed. However as is the case with music projects, particularly thematic releases, once the accompanying exhibition left Australia interest waned, and the disc did not receive an ongoing release. Hence it was decided in 2011 that this project was suitable for a re-exploration to allow the music itself to be the stimulus for new art – to subvert and change the role of installation music in the creative arts.

The structure of the paper is grounded in practice led research. The paper should therefore be judged on the art it describes, for it is primarily concerned with interpreting the process of making a new work of multimedia art for exhibition and identifying any new or emergent knowledge that has taken place. As such it is a action based project with reflection and analysis, a methodology that forms a type of triangulation, allowing the art to be deconstructed, yet still appreciated for what it is, a transient work of beauty intended to inspire others.

Cunio and Harvey have also therefore elected to write in the first person, utilising methods that have achieved some precedence in the English speaking world in recent times. Both contributors have written an exegetical response to their part of the project.

Auto ethnography, as defined by writers such as Carolyn Ellis in *The ethnographic I: a methodological novel about autoethnography* (Ellis: 2004), is a potent methodology for investigating artistic practice and creative work. In addition to formal autoethnography, journaling as detailed by academic and author Stephanie Dowrick inspired the discourse between the practitioners. Dowrick advocates a connection between feeling, writing and reflection in her work *Creative Journal Writing: The Art & Heart*

of Reflection, which is also cognizant to the project and its reportage. Dowrick defines the developing skills of journaling in relation to this project:

> *Skills in observation and mindfulness, the capacity to "vent" effectively and an inspiring method to write freely and with great release and enjoyment.* (Dowrick 2009: 1).

There is an additional background to this project, briefly introduced in the abstract to this paper. For some time academics at QCGU and GFS have been looking to build a collaborative culture across the student cohort. Such projects take time and the initial decade of this interaction has been spent in developing project related studies between the two institutions and allowing a greater flexibility of course delivery between QCGU and GFS. Two papers have been written in response to this project; with both recommending greater staff collaboration between the two institutions.

Crossing Boundaries: promoting cross-disciplinary projects in four creative arts faculties, published and in the proceedings of the 2010 AUC Create World conference in 2010 focussed on student led projects and the movement of students between institutions. The need to foster emerging student project work was a core finding of the paper.

> *Regardless of any distinctions between the two however, the workplace opportunities that graduates can expect to move into are still largely project based, with intense pressures to be self-driven, proactive, confident and innovative in recognising and creating opportunity. Professional careers in many music, moving image and gaming related disciplines have long been mobile, transitory, project based and network driven with considerable advantages for those individuals who can cross disciplinary boundaries. (Hitchcock, Cunio, Harvey, Chircop 2010: 2).*

The paper also addressed the matching of project related learning to established pedagogy and the manner in which academics facilitated project based collaborations between their students. Most relevant to this paper was an identified need for staff to model the emerging work of students in their own practice.

> *It is also pertinent that such developments be supported through the provision of staff resources. Possible future directions include the embedding of relevant academics within co-located faculties, having a composer in residence at GFS and a film-maker in residence at QCGU. Such medium term collaborations will allow a greater contest of ideas, practices and exegetical outputs, foster co-located research projects and facilitate project based interfaculty public works.* (Hitchcock, Cunio, Harvey & Chircop 2010: 2).

Cunio and Hitchcock extended this investigation in a paper and presentation for the (INTED), International Technology, Education & Development conference in 2011. In this paper the larger context of higher education in Australia was also addressed, which has altered notions of what constitutes academic life, particularly for creative artists. This paper also responded to the ramifications of full time creative arts workers taking academic positions, something that has taken place since the introduction of practice based doctorates in the mid 1990s.

> *The challenge for academics within this project has been to stay connected to peer networks and academic associations beyond the scope of their general teaching and learning responsibilities. This is evident in the many creative arts faculties where academics have often moved into their position from project based careers that allow the formation of large and fluid networks, as well as the dissemination of cross discipline creative works. Ironically this connection with industry and creative networks can disappear very quickly within the confines of a full time position, as many academics are simply not able to stay abreast of maintaining professional network connections. (Cunio, Hitchcock 2011:3).*

These two papers set the background to this project; two full time academics with extensive creative resumes looking to mirror and extend the culture of project based work in their institutions, while creating a piece of new collaborative art with high aesthetic and production values. A few clear project goals were set between Cunio and Harvey:

- To work at the creative and technical level of current industry practice, and to benchmark the work with industry practitioners.
- To create a work of approximately ten minutes that is capable of physical or virtual installation / performance.
- To give the project achievable and quantifiable performance / exhibition outcomes, and to allow the work to rest firmly in the Excellence in Research for Australia (ERA) guidelines for creative works.[1]
- To have the project exhibited in multiple territories and entered into relevant competitions and awards.[2]
- To evaluate and document the project in a

[1] ERA is representing a significant shift in the publishing outputs of creative arts academics, allowing working artists to publish and peer review creative works, which are then framed as equivalent to traditional publications.

[2] ISHQ has already been exhibited at the QCGU in September 2011, and at *Shared Visions*, exhibition of fine art by QCA staff, hosted by the The Academy of Art and Design Wroclaw, Poland.

scholarly manner in the fields of technology, screen practice and screen composition.

Part 2: Cunio

Religion and politics have their own languages, but the language of art is universal. (Khalili: 2007).

Figure 1: Cover of *ISHQ Divine Love* (Cunio 2007a: 1). [3]

The music responds to a number of pictures and texts in this collection, the spirit of the whole collection, and indeed even the ethos of the collector. A project like this has to be done in an informed manner, for ISHQ is not just an exploration of the art and music of Islam, but also an exploration of what Islam means in a country like Australia. Islamic music and art have a great history with the West, that is too easily forgotten. (Cunio 2007a: 3).

ISHQ, was more than a commission to me, it was an opportunity to reinvestigate some of the hidden Islamic past of my own family, as many of my family came originally from Baghdad, the home of the Islamic Caliphate for much of the period alluded to in this exhibition. As such it constituted an attempt to reconcile my Jewish religion with my Arabic heritage, a therapeutic process that I immediately identified with.

This was also a practical job, to accompany an exhibition while also making an art music CD, something I responded to in the liner notes for the disc itself.

For the exhibition four spaces have accompanying music. The first is 'The Gathering', a place where people enter the exhibition, and the world of Islam. The second is a central, mystical space where the Call to Prayer is played, where a high ceiling and sparseness give the spiritual feeling of a mosque. The third room houses the Jami' al- Tawarikh (Compendium of Chronicles) which are set to music, and the fourth room contains The Shahnama, the Book of Kings, the great Persian epic. (Cunio 2007: 3).

Beyond the purely functional a commission such as this includes a responsorial role, to set emotional markers for the exhibition in a manner not dissimilar to film composition. Contemporary installations often mirror and distort our prevailing attitudes towards the major themes of our lives, and a historical installation such as this still comments on society itself.

In addition to this functional role I wished to mirror the beauty and magnificence of the Persian city of Isfahan in this commission. Isfahan is a cultural and spiritual powerhouse, a place where spirituality and aesthetics are combined, where the treasure trove of Persian art is still alive today, as well as being the birth place of David Khalili the owner of the collection. The philosopher Hegel (2011:1) is quoted in the Iran review:

> *In Persia first arises that light which shines itself and illuminates what is around… The principle of development begins with the history of Persia; this constitutes therefore the beginning of history.*

David Khalili (the owner of the collection) has some important light to shed on the style of this art and its potential to be represented in music and film.

In a 2007 lecture he stated that the true genius of early Islam is in how it was able to make so many magnificent secular works and preserve them within a sacred framework. He continued stating that approximately 90% of his collection was secular, something that is surprising given the corresponding sacred monopoly on art exerted by the Christian Church at the same point in time. Much of this is due to the strict forms of representation in Islamic art, that privilege the abstract and the great mathematical insights of medieval scholars of the Caliphates of iconography. I first addressed this in the notes to a 2001 commission, *Tomorrow's Islam:* [4]

Great care is taken in much Islamic art to avoid anthropomorphic representations of God or divinity, which is seen as idolatry, something reinforced by the literal nature of the Q'uran itself. (Cunio 2001: 4).

Although a detailed exposition of the manner of composition, production and research is outside the scope of this paper I feel that the weight of the academic and artistic work is evident in the music. Little things give it away; the mean tuning [5] of the Persian santour (hammer dulcimer) as played by the Persian master Jamal Rekabi; the perfectly tuned gongs in the opening piece; and the extraordinary

[3] Painting credits in reference list.

[4] A two part documentary series made to represent progressive Islamic thinkers, narrated by Geraldine Doogue.

[5] Mean tuning refers to a tuning scheme in an instrument that is not part of the well tempered system of modern western music, something that is rare in western art music.

fusion between Persian and Western classicism in the final work of the disc, composed for solo soprano and kemanche (Persian spiked fiddle) orchestra.

Process

Normally I would not have the luxury of selecting music from an existing project and sending it to an animator. 'Normally' I would receive a selection of images or a cut with a brief to write music to, and I would be the one 'fitting in'.

The basis of this process was for me to send the full disc to Dr Harvey with a selection of pieces for her to work with. After a few meetings the creative work was Harvey's. She needed to have complete artistic freedom, to not work simply to a brief, but to explore the themes of this disc, and of Islamic art and culture in general.

Certain non-musical elements in the disc do provide a template for a project such as this, the sumptuous design of Analeise Cairis, and the ornate calligraphy of Salim Mansour, seen in the luminous, pale gold watermark of much of the disc.

Figure 2: Gold watermark as used in *ISHQ Divine Love* (Cunio 2007b: 1).

Although responding to these cues may sound easy it is not, my experience has been that the more latitude we receive as creative artists the greater the challenge. [6]

Actually working like this is quite refreshing. This project offered the chance to put pieces together and process what is happening on a subtextual level. Although my initial process in the making of this new installation was to listen to the music I had already made I soon realised there was more to do. I had to identify pieces that would lend themselves to a visual narrative and then hand these works over to be re-contextualised, or in other words, hand over my authorship.

[6] I see this in two ways, the first is the human natural desire for order which battles the desire for creativity. When we can do anything we often do nothing; one of the great paradoxes of modern society and its almost limitless choices that divorces us too often from the outcomes of our actions. This aesthetic is well illustrated in the nonsensical works of the mid 20th Century that find absurdity as a means of expression, Stoppard, Ionesco and Beckett being primary examples.

After this all I have to do was watch the unfolding response and then be ready to respond again if needed. Certain things were agreed upon: How many sections there would be, how many times we would move the project back and forth, and how we would compile the final version.

Compilation and coordination

When Dr Harvey sent the cut of the film to me I was delighted. Too often collaborations have to deal with the added problem of competition, that battle between artists for supremacy in the final artistic product. A great example of this is in the order of key personnel in the credits of discs. This is an area where modesty does not rule, all too often the party with the funding or the greater profile rules. But in this project none of this mattered, Harvey and I were working in a genuinely cooperative manner, looking to build a shared artistic experience.

Upon receipt of the moving image it was clear that Dr Harvey had taken the cues of the music and visual art and made something much more, a living, breathing installation with depth of field and incredible visual detail. After some reflection it was also clear that I needed to respond to this by re editing an audio compilation out of the existing disc for the installation.

This process took some time. As the visuals were fixed I had to edit static music compositions (recordings), to existing cues, while maintaining the feeling of freedom inherent to the work. Accordingly a small number of pieces from the initial commission were edited, making the audio truly different from the initial disc and installation - something that is very important in hindsight. The final product also needed a new name which was suggested by Dr Harvey.

ISHQ, Divine Music for the Animated Imagery of Islam, was opened at the Queensland Conservatorium in September 2011 and now has its own life as a standalone work of art.

Part 3: Harvey

If a person's a static artist and a musician, the chances that he or she will be an animator are much higher, because he's [sic] interested in motion – the whole flux and flow of what's happening. Music is organised in terms of small phrases, bigger phrases, sentences, whole movements and so on. To my mind, animation is the same kind of thing (McLaren in Furniss 1998, p.257).

Background

The *ISHQ* animation project provided an opportunity for me to explore the realm of abstract animation. This

was an area that, as a character[7] animator, I was relatively unfamiliar with but was excited to try. One of the key ingredients to the successful animation of abstract forms is the musical accompaniment, so it was with enthusiastic delight that I accepted Dr Cunio's proposal to animate his wonderful ISHQ musical work. It soon became clear to me however, that the musical content constituted more than just accompaniment to the animation – it was also the motivator and the narrator. The following contribution to this joint paper represents my experiences in meeting this project brief. This includes the interpretation of the music into visual form, locating suitable animation software for the project, formulating a suitable production strategy, reflecting on the creative output, and responding to this reflection by re-strategising and revising the output as necessary. In so doing, I acknowledge Cunio's assertion that this paper "...is primarily concerned with interpreting the process of making a new work of multimedia art for exhibition and identifying any new or emergent knowledge that has taken place."

Responding to the artistic brief.

The brief I received was to create approximately ten minutes of animation for an installation to be held at QCGU to celebrate the opening of their new foyer on September 6, 2011. The output format had to be compatible for display on widescreen TV monitors. I was given little artistic direction—the main requirement being that the animation should provide a successful visual representation of Dr Kim Cunio's musical works ISHQ: Divine Love.

Developing a production strategy

The main challenge in this instance was to generate the animation within the twelve-week production window. Character animators can produce around 25 – 30 seconds of animation per 50-hour week. At ten minutes long, this production contained 600 seconds or 15000 frames of animation. That required a completion rate of 50 seconds per week in order to meet the deadline. Considering that I also needed to carry out my full-time duties as a lecturer, this level of animation output would not be possible for me to achieve. That meant that I had to devise an alternative strategy to generate animation more rapidly. Character animation was therefore discarded as a production methodology and other semi-automated approaches were considered.

[7] Bringing an inanimate object to apparent life is a subcategory of animation known as character animation. Character animation distinguishes itself because it involves breathing life, rather than mere movement, into humans, animals, creatures, and other living or non-living things. Adding the illusion of life to an otherwise inanimate object or creature involves giving it personality, emotion, motivation, and reactions (Cantor & Valencia 2004 pp. 311-313).

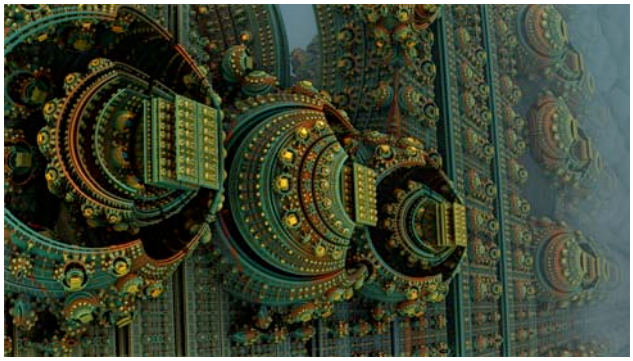
Computer-generated animation is rarely ever generated entirely by computer—the hand of the animator is still present to a significant degree. However, the level of input of the animator can be minimised where procedural forms of animation are utilised. Essentially, procedural animation requires the animator to set the parameters of a number of variables at certain key frames, and then the computer calculates the values of these variables over time between these key frames. This is referred to as 'in-betweening'. The type of visual output where procedural animation really shines is in abstract, non-figurative forms. There are many, many software programs available to produce this kind of animation. The next step was to locate the ones that were affordable, accessible, relatively easy to learn and operate, and which would produce the kind of imagery which would suit the production. This meant that a certain amount of time needed to be invested in research and experimentation. I investigated the potential of software that was already available to me and which I was familiar with. These were:

- Adobe After Effects
- Autodesk Maya
- Adobe Flash

I also investigated the production methods of other notable artists who create animation intended to accompany music. Primarily these were Esteban Diacono (Diacono 2011) and Kenneth Huff (Huff 2010)

Fortuitously, I had recently been involved in an artistic project where I was required to produce still images for exhibition, which had led me to the discovery of fractal-generating software. Fractal software has been around for a good number of years, and its more common forms of deep-image zooming of Mandelbrot sets would be familiar to most readers. However, I was pleasantly surprised to find that over the last several years, fractal software had been quietly progressing to a new level of technical capability, and now it is possible to generate animation of fractals in three dimensions (3D). Additionally, whilst browsing through a number of fractal art galleries, I was astounded to observe that some of these fractal images had a distinctly Islamic-art 'feel' to them, sharing a number of visual characteristics with the geometric forms of Middle Eastern art and architecture. However the real selling-point for me was that many of these programs were free.

Figure 3: still image from *ISHQ, Divine Music for the Animated Imagery of Islam*. This is a 3D render of a Julia Supercube, generated from the software program *Mandelbulb.*



Developing a 'story' to animate

In most abstract animation there is little or no narrative present. As Furniss (1998, p.252) explains:

> *In abstract animation, there are no characters with which to identify, there is no diegesis to transport the viewer to a different time and place and, when the animation is over, the viewer does not have a complete 'understanding' of its meaning as he or she would with a closed narrative structure.*

Character animators, however, are familiar with animated storytelling, and as such I felt more comfortable working to a fairly loose narrative with which to motivate the visuals and to act as the string to connect the visuals in a relatively linear way. My desire was to create harmony within the work, and avoid creating a disjointed collection of disparate images. In response to this, I invented the idea of a 'soul's journey' to act as the story focus, where the work followed the journey of the human soul's circular evolution through its genesis as a spark of life in the heavens, its birth and journey through an earthly life and the distractions of earthly desires, its descent into the underworld and its deliverance into the afterlife as it arrives 'home' once again.

This story and the limitations and possibilities of the chosen software imposed a creative framework from which to construct an appropriate artistic response. This framework helped to shape, evolve and also limit the project's visual scope. This addressed the dilemma that Dr Cunio has earlier pointed out – that the more latitude we receive as creative artists the greater the challenge.

Developing creative ideas and responding to the music

In creating animated content that was reminiscent of the art of Islam, it was necessary to be mindful and respectful of any cultural and religious sensitivities surrounding the representation of this art. Preserving the integrity and dignity of any original artwork contained in the animation was vital. The avoidance of figurative representations in Islamic art forms and the prevalence of geometric forms provided another influencing factor in the creative framework that developed. Fortunately, procedural forms of animation lend themselves particularly well to the generation and animation of geometric imagery and also of fractals, as we have seen.

The music was of course another primary factor in the development of the visuals. The renowned abstract animator John Witney explains the relationship between music and animation succinctly:

> *You would not ask if a musical composition is driven by a piano or by a violin – I think of the aural and the visual as two voices, so at one moment a sound pattern inspires a graphics pattern and at the next moment it's vice versa (in Furniss, 1998, p.258).*

Witney's statement outlines the process that I intuitively employed during the production phase. Dr Cunio allowed me to animate any of the musical tracks from *ISHQ: Divine Love* that I wanted, suggesting that I choose the ones that I found to be most visually inspiring. When listening to the music, I was variously emotionally transported through feelings of calm, mystery, grandeur, happiness, gloom, hope, urgency, quiet and so forth. Beauchamp explains that music contains innate elements that elicit universal emotional responses from audiences and that the pairing of music with image has the ability to elicit and direct our emotional responses. My job was to identify the emotional content in the music and represent it via animated imagery.

Reflecting, evaluating and revising

The animation production process involved some experimentation. Typically the process involved creating a rough, low-resolution render of a piece of animation and then placing it into the editing software along with the music that had inspired it to see if the combination of the audio and visual was successful. In other words, did it feel right together? If not, I'd try combining the render with another of the music tracks, or a different section of the same track to see if this combination was more effective.

I also sought out the opinions of my peers, who (among other helpful suggestions) reminded me not to bombard audiences with busy and apparently unrelated imagery and to vary the overall pacing to create spaces where the audience could relax a little.

Technical problems and solutions

During this production journey I encountered a number of technical challenges. Learning how to use the fractal software programs effectively was one of the greatest challenges. Most of these programs are

created by enthusiasts, and so there is little formal documentation or instruction published on how to use these programs. However, I was supported in this regard by the generosity of spirit present in the online communities of fractal enthusiasts, who freely shared their hard-won knowledge of these programs via video and written tutorials.

Part 3: Reflections

Cunio: Despite the business of education which is prominent in the academic cycle there is something intensely satisfying about making a new work of art in the academy. It is a given that we have to examine ourselves, our motivation and the logistics of time in order to make anything work in this environment. I am delighted that Dr Harvey and I have responded to the suggestions of the earlier research documented in this paper, by taking the step towards a professional / academic co production, a phrase that I do not use lightly. It is difficult to work artistically and write exegetically at the same time, and this skill will be the basis for much of the creative work of the emerging generation of academics who will reject traditional publication models as well as the assumption that creative practice must come second for an academic in a creative arts faculty. I am delighted with the outcome and hope that it will lead to many more such projects.

Harvey: The idea of lifelong learning is intrinsic to the world of academia and also to the animation industry. Through participation in collaborative projects such as *ISHQ: Divine Music for the Animated Imagery of Islam*, it is possible for practitioners such as myself to maintain the currency of their vocational knowledge. Fortunately, in addition to these very pragmatic outcomes, I experienced other, more intangible benefits, not least of which was the satisfaction of being given the opportunity to manifest my own visual interpretation of Dr Cunio's compelling musical creations. I now have a greater understanding of Furniss' (1998) assertion that the production of abstract animation is often closely aligned to the animator's search for understanding of the self and the mysteries of life on a universal level.

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From ‘hands up’ to ‘hands on’: harnessing the kinaesthetic potential of educational gaming

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Abstract: Traditional approaches to distance learning and the student learning journey have focused on closing the gap between the experience of off-campus students and their on-campus peers. While many initiatives have sought to embed a sense of community, create virtual learning environments and even build collaborative spaces for team-based assessment and presentations, they are limited by technological innovation in terms of the types of learning styles they support and develop. Mainstream gaming development – such as with the Xbox Kinect and Nintendo Wii – have a strong element of kinaesthetic learning from early attempts to simulate impact, recoil, velocity and other environmental factors to the more sophisticated movement-based games which create a sense of almost total immersion and allow untethered (in a technical sense) interaction with the games’ objects, characters and other players. Likewise, gamification of learning has become a critical focus for the engagement of learners and its commercialisation, especially through products such as the Wii Fit.

As this technology matures, there are strong opportunities for universities to leverage the use of gaming consoles to embed levels of kinaesthetic learning into the student experience – a learning style which has been largely neglected in the distance education sector. This paper will explore the potential impact of these technologies, to broadly imagine the possibilities for future innovation in higher education.

Introduction

Universities have a vested interest in leveraging technology to improve student learning through engagement. This is especially true of distance learning institutions as this mode can often be more challenging than with a purely face-to-face cohort. In a traditional on-campus lecture, it is easier to engage students by presenting material which appeals to multiple learning styles, but this becomes more difficult when trying to encourage deeper learning in off-campus students. Some lecturers have addressed auditory learning styles through the use of cassette tapes and later via podcasting; whilst others have utilised video or screencasting to engage with those who prefer visual learning experiences. By combining these with social learning tools such as forums embedded in the Learning Management System (LMS), lecturers can provide students with a range of resources which empower the learner to select the 'best fit' between their learning style and the content of the course.

One learning style which technology has thus far been unable to fully address has been kinaesthetic learning. Some disciplines, such as performing arts and medicine, require kinaesthetic elements to support authentic learning. With the advent of commercialised, consumer-driven advances in gaming consoles, educators can access a range of tools which could be effectively utilised to facilitate kinaesthetic learning. This is provided that certain shortcomings are understood and that a basic understanding of subjects such as social learning and immersion underpin pedagogical decisions for their use. This paper aims to address these issues in relation to the Nintendo Wii and Microsoft Kinect (in particular Avatar Kinect) and highlight some existing projects for educational consideration.

Doing, Playing, Learning

There is evidence to suggest that the game technology employed in many virtual environments may improve learner motivation and engagement via immersion (Fassbender & Richards, 2008: p. 1). Engaged students who are responsible for their own learning through an active approach tend to experience a deeper level of learning compared to those who are merely passive recipients of information. Problem-solving, authentic learning experiences, virtual learning, online collaboration and other active methods, will usurp more conventional didactic approaches to learning. Further, Curtis Bonk and Ke Zang (2006) also flag a greater emphasis on reflection for students to 'internalize and expand upon their learning pursuits' (Bonk & Zhang, 2006; Sanders & McKeown, 2008: p. 51) and this can be readily facilitated through interaction in and with an immersive virtual environment.

Persistent online worlds such as the one in which World of Warcraft (WoW) players are immersed, often have a learning curve due to the inherent complexities of the world. As the virtual geography, player options, and social interactivity (such as WoW's Guild structure) mature there needs to be a process through which new players are inducted and achieve the threshold concepts of the game. In this context, players will learn the social complexities of the game (such as forming alliances or strategically integrating their characters' abilities into a larger group), search for information related to specific

quests and character advancement (and then apply that knowledge in a range of circumstances), and discuss the game via in-game chat or forums. In essence, players create their own learning communities akin to communities of practice aimed towards inculturating new players, information seeking and social learning (Oliver & Carr, 2009; Galarneau, 2005). What has just been described is a community of engaged, self-directed, location-independent learners; equivalent to a cohort of students from any distance learning institution. The point of differentiation is that WoW players may not acknowledge the 'gamified' learning which is occurring (and in which they actively participate).

Although there is great fanfare about the potential of these three-dimensional immersive spaces for application to higher education, there are still significant shortcomings in the available technologies that need to be addressed to reliably harness that potential. An obvious example is the constraint of natural movement in these spaces due to the limited flexibility afforded by the conventional mouse and QWERTY keyboard. A further constraint is the lack of haptic (tactile) feedback when interacting with virtual objects. For many reasons, achieving more natural motion, tactile precision and haptic interaction remains a largely unrealised dream for human computer interface designers across disciplines as diverse as gaming, IT, engineering, health sciences and education.

Propelled by the lucrative consumer market, gaming developers are at the forefront in the quest to radically change the way users interact with 3D immersive spaces. Speed, responsiveness and dimensional motion are generally not facilitated by most user interfaces, diminishing the participant's experience (Champy, 2007). Further, gaming developers are focused on how to best exploit intuitive skills through tangible user interfaces (TUIs) and intuitive tangible controls. Xin and colleagues (Xin, Watts, & Sharlin, 2007) have reinforced the value of this research, discovering that sensory immersion is enhanced in games using such controls. The provision of haptic feedback further enhances the immersive experience, leading to heightened believability through interaction with 3D objects (Butler & Neave, 2008).

Persistent multi-player virtual environments are so appealing to students and educators because the senses are artificially stimulated to evoke emotional responses, introduce new ideas and entertain in new and exciting ways. These computer-mediated environments provide sensory information including visual, audio and haptic information so that a multi-modal understanding of the environment can be constructed (Butler & Neave, 2008: p. 140). The simple presentation of information is arguably not as valid as engaging students in interacting with that information as becomes possible in an immersive virtual environment (Tashner, Riedl, & Bronack, 2005). From a pedagogical standpoint, therefore, it makes sense to examine the elements of persistent virtual worlds, and the options available via the advances in commercial, consumer-driven console gaming in the context of providing alternative, yet sound, methods of teaching and student engagement (Dalgarno & Lee, 2010).

Although the velocity of growth in IT-related development continues to be exponential, there has only been limited success in exploiting human spatiality, senses, innate human physical movements and tactile precision in interfacing with computer-generated environments. In fact, as stated by Xu (2005), 'It is commonly believed that physical action is important in learning, and tangible objects are thought to

provide different kinds of opportunities for reasoning about the world. Arguably, many classic computer interactions offer very limited stimuli, little freedom to behave and low ecological validity (that is, little relevance to normal, everyday human behaviour in the real world)' (p.1). In searching for technologies that offer potential to be adapted to learning tasks in virtual 3D spaces, we were particularly interested in those that could support the application of theory-to-practice and would be enhanced by more tactile precision, natural movement and haptic feedback.

Kinaesthetic learners are frequently insufficiently catered for and authentic movement in 3D worlds may help to meet this need. Kinaesthetic learning activities compel students to move, sometimes requiring significant exertion (Begel, Garcia, & Wolfman, 2004, pp. 183-184). This exploits what Jean Piaget called 'sensori-motor learning,' in which physical activity transforms into representative mental symbols (Piaget, 1999, pp. 37-38). The increasing importance of hands-on learning has already been glimpsed in the rising prevalence of realistic and complex simulations, interactive scenarios and commutative news stories (Bonk & Zhang, 2006, p. 251). Given the diversity of students attending university, it seems prudent to seek out an environment where all learning styles can be accommodated. As such, the Nintendo Wii and Microsoft Kinect bear closer examination within educational settings.

Nintendo Wii: old folk and young folk and all inbetween

> *'Of course, when playing a game, the nearest thing to the player is the controller. The controller should therefore be regarded as an extension of the player rather than as part of the console. I always bear in mind the importance of the fact that the player will have far more contact with the controller and UI [user interface] than the console itself.'*
>
> (Akio Ikeda, responsible for accelerometer hardware in the Nintendo Wii ™, in an interview with Satoru Iwata, Wiilaunch website, Summer 2006)

A controller that holds more promise in this context currently is the Nintendo Wiimote that comes with the Nintendo Wii console. Haptic feedback is simulated via the onboard vibration-producing motor (Brindza & Szweda, 2008). The Wiimote is the device with the most potential for educational use due to its low cost, adaptability and its popularity as a gaming controller. For example, some enterprising gamers are using the Wiimote to interact with the MUVE, Second Life to provide many exciting possibilities (Boulos, Hetherington, & Wheeler, 2007; Sreedharan, Zurita, & Plimmer, 2007).

The Nintendo Wii also incorporates a number of innovative features that enable more tactile precision. Its most unique feature is the Wiimote (Wii remote) which can detect motion and rotation in three dimensions via three accelerometers and an infrared sensor (Brindza & Szweda, 2008). This is intended to make motion sensitivity more intuitive and natural. The Wiimote is designed to be easy to grasp and point, and makes the device seem more familiar to the non-gaming public. This broadens its use to nontraditional audiences such as the elderly and disabled people. Users control the movements of their avatars (or Miis) in the games by moving their arms while holding the Wiimote (Pearson & Baily, 2007).

For example, Wii Sports contains a tennis game and participants play by using the Wiimote as they would a tennis racquet, swinging it as the tennis ball approaches their avatar.

The Wiimote is wireless and communicates with the Nintendo Wii console via Bluetooth. The Wiimote has been reverse engineered, through the contributions of several individuals to the WiiLi and WiiBrew projects (programming libraries), making it possible to both send data to the Wiimote and interpret most of the data received from it. Transmission is through a standard Bluetooth signal, enabling communication between the Wiimote and any computer with a compatible Bluetooth adapter (Brindza & Szweda, 2008). The Wiimote's unique features will facilitate such tasks as motion capture and gesture recognition, ensuring that the device will be used beyond the gaming industry (Brindza & Szweda, 2008). It has already been used successfully for teaching CPR techniques at the University of Alabama in Birmingham to track hand precision and give students feedback on their depth and rate of compression (Coldewey, 2009). The release of the Wii MotionPlus has boosted precision and motion-sensing capabilities compared to the original Wiimote, as it can more accurately track the user's arm position and orientation in real time on the screen (Hearn, 2009).

Even with the Wiimote's obvious advantages there are still significant hurdles that need to be overcome before the Wiimote can be used in a wide range of virtual educational contexts. There are very few options for customizing the Nintendo Wii console without buying the expensive official Game Development kit. The kit is intended for use by professional development companies only. In addition, there are very few software tools available to assist development (Morgan, Butler, & Power, 2007). And although the Wiimote has been successfully reverse engineered, there are some aspects that are poorly understood. For example, the speaker embedded in the Wiimote is not yet functional outside of Nintendo authorized games and will not emit any meaningful audio in any Wiimote library (Brindza & Szweda, 2008). Finally, they are only sensitive to motion in the hand in which they are being held. The addition of a 'nunchuck' which also contains an accelerometer and is attached to the main Wiimote by a cord about one metre long, overcomes this to a certain extent. The nunchuk attachment does lack the inbuilt motor of the Wiimote, so is not able to simulate haptic feedback. Technologies utilizing depth-sensing cameras offer some advantage over the Wiimote (Naone, 2008).

Another floor device recruited from gaming is the Wii Balance Board. The Wii Balance Board is available for use with the Nintendo Wii console and Wiimotes. Within the gaming context, it is used to play a number of games many of which simulate snowboarding (such as Shaun White Snowboarding: Roadtrip and Snowboard Riot) and skateboarding (such as Skate City Heroes and Skate It) (see Hudson Soft, 2009; Ubisoft, 2009). It is also used for balance, aerobic and yoga activities in Nintendo's Wii Fit and Wii Fit Plus games. The Wii balance board itself is a sturdy, rectangular panel that rests on four feet each of which contains a pressure sensor. The pressure values are conveyed to the Wii console via Bluetooth (de Haan, Griffith, & Post, 2008).

There are numerous possibilities for movement in three-dimensional space. The most obvious use would be to control first person travel using natural proprioception and kinaesthetic senses. The user would step onto the centre of the balance board and then move to the rim to indicate movement in any

direction (de Haan et al., 2008). Engineer David Philip Oster created some software for Bluetooth-enabled Apple computers that enables users to 'surf' Google Earth (Oster, 2009a, 2009b). This software is easy to download, install and use and within minutes it is possible to be exploring the three-dimensional features of the Amazon or the Himalayas. A lesson in geography becomes much more interesting if the student can learn about the Grand Canyon by surfing the Colorado River. Matthieu Deru and Simon Bergweiler also hacked the Wii Balance Board so that it could be used to surf Google Earth. In addition, they used it as a means of moving avatars in the MUVE of Second Life (Deru & Bergweiler, 2009). It would also be possible to use the balance board while sitting down and in that way could simulate pedal control (de Haan et al., 2008). The board can also be used as rotational input device whereby the user can rotate a particular object. Further, it would be useful in those contexts when the user's hands are already occupied with another task (de Haan et al., 2008).

Xbox Kinect

Launched in November 2010, the Xbox360 upgrade known as Kinect creates the environment for a deeper level of immersion and as such has interesting educational implications. The major difference between the Kinect and the Nintendo Wii is that it allows users to interact with Xbox 360 games by moving their hands and bodies in front of a screen, in a manner reminiscent of how people play games on Nintendo Wii consoles. The significant difference is that players will not need any sort of controller. All that is required is a camera bar and a microphone which sits above or below the screen to record a player's movements.

The Kinect offers educators the opportunity to utilise kinaesthetic learning within a broad range of environments, and not only in those where there could be a potential risk to participants (such as in chemistry or any situation involving potentially hazardous substances or environments). Already there have been a range of applications for the Kinect which have educational value. Medical researchers have begun to use the Kinect to assess motor skills development in children with developmental coordination disorders (Straker, et al, 2011); and to view patient MRIs during cancer surgery (Moretti, 2011). The latter is especially useful as it allows surgeons to view data in a sterile environment, without the need to leave the operating theatre or change their surgical garb. In the language classroom, a Kinect application has already been designed to teach American Sign Language. The software is able to match the learners gestures with those of the virtual teachers to ascertain if the learner is signing correctly (Kissko, 2011).

Avatar Kinect (Microsoft Corporation, 2011) has implications for distance learning as it can allow groups of geographically dispersed learners to meet in a virtual space and interact through their motion-driven avatars. The same software allows for the users to create presentations, performances or interviews within a virtual environment which capture body movement, gesture, and facial expression as well as voice. Used as a medium for assessment this offers applications for almost all disciplines - from a project management team comprised of business students, to a groups of nursing students performing a diagnosis, or pre-service teachers interacting with mock students in a classroom. It is theoretically

possible to teach even performing arts via distance education and assess students within this environment.

Lastly, in the field of religious studies, the Avatar Kinect could offer tools for greater immersion and understanding of ritual and body language. Most religions have a strong kinaesthetic element for adherents, from the Catholic genuflecting to the use of dance as a celebratory or ritual tool (Sautter, 2005) and neopagan religion is heavily reliant on ritual yet at the same time has small numbers of geographically isolated adherents. The use of Kinect aligned with virtual worlds such as Second Life, would allow studies in religion learners a greater level of immersion and appreciation for the movement-based nuances of religious observances.

Conclusion

User interfaces from gaming consoles such as the Nintendo Wii and Xbox Kinect confer numerous advantages for education over traditional input devices: the keyboard and mouse. Creative arts students can dance or perform at a distance for their peers or lecturers by exploiting the affordances of Avatar Kinect for the Xbox. A more natural way of interacting with a virtual environment can reduce the learning curve of navigating for the elderly or the very young and it is precisely this element that contributed to the enormous sales of the Nintendo Wii through the recruitment of players in non-traditional markets. This natural interaction coupled with haptic feedback (in the case of the Wii) helps facilitate immersion in a virtual environment such that players feel like they are really there. Already, a number of applications have been developed for both the Kinect and the Wii, which facilitates kinaesthetic learning. This is a boon for distance learning that has struggled to provide authentic learning at a distance for students enrolled in action-based programs such as nursing or for those students identified as being primarily kinaesthetic learners.

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Do virtual worlds have a role in increasing student engagement as measured by their higher academic grades?

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Abstract

Student engagement has become an increasing focus for higher education institutions in the market driven environment. Improved student engagement leads to improved student performance and this also results in higher levels of student retention. Student engagement has often been more challenging for off-campus students but improvements in technology and communications have opened up new possibilities for student engagement. Virtual worlds appear to provide a venue for students to engage with academics, other students and the material they need to master. This article examines the impact of the virtual world *Second Life* on student engagement as measured by the higher academic results for students participating in learning via *Second Life* activities.

Keywords

Virtual worlds, *Second Life*, engagement, retention

Introduction

Virtual worlds have the potential to reduce student attrition because they provide students with a vehicle to engage in their studies. Tinto (1975) suggests that students are at risk of withdrawing from an institution unless they are socially engaged in the institution. He further points out that this engagement does not need to be with the total institution but with some group with which they can share a common interest.

With off-campus students, the opportunities for engagement are limited by distance and available time. *Second Life* is a 3D immersive virtual world that provides an avenue for groups of students, both on- and off-campus, to develop a community of interest necessary to remain engaged in the institution. Student experiences in the virtual world of *Second Life* are explored in this paper through measuring their engagement.

Background

Students at this institution have been learning through a virtual world since 2008, both voluntarily (off-campus) and as a requirement of their studies (on-campus) across several education units. Those students who choose to study using a virtual world are all education students at a variety of levels of their candidature from pre-service teachers to Masters students. They study in off-campus mode and are situated mostly across Australia, with some from overseas. Only analysis of off-campus students' learning is reported in this paper. The virtual world platform of *Second Life*, released to the public in 2003 (Collins, 2008), has been used because the members can inhabit and build their own 3D world (Linden Research, Inc., 2010). As of December 2010, registration was

available for anyone over 13 years of age to cater for the decommissioning of Teen Life (Cummings, 2010b). *Second Life* also offers immersive experiences for students because it provides "interaction and engagement for the users" through a combination of "asynchronous and synchronous communication" for collaboration and simulation where the context can be emulated (Gregory & Smith, 2010, p. 245).

Engagement and Retention of Distant Learners

Engagement

Engagement can be measured by student's feelings (affective), observable actions or performance (behavioural) and perceptions and beliefs (cognitive), or a combination of them (Russell, Ainley, & Frydenberg, 2005). Engagement can be considered the attitudes to, and interest in, a particular learning domain. Student's perceived ability and learning goals can determine achievement in their study (Greene & Miller, 1996). Engagement can be measured by the interaction of the student and institutional characteristics (Hu & Kuht, 2002). Raeburn, Muldoon and Bookallil (2009) state that if a student is engaged they have an "energetic and effective connection with the activities they are undertaking" (p. 702).

Retention

An advantage to students, institutions and society as a whole is the increase in the level of retention in higher education institutions. Often more than 30% of students who enrol in a program withdraw before completion; Tinto (1987) 42%, Reisberg (1999) 46%, and Martin, MacLachlan, & Kamel (2001) 33%. Research has been focused on identifying 'at risk' students by looking at the characteristics of students that failed to complete. Over the years, these have been identified as lack of integration into the academic and social domain of the institution (Tinto, 1975), poor course choice, financial difficulties and poor student experiences (York, 1999). From this knowledge, interventions to produce positive results have been developed, but not necessarily reducing, the overall magnitude of the problem. Young, Glogowska and Lockyer (2007) emphasise the need for higher education institutions to change as opposed to bringing about change in students.

The question still remains why student attrition is still so high despite decades of research and ample individual examples of success. The answer to the question, according to Young et al., (2007) is that these findings and successes have yet to infiltrate the views of ground level teaching staff.

What we can take home from this, for students using a virtual world for their studies, is that virtual worlds can provide students with the required positive experience bought about by the engagement and immersion provided through this learning environment. Although a virtual world cannot address all these issues, it can address the 'poor student experiences', 'integration into the academic and social domain of the institution' and the 'change the higher education institution undertakes' in using a virtual world to assist in reducing students withdrawing from their studies.

Distance Learners (off-campus students)

By measuring the level of student engagement through their participation in virtual world activities conducted in *Second Life* we are able to ascertain the student experiences. In a study by Ostlund (2008), it was revealed that students chose distance learning due to obligations in their work and family lives and would have preferred

regular on-campus education. Students miss the collaboration and social activities with others that come from face-to-face settings. His research found that distance education requires self-discipline, organisational ability and in an autonomous capacity as interaction with other students is often inconvenient. His research revealed that students made many spontaneous contributions in the distance learning mode of study, taking note of peer group problems and using informal language as supported by Dabbagh and Bannan-Ritland (2005). Whilst learning in a virtual world through authentic activities designed to achieve learning outcomes (Krause, 2005), students "learn the skills for seeking out the required knowledge as the changing situation demands" (Gregory & Lloyd, 2010, p. 821). Students value synchronous environments such as virtual worlds and chat room because they are familiar with using tools such as MSN, Facebook, Twitter and other social networking tools.

The effectiveness of online learning tasks depends on the way they generate interaction. However, it is not obvious what types of interaction is most effective (Lander, 1999). The effects of interaction between the learner and tasks can be richer and more effective in an online environment than face-to-face situations, enabling interactions in a virtual world that are not always attainable in real life. Students can collaborate in group work from any location worldwide, at anytime and on tasks that are not possible in real life, such as visiting outer space to learn about other planets. Due to the interaction that students have with each other in an online situation, they are gaining valuable skills in team work and learn from others in the group. Online interaction can enhance learning because students are engaging in the materials, in discussions with peers and colleagues, and in the technology.

In contrast, Calladine (2008) states that many of the current Web 2.0 tools are only a one way representational, meaning that the materials only interact with students, as opposed to two way interaction where the interaction occurs between the students and educator, such as virtual worlds, chat rooms and video conferencing (all synchronous tools).

Anderson and McCormick (2005) discuss issues that occur with Web 2.0 technology such as relying on resources, teaching design and learning activities, enabling ownership, matching the curriculum, inclusion, learner engagement, innovative approaches, effective learning, formative and summative assessment, coherence, consistency and transparency, ease of use and cost effectiveness. All these factors need to be considered when creating a learning environment for higher education students. Students' needs must also be considered so that they are receiving the best possible instruction from Web 2.0 technologies.

The universities that are prepared to teach in innovative and new ways are the institutions that will gain the students in the marketplace (Barnes & Tynan, 2007). They need time, resources and organisational space in order for this to happen. Universities live in a competitive environment and the traditional lecture is not an appealing product to the Y Generation who find it old-fashioned and boring. Barnes and Tynan, (2007) claim that undergraduate students prefer not to attend lectures if effective online alternatives are available. This is supported by Kehoe, Tennent and Becker (2005) in their study where less than half of their respondents preferred a traditional lecture.

Many students are looking for blended learning for purely practical reasons. Online materials are seen as providing students with the ability to engage with material and include information that is complex (Barnes &

Tynan, 2007). Effective use of Web 2.0 tools can reduce poorer students. Students are now shaping their own learning environment as the teacher only facilitates the learning process through a range of learning activities by using the tools that are most beneficial to them. The higher education community needs to take into account issues such as access, security, free expression, privacy, freedom of information and student safety (Crie, 2004) and consider that not all students will want to engage in these new technologies (Prensky, 2001).

The incorporation of Web 2.0 tools are changing teaching and learning strategies by enabling students access to resources anytime, anyplace (Roberts, Barkely, Cross, & Major, 2008). Many of the Web 2.0 and emerging tools such as virtual worlds support collaborative learning both in and out of the classroom. Social networking places were students gather are now becoming educational spaces where students are using technology for their learning. Web 2.0 enable learners to find each other online through chatrooms and other synchronous communication tools continue to bolster performance improvements of students through learning and long afterwards (Allen, 2008). Online communications reduce the distance between people.

Virtual Worlds and *Second Life*

Online communications incorporate text, voice, body language and shared experiences making communications much richer (NMC White Paper, 2007). Virtual worlds have been around since the late 1970s and the inclusion of graphics and chat saw the emergence of immersive 3D virtual worlds (Constance, 2007). Interactions happen more quickly in an online environment than they might otherwise (NMC White Paper, 2007) and this has been observed on many occasions with students in *Second Life*.

Figure 1: The authors' avatars

Virtual worlds provide interaction and engagement for the users within the virtual environment. They combine asynchronous and synchronous learning and can provide an environment for collaboration, simulation and emulate the environment in context. Virtual worlds require the creation of one's own avatar to enter the world and interact with others. An avatar is a person's online 3D graphical presence (Gregory & Smith, 2010) (see Image 1 – the authors' avatars). In a virtual world, educators can set up classroom situations and tasks for their students. Educators and students communicate via chat and audio and are able to see each other's avatar 'live'. They can also hold one to one discussions with people in different locations within the virtual world and send messages for the next time that person goes online to receive asynchronously or via email if enabled. Educators can hold virtual presentations, videos and use a variety of virtual tools to present to their students (Gregory, 2009). Through the virtual world of *Second Life* some university institutions are emulating face-to-face models of teaching where they deliver lectures as they would in 'real life'; ie stand out the front and give the lecture and may use a presentation or video in conjunction (Gregory & Smith, 2010). Others are using tools available in *Second Life* and are using the environment to emulate real life situations. Often bots (non-player users like robots) are used to interact with avatars to create role-plays for the user (Dron, Reiners, Gregory, 2011).

Second Life has been found to be engaging on many levels and students come away from their studies with positive impressions (Constance, 2007; Wood & Kurzel, 2008; Farley, 2009; Gregory & Tynan, 2009; Zagami,

2010, Gregory, 2011). Mock trials in *Second Life* by Harvard and Bradley Universities have found that sessions ran smoothly through text chat because the participants were more concise with their arguments as opposed to session in a real classroom where the participants tended to speak too long (Constance, 2007). Zagami (2008) states *Second Life* is an effective environment where students work collaboratively and produced more creative responses when working this way. Students using a virtual world developed rapport, stayed interested longer and debated subjects more deeply (MCT, 2008). Gregory and Tynan (2009) support this where students perceived a virtual world was like a real face-to-face experience which "gave them the perception of being there, being in a real face-to-face discussion" (p. 384). Features of *Second Life* enable the emergence of different approaches to education (Ondrejka, 2007). Residents are approaching learning with a passion and excitement they may not have possessed in school. Educators use virtual worlds to conduct classes and their success is due to its immersive environment and the engagement of the users (Bowers, 2008).

The quality of interaction within the virtual world is difficult to describe and it does not replace face-to-face interaction, however, it does enable working with people all over the world (Apel, 2006) in a more interactive environment that is not available from other Web 2.0 tools. An example of this is through a research project on Professional Experience in a virtual world (VirtualPREX) which is being undertaken by five Australian universities in collaboration with the University of Hamburg (Gregory & James, 2011).

It is reported that the number of virtual worlds is greater than 200 (Gregory, Lee, Ellis, Gregory, Wood, et al., 2010) which grew from a reported 100 in 2008 (Collins), with Mitham predicting the number will expand to 900 by 2012 (2008). The number of educational institutions using *Second Life* is not definitive with Cummings (2010a), an employee of Linden Lab, the proprietors of *Second Life*, reporting 750 educational institutions operate their own island. Calonge (2007) reported there were more than 250 universities using *Second Life* as an educational tool, however, John Lester (2008) former Academic Program Manager at Linden Lab, stated "There are more like 1,000 educational institutions using *Second Life*, although it is difficult to actually state accurately". There are no firm figures to date on the number of higher education institutions using *Second Life*.

Methodology of Student Engagement in *Second Life*

Students attended inworld (in *Second Life*) sessions to ascertain whether there was potential to use this, or a similar environment, for teacher and learning in a variety of disciplines and age groups over a four year period. The groups met weekly of an evening over a semester and it was voluntary for students to attend. In the first two years sessions were advertised to be a length of two hours. In 2010 and 2011 sessions were advertised as one hour in duration. Mixed methods were used to gather data.

Data was collected by recording weekly inworld conversations over the semester in which the units were taught. There were two units in 2008 and 2009, seven in 2010 and six in 2011 teaching using a virtual world. Pre-semester surveys were conducted to find out students' computer capabilities and knowledge of social networking tools and virtual worlds through a series of open and closed questions. Demographic details were also collected. To understand student's perceptions of their learning in a virtual world, end of semester surveys were also completed.

Analysis of Student Engagement in *Second Life*

The analysis of student engagement in their learning in the virtual world is broken into several sections to demonstrate that triangulation was used to analyse the data to find consistency. Table 1 shows the number of students who attended the virtual world sessions. Over four years of teaching in a virtual world across several education units, the numbers of students volunteering to participate increased significantly which shows a growth from 12 participants in 2008 to 110 participants in 2011.

Table 1: Number of students attending *Second Life* sessions

	2008	**2009**	**2010**	**2011**
Students who attended voluntary virtual world sessions	n=12	n=18	n=99	n=110

Table 2 is the average length of time students stayed inworld over the advertised session time. Lagorio (2007) finds that students hold after-class discussions about their courses when in *Second Life* and prefers classes to be discussions as "things pop up in a less linear fashion (in *Second Life*) than they do in a regular classroom" (online). Students reported that they stayed beyond the advertised length of time for a number of reasons: they wanted to continue the end of session discussions; they were totally absorbed in the activity that they lost track of time; guest lecturers went beyond their allocated time or they hadn't completed a task that they wished to complete.

Table 2: Average time staying in *Second Life* sessions beyond advertised session times

	2008	**2009**	**2010**	**2011**
Time students stayed in *Second Life* sessions after session concluded	50 minutes	1 hour 20 minutes	1 hour 41minutes	1 hour 11 minutes

Student grades

Student grades over the four years (2008-2011) have been analysed, comparing the grades of those students who chose to use *Second Life* as a learning tool and those who chose not to. Figure 2 shows a break down of these grades across 3236 students. The left column in Figure 2 represents the *Second Life* group of students (n=232) which shows that they received, on average, higher grades, than those who chose not to study using Second Life (right column, n=3004) across the four years of research. High Distinctions, a grade of 85% or higher were received by 24.1% of the *Second Life* students compared with 9.9% of those who chose not to study using the virtual world. *Second Life* students also received 55.2% grade of Distinction, a grade between 75% and 84% as opposed to 36.6% of other students. Overall, the group that studied in *Second Life* performed at a much higher level. Those students who received a Credit or less, ie less than 65%, were 20.7% of Second Life students and 53.7%, indicating that those who chose not to use Second Life as a teaching and learning tool were in the lower portion of grade results.

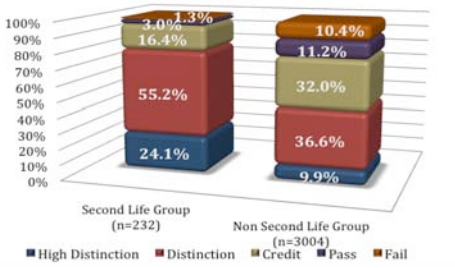

Figure 2: Grade comparison across four years from 2008 to 2011 between students who chose to study using *Second Life* as a learning tool and those who chose not to

It is noted that students who chose to study using a virtual world may be more motivated students and would receive higher grades no matter what tool they use for learning. These students may already be more engaged in their learning. However, analysis is consistent and shows the same trend across the four years. Students who choose to use a virtual world for their learning, on average, receive a higher grade for that unit of study than those who chose to use only conventional Web 2.0 tools for their learning.

Effective engagement

Student quotations from discussion demonstrate how they felt about their experiences during their learning in a virtual world through affective engagement, that is, engagement through feelings (words that depict those feelings are in bold and italics):

- Students will be having ***so much fun***, that they will ***not even realise*** they are learning
- *Second Life* has been a ***surprising discovery***, and ***has exceeded my expectations***. Initially I was ***cautious***, and chose to join partly out of ***curiosity***...but found with each visit with Jass more possibilities for use in education were introduced to me. Its very ***exciting*** and I intend to continue visiting and learning in *Second Life*.

Behavioural engagement

Behavioural engagement is demonstrated through student actions whilst learning in the virtual world. Table 1 shows the number of student attending over the four years, 2008 to 2011. Recorded inworld text conversations demonstrate the amount of activity there was through discussions. The pages of dialogue, outlined in Table 3, show that there were many comments made, through text, in the virtual world. Some lines were short, others were whole paragraphs. Over the four year period, there were more than 52,000 lines of recorded text in a spreadsheet. Audio is now predominantly used for inworld discussions.

Table 3: Number of pages of inworld discussions recorded and average time spent at each inworld session

	2008	**2009**	**2010**	**2011**
Pages of inworld dialogue recorded over the semester	190	306	189	165

Average time spent inworld each session	2 hours 50 minutes (advertised 2 hour sessions)	3 hours 20 minutes (advertised 2 hour sessions)	2 hours 27 minutes (advertised 1 hour sessions)	2 hours 23 minutes (advertised 1 hour sessions)

These figures suggest that students were so immersed and engaged in what they were doing they lost track of time or wanted to learn more, as depicted by a student's statement, "… so much for ***not staying*** the full 2 hours!"

Cognitive engagement

Student's perceptions and beliefs were demonstrated through the following student comments (cognitive words in bold and italics):

- I had my first visit to *Second Life* on Wednesday and it was a blast. I can ***see*** the ***students engaged*** in this environment and developing understanding in life skills and applying these to real life.
- Your … work … doesn't just recreate classrooms and lecture halls but ***seriously uses the creative potential*** of *Second Life* of teaching.
- Everyday I am more and more ***intrigued and excited and bewildered*** by the wonder of *Second Life* and it's possibilities.
- At first I could only see problems with using it as a tool in a classroom however as I have learnt more I ***can see*** a huge benefit for students especially the quieter ones or even ones with a learning difficulty who may be able to be ***engaged through this type of learning***. As we aim to engage all students this is very important.

The future and concluding remarks

Second Life offers institutions the opportunity to engage students by creating an environment that gives them a sense of belonging and Australian Higher Education institutions are taking advantage of this opportunity. 47 academics from 28 Australian higher education institutions report that they are using virtual worlds "for diverse teaching and learning activities such as business scenarios and virtual excursions, role-play simulations, experimentation and language development" (Gregory, Gregory, Wood, Masters, Hillier, et al. in press). Students can join a group to enable them to undertake their studies with others from any location in the world in an engaging and immersive community. The students used in this research were totally engaged with learning in the virtual world. By exploring a combination of online learning (including virtual worlds) and engagement, a model has emerged were the use of virtual worlds has the potential to increase a student's desire to continue studying for their higher education. By taking into consideration the notion of improving student's experiences, then transposing those requirements into a virtual world could, indeed, increase the retention rate of students. To sum this up, a final quotation from a student on how they perceive virtual worlds could be used to increase the experiences of fellow students: "Virtual worlds are an outstanding educational tool. They are exciting and empowering. They enable students to take control of their own learning, thus creating deeper learning experiences". However, more empirical research must be undertaken to provide the wider academic section evidence that a virtual world is engaging for the learners and has the potential to increase student retention and grades.

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Digital Audio Workstations: Master or Slave?

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There's no doubting that the Digital Audio Workstation (DAW) is here to stay. A variety of platforms have been sufficiently refined, re-priced and re-marketed over the last twenty years to bring about a veritable revolution in how professionals, and novices alike, create their recordings. However, according to sound engineer Mike Stavrou (2003), a good mix depends not so much on the tools available, but moreso one's frame of mind. The same can be said for all aspects of the record production process. In order to avoid what George Massenburg calls the 'cookie-cutter' syndrome (Stewart, 2009); practitioners must constantly challenge their tacit assumptions regarding each stage of this multifaceted, creative process. Brian Eno likewise states that magic only happens "when you've abandoned the lifeline of your own history" (Tamm, 1995: 184). So what happens when the tools of the trade become so 'smart' and powerful that they impact upon one's creative frame of mind in ways too subtle to be easily noticeable (that is, to all but the most rigorous of phenomenologists)? This paper will explore relevant aspects of creativity and play theory in order to assist budding DAW enthusiasts to utilise these powerful tools as their master, rather than as an unwitting slave. In particular, a variety of theoretical models proposing the creative benefits of a playful frame of mind will be contrasted and compared (Meares, 2005; Claxton, 1997; Amiable, 1996; Apter, 1991 & Lieberman 1977).

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Radio IMERSD.

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Abstract

This paper presents a report on the creation of an online publication and dissemination project titled Radio IMERSD at Queensland Conservatorium Griffith University. Radio IMERSD, supported by a 2007 AUC Development grant, is an ongoing experiment in web distribution of rich media via multiple forms, including podcasting, streaming, audio and video content-on-demand, text and image with a central goal being to reflect professional communities where the responsibility for knowledge creation is shared or socially constructed among the members rather than 'delivered' to students by a lecturer. I report on the experimental system configuration, as well as problems and findings. Issues and solutions include managing copyright demands in a tertiary education context, content creation, data management, and the blend of open source and proprietary software. I look at how some of these challenges have been met and how they may be taken forward in the future.

Keywords

Keywords: Web radio, streaming, podcasting, music copyright,

Background and Context

Radio IMERSD is briefly summarised as an "open-access publication vehicle for digital arts including creative thought, music, visual media and other forms of technological imagination from across Griffith University" (Radioimersd, 2010).

The radio station comprises a 24/7 radio-styled non-interactive internet-only broadcast of rotating and randomised playlists, on-demand streaming exemplars accessible via web browser, and a series of downloadable podcasts. Broadly, the content includes public speeches, guest lectures, viva voce and workshop presentations; musical compositions, performances and sound recordings; and commentary and review intended to stimulate critical discussion.

Since the mid 1990's the Music Technology area has placed an emphasis on problem based learning (Sweller, 1988; Hmelo-Silver et al., 2007), scaffolding (Brown et al., 1989; Rogof et al., 1996), and collaboration and mentoring from industry aware and capable staff. The area had self-developed extensive online and electronic resources and used many web-based mechanisms for delivery to students. Due to network access restrictions however, students network access was limited to downloading materials posted by academics rather than being active participants in bi-directional online communications. Consequently, there was no real opportunity for students to take an active role in online publishing processes and approaches, where academic staff had the sole ability to create and maintain any online activity. This resulted in the skills underpinning the online activities and processes being largely hidden from students' awareness or consciousness despite academics integrating the underlying concepts into the curriculum via simulated projects and theoretical discussion.

There was a therefore a need for the replication, more than a simulation, of a professionally oriented community within the music technology area in order to integrate these professional skill-sets into all aspects of the learning landscape, reflecting "digital music's new role as a 'strategic necessity' of the music industry" (Bockstedt, Kauffman & Riggins, 2005, p.5). This would then create opportunity for students to negotiate and appropriate the different "ways" increasingly associated with their prospective professions (Wenger et al., 2002).

It is commonplace within the Music Technology learning community to have students working in cross-year and cross-disciplinary teams. One such activity in the Music Technology area is termed concert recording, where cross-year teams of music technology students record ensembles variably comprising students, staff and guest artists. Since 2006 these recordings have then been disseminated to the student cohort via networked iTunes playlists run from a central computer, as well as disseminated publicly via podcasts and web streaming.

The parts of the process beyond the delivery of the recordings to their lecturers was however largely hidden from community view, with the recordings predominantly serving as assessment items graded by an academic, submitted at the end of semester portfolio, and then largely forgotten about. Often, even the ensemble members would never hear the

final recordings of their performances. Many factors contributed to the limited use of recorded student and staff performances, including replication costs, administrative processes and managerial issues. These issues have simple if not easy solutions that the allocation of time and money can address. Conversely, the most significant block requiring the most time and energy toward finding a partial solution was that of copyright. This issue is addressed in more detail later in this paper.

As such, the Radio IMERSD project then became an informal teaching and learning opportunity and research vehicle where the goal was to provide generative practical opportunities for students and researchers to become connected in meaningful ways beyond the limits of modules, courses, programs and year levels. Student involvement was then sought for parts of the production chain right up to the broadcast stage not only for the purpose of student learning, but to engage them in a holistic way where all parts of the production chain could be understood. One important aspect of this strategy was to introduce a deeper level of complexity to the students' understanding of the whole end-to-end process of producing and disseminating projects.

Students are therefore more than content producers, working collaboratively toward complex common goals where mentoring, problem solving, social construction of knowledge, negotiation of meaning and a developing sense of esteem between students is fostered. This creates a shared ability to shape a new social and community structure that more closely resembles the sorts of passion based and intrinsically motivated interactions found in professional communities (Brown, 2006), with the potential to significantly enhance the intellectual quality of the learning environment (Swan & Shea, 2005; Garrison et al., 2001).

GENESIS AND OBJECTIVES

The initial vision that was to become Radio IMERSD was first born in 2001, however left unrealised until after my AUC-sponsored trip to the Apple World Wide Developer's Conference (WWDC) in San Francisco in 2004. A range of presentations at WWDC '04 highlighted the growing academic, consumer and audience support for web streaming as a viable alternative to terrestrial radio.

This raised the concept of streaming internet playlists as an efficient, functionally equivalent and economically viable medium to terrestrial radio which could be seen as a pedagogical platform on which to base learning and teaching projects. David Black proposes that "a medium's identity stems in part from how it is received and treated by its users. Listeners may of course be nudged in this or that direction by the industry. But if, for whatever reason, Internet audio is treated as if it were radio, then to some irreducible extent it is radio." (Black, 2001: 398)

Additionally, a new trend was emerging at the same time, that of podcasting. The origins of the term Podcasting can be traced back to earlier that year (2004) when the Guardian journalist Ben Hammersley observed:

> *With the benefit of hindsight, it all seems quite obvious. MP3 players, like Apple's iPod in many pockets, audio production software cheap or free, and weblogging an established part of the internet; all the ingredients are there for a new boom in amateur radio. But what to call it? Audioblogging? Podcasting? GuerillaMedia? (Hammersley, 2004)*

The idea of Podcasting was not a far reach from the activities already being undertaken in the Music Technology area at the time with the exception that the push-pull technologies of RSS and Atom feeds using XML encoded pages with media inclusions carried with it the attraction of a subscription-based model. For this reason Podcasting was quickly embraced by the Music Technology department as a way of attracting and tracing our listening audience.

At that time in 2004, a Google search for the word 'Podcast' would return somewhere in the order of 6000 hits (Terdiman, 2004). In September 2010 the same search returned over 44 million hits, and at the time of writing this (September 2011) the same search returns over 315 Million hits.

Since then, internet radio has been eagerly embraced by traditional media corporations, down to small independent organisations and is now accessible to any individual through online projects such as last.fm, Live365, Shoutcast Radio and an ever increasing number of terrestrial radio stations working to reach an international audience. Research undertaken in 2007 found that around "72 million Americans listen to internet radio every month", projected to reach 148 million listeners nationwide by 2010 (Castro, 2007). A Google search using the Boolean term "internet radio" in 2004 returned around 4000 hits, in September 2011 over 48 Million hits.

The conceptual and philosophical reasoning underlying the development of Radio IMERSD was therefore to establish a context around which the following activities and ideas could be located.

Learning and Teaching: to provide a vehicle for new learning and teaching initiatives, both technical

and aesthetic. Students are working in fields increasingly influenced or even dominated by electronic dissemination technologies and strategies. It therefore behoves us to provide them with the opportunity to engage with these constituent elements. This enables an array of activities that have at their core the tenets of social construction, reflective practice, master-apprentice, proximal development and social constructivism. Further, the intent was to provide additional motivation to students to invest themselves in creativity because the result of their work was being made public.

Industry relevance: To provide a realistic industry-relevant opportunity for students and staff to engage in professional practice in conjunction with research-informed / research-led learning and teaching. This reflects the changing role of digital distribution approaches in the music industry value chain. The adoption and diffusion of digital music, reduction in "distance" between artists and consumers, wide distribution networks through the online channel and the reduced costs of replication and production (Bockstedt, Kauffman & Riggins, 2004) provide significant opportunity for the modern musician, regardless of whether they are performer, composer, engineer or producer. This is evidenced by statistics showing the number of active Apple iTunes customers growing from 861,000 in July 2003, through 4.9 million in March 2004 (Borland & Fried, 2004) and up to over 160 million in September 2010 (Butcher, 2010).

Professional Practice: to provide students access to an e-publishing platform. Students are being encouraged to think of themselves as professionals and experts in various domains as they move through the roles of "apprentice" to "master". These roles require that students be provided with opportunities in support of and commensurate with their growing expertise. The design philosophy has been one of participation to harness the creative, intellectual and philosophical outputs of academics, researchers and students. Our own research clearly shows that students treat their studies differently when there is a publicly accessible outcome.

Research: to broaden notions of access to creative output for students and academics; With the developing landscape of the ERA in Australia (known as RQF at that time), as well as a growing awareness and respect for diversity and specialisation, new models and forms of output are being recognised and supported. Additionally, there is growing awareness and support for multi-format exegetical works in research higher degree programs in music. In this context multi-platform exegetical works are ones where forms other than text, such as score, compositions, audio and video, may also form part of the exegesis. Consequently, traditionally recognised text-based outputs are no longer accepted as the only way forward. It was clear therefore that a need existed to develop a directory of research and performance resources regarding QCGU performing arts activity, with the desire to make this as accessible to as many people as possible, and that it cater for future data collection and collaborative research.

Public Exposure: to augment access and engagement in the activities of existing and healthy learning communities and to promote and make conspicuous a range of active and interdisciplinary collaborations by providing a space for creative output intended to foster interaction and to stimulate the cross-pollination of ideas and activity.

Digital curatorship of socio-cultural history: to index and provide an ongoing record of performing arts events at the Queensland Conservatorium. Apart from some large and major productions at the Conservatorium, many performing arts events were largely forgotten about soon after the event. Subsequently, it became evident that the Radio IMERSD project could serve a valuable role as a digital library with the potential to provide cultural insights not otherwise possible. Digital Libraries defined by Digital Library Foundation as "Organizations that provide the resources, including the specialized staff, to select, structure, offer intellectual access to, interpret, distribute, preserve the integrity of, and ensure the persistence over time of collections of digital works so that they are readily and economically available for use by a defined community or set of communities." (Waters, 1998)

Flexible and open access: to provide users of all technical persuasions access to the online materials, and in a variety of formats according to each individual's preferences and technical know-how. This resulted in three fundamental ways to access content:

1. On-demand streaming of single files for the casual listener who lands on a page and would like to audition a single file;
2. Podcasting for the return visitor who would like to subscribe in order to be notified when new content is posted;
3. Radio styled streaming for the "all important at-work listener where the significant consumption of on-line radio takes place." (Bridgeratings, 2010)

Original content: generated by QCGU activities and participants. The works contained within Radio

IMERSD, spanning 9 years of staff, guest and student creative output is currently over 2000 unique pieces from almost all styles, genres and nationalities, including public lectures, Javanese Gamelan, Gregorian Chant, various sub-genres of Metal, World music, spoken word, Jazz, Noise music and Electronica. All works are performed and recorded at QCGU events, mostly within QCGU venues, and includes original thoughts, research and compositions by visitors, guests, students and staff.

CHALLENGES

COPYRIGHT AND INTELLECTUAL PROPERTY CHALLENGES

The most significant challenges to creating Radio IMERSD were those to do with copyright and intellectual property. Music recordings contain multiple holders over intellectual property and copyrights. The sound recording consists of the original composition comprising notes and lyrics, intellectual property of the publisher if the work has been formally published, the intellectual property created through the interpretation of the musical score by the performing artist, and the intellectual property of the recordist (engineer and/or producer) in making the recording (Mechanical copyright). The mechanical copyright exists in any sound recording (via a mechanical or electrical device) because a recording 'fixes' the work in a new material object or form known as "the recording". A publisher's intellectual property and copyrights will also exist if the musical work has been performed from a published score, where the publisher can hold rights over the ability to record, or indeed sometimes even over the nature of the performance of the work(s). These different sets of rights holders, and their overlapping rights, have made the licensing of music copyrights "an excruciatingly complicated matter for decades" (Uber-Middleman, 2007, p. 852). This complex chain creates a minefield of difficulties that has been a primary restraint in the development of Radio IMERSD.

Additionally, while the differences between terrestrial radio broadcast and internet radio broadcast are minimal, terrestrial radio is largely exempt from paying performance royalties for sound recordings to the copyright owners. In contrast, all other forms of broadcasting, including internet radio, satellite radio and digital music services (such as Pandora and last.fm, and now including services such as Youtube) must pay for these performance / broadcast rights.

The discussions regarding copyright and intellectual property were prolonged, lacked clarity, were often contradictory and failed to provide concrete direction on what was possible.

Representatives from the Australian Copyright Council (ACC) in 2001, as well as literature at the time, suggested the Digital Millenium Copyright Act (DMCA) as a primary source of understanding what was achievable in Australia. While the DMCA is a US Copyright Law and therefore has different provisions than Australian law, the gradual homogenisation of western copyright law was proposed as the reason for using the DMCA as a base framework. Certainly, the differences between US and Australia were further eroded after the introduction of the 2004 American Free Trade Agreement (AusFTA). As a layperson therefore, with no in-depth specialist legal expertise, decisions about the design and implementation of Radio IMERSD have been done with sensitivity to USA law as well as Australian law wherever possible.

What was eminently clear from the outset however, and consistently confirmed as the project developed, was that this project could only proceed if the radio content was limited to original content. Far from being seen as any impediment, this was seen as a positive point of difference and ownership when compared to the common practice of populating broadcast material through selecting, aggregating and filtering commercial content.

At first glance the idea of limiting the content to works generated at QCGU may seem problem free given that a sizeable part of the conservatorium's repertoire comes from works that have entered into the public domain, and there are many students who create and perform original works. However many compositions that exist in the public domain still present challenges because these works are often performed using published musical scores and these published scores contain publisher's copyright. As an example, one particular publisher's agreement includes charges of around $120 per finished minute if a work is to be recorded for commercial purposes. This means that a typical concert recording, comprising between 50 and 80 minutes worth of music performed by students, would cost QCGU between $6,000 and $9,600 per concert up front just in publisher's fees. Approximately 200 concerts take place each year. If all performances fell under the aforementioned circumstances the bill to QCGU would be over $1M to record each year.

However, considering only around 120 of the concerts are recorded and then half those (an arbitrarily chosen number) might be deemed suitable for publishing, with the chosen concerts having between 45 minutes and 90 minutes of finished material (averaging out at around 55 minutes of

material per concert), the bill to QCGU dives right down to a much more respectable $120 per finished minute multiplied by 55 minutes (average) multiplied by 60 concerts with a result of just under $400,000 per year just relating to the publisher's copyright fees.

This is simply not feasible unless considerable effort is put into developing business and commercialisation strategies and associated infrastructure in support of a commercialisation agenda that would return or offset the costs involved. This therefore becomes a completely different project, and one that subverts the original intentions of open access and freedom to sharing ideas (while still respecting intellectual property considerations).

Further complicating matters was that the Copyright Term Extension Act (CTEA) of 1998 extended copyright terms by 20 years. Since the Copyright Act of 1976, copyright would last for the life of the author plus 50 years. The Act extended these terms to life of the author plus 70 years, and copyright protection for works published prior to January 1, 1978, was increased by 20 years to a total of 95 years from their publication date.

The contemporary and Jazz programs rely on songs known as traditional "standards" as part of their learning and teaching – a valid and beneficial pedagogical approach the world over. While the recording is being made of our students interpreting and re-interpreting these standards, composing on the fly (improvising), with a large degree of unique and new intellectual property being generated, the underlying melody or 'work' is one that still retains copyright.

This then meant that works due to come out of copyright in the late 1990's and early 2000's were placed back under copyright restrictions, and as a result further complicated any idea of being able to publish student and staff performances on a format that could be confused with commercial activity.

The complexity and confusion continues to grow the further down one drills, however for the purposes of this paper the above précis should afford a basic understanding of the far more elaborate and intricate landscape than, for example, the relatively straightforward concept of patents.

As a result, Radio IMERSD is positioned as an openly accessible and non-commercial vehicle for publishing student and staff work that further includes the means to disseminate this creative work without prejudice to any copyright holder with intellectual properties invested in any work. In sum therefore, Radio IMERSD is explicitly created to focus on the original contributions of creative collaborations between students, academics and guests, performers and composers, philosophers and researchers.

Technical Infrastructure Challenges

The research into workflow, functionality and specific software titles was broken into three phases. The first phase was a functional trial phase where different types of software were categorised by functional type and injected into a workflow trial to investigate how they suited or suggested different workflows. This produced a secondary overlapping phase that investigated the efficiency and interconnectivity of different workflows – the workflow experimentation phase. Once a workflow had been decided on, the third phase of software assessment was initiated. This concluded with the implementation.

Certainly the most significant challenge to involving students in projects that include the ability for students to upload content is in satisfying any concerns of the network and network security group. To address concerns expressed by the group responsible for the University's networks a solution was devised that would allow restricted student access to a computer that was not directly serving content to the web. Understandably, academic staff are not in a position to be providing students with direct access to the streaming server. The solution was to separate out the various components and create a student accessible broadcast computer that housed the media files, media playback software, scheduling software, and the broadcast relay software. The broadcast computer would then relay a single audio stream to the protected web server that housed QTSS – the streaming server that the general public would connect to in order to listen.

A further complexity came in the need to IP delimit the streaming server so that the general public could not access the radio broadcast. This was for reasons of complying with Australian copyright restrictions by keeping the broadcast within the University network.

Conversely, we did not want to restrict public access to all other materials that we had full rights to use. These included our own work, podcast materials, research outputs, original staff and student works, and public lectures. The decision was therefore to create an environment where two servers were deployed – the first to host our websites and publicly accessible materials and the second to run QTSS and to limit public access to only those computers on the Griffith network (based on IP address therefore IP delimited).

This resulted in a distributed cluster of three machines: [1] the broadcast computer accessible by students; [2] the web server that hosted all web viewable content; and [3] the QTSS server that streamed the audio content to the IP delimited network.

At this juncture, an Apple University Consortium Innovation Development Grant that awarded two Apple Xserves afforded this research project the much needed resources to establish the viability of the project with respect technical resources.

PRAXIS - INTELLECTUAL PROPERTY

The challenges of managing copyrights and intellectual properties associated with publishers and composers are ones, as previously discussed, with a known resolution typically involving large amounts of money.

As above, other forms of intellectual property and therefore claims over copyright invested in a recording will include the composer's rights, possibly an arranger's rights, and certainly the performer's, recording engineer's and recording producer's rights.

A direct result of using only music / media created by QCGU staff and students is that the performers, recording engineers and producers are predominantly QCGU staff and students. This therefore transforms the challenge from one of sourcing, locating and paying for the rights, to one of managing the rights. The real issue is that where there might be a single composer, or a single publisher involved with a musical work, there can sometimes be up to 100 people in a large ensemble, a team of two recording engineers and a recording producer. All of these participants have a share in the intellectual property and therefore copyrights. All in all, there are 200 concerts a year, drawing from around 900 students and staff. There are, of course, very few sensible solutions, and ignoring this all and pretending it didn't exist was not an option.

The solution is in blanket waivers that everyone signs once during the duration of their employment or education at QCGU. This form grants QCGU a revokable, non-exclusive license to use any copyright material, image, recording and name, together with information about the individual's participation in QCGU initiatives, for non-commercial use by QCGU and Griffith University. The events administration take note of any performances involving external guests, and in instances where the guest is unable (e.g. contractual obligations) to sign the waiver, the performance remains unrecorded.

This establishes a base-level of freedom for the Music Technology department to function without a weighty administration load.

PRAXIS - FUNCTIONAL INTEGRATION

Following WWDC '04, a 12-month investigation was undertaken into various forms of content collation and dissemination including our already developing podcasting strategies. The strategies investigated included: socially constructed playlists (Hayes & Cunningham, 2001; Hayes, 2003); individualised audience-oriented playlists; juke-box styled media libraries; podcasting (Ben Hammersley, 2004), flycasting (D Hauver, J French - wedelmusic, 2001), and radio-styled non-interactive broadcast strategies.

Socially constructed playlists allow end-user access to a database of music files where they are able to construct and save playlists for their own enjoyment as well as share these playlists with other users. Software in this category was dismissed as this style of interactive software was in its infancy (Hayes & Cunningham, 2001), and creating the underlying technological infrastructure was a non-trivial task (Pachet, 2001), quickly becoming too demanding and inefficient. Software shortlisted for investigation included Jinzora Media Server, ZINF, RIMPS Party Net Radio and P2P-Radio.

Individualised playlist strategies were thoroughly investigated but eventually dismissed because they tended to require more audience commitment in terms of searching, filtering, sorting and compiling. Further, the underlying hypothesis behind dismissing this approach was that the audience who were prepared to invest the time required in developing personalised music playlists were primarily people browsing digital libraries in order to access or find music from commercial music libraries. Software shortlisted for investigation included Pleiadian Broadcast, PHP Music Serve, X Audio Database and TINAR.

Juke-box styled media libraries also afforded the creation of individualised playlists and were dismissed for similar reasons. Further, most of this sort of software was intended for smaller scale and scope than the Radio IMERSD project demanded. Software shortlisted for invesigation included NetJuke, JukeMote, Scism and Mp3Act.

Radio Styled Broadcast software. This was quickly broken down into three separate components: [1] playlist management and scheduling software (including RadioLogik DJ, Backbone Radio and Megaseg, Theis Playlist Manager); [2] software that could be used as a Broadcast relay (including

QuickTime Broadcaster, ShoutCast, IceCast and Nicecast); and [3] Streaming software (QTSS). As a result of the existing resources and widespread use of Apple hardware and software in the Music Technology area the streaming software was chosen to be Apple's QuickTime Streaming Server (QTSS). All other decisions were therefore influenced by their ability to function in conjunction with QTSS.

Significantly, a common thread was beginning to arise throughout the functional trial phase. Many of the open source projects were showing a lack of development activity and maintenance, and projects of a similar nature appeared to suffer similar technical blocks and issues. It started to become evident reasonably quickly in the functional trial and workflow experimentation phases that a single large piece of complex software would not present a viable solution. What was needed was a collection of specialist components that could be swapped out if one of the elements proved ineffectual or problematic.

As a result the sustainable long-term approach was to create a distributed component architecture comprising a small number of carefully targeted but functionally decoupled elements. This meant that the functionality for each component could evolve without impacting the rest of the overall system, and that each component's function was of a specialist nature rather than one system trying to be everything to all people. Additionally, an emphasis on open source software was retained wherever viable.

RADIO IMERSD STRUCTURAL FORM

At the heart of the Radio IMERSD architecture is Apple's iTunes. Playlists are created in iTunes, currently 5 different playlists: Classical; World; Jazz; Mixed Bag; and Contemporary. These playlists are shared on the local network to enable students and staff to access individual media files throughout the Music Technology area in an on-demand basis. These five playlists then populate the media player, event handler and scheduling software, Megaseg.

Megaseg was chosen for its ease of use, simplicity in accessing a rich range of features, and because it targets the niche requirements in the overall chain of distributed components. This software handles: the playing of the media; events such as timed rotation of playlists and randomisation of playlists to ensure appropriate separation and grouping of tracks based on sets of rules; schedules where playlists are generated based on a set of user defined rules using file based meta-data such as Genre; and the creation of log files using html templates that are used to populate the "now playing", "recently played" and "coming up" pages on the Radio IMERSD website. Importantly, the template-based log file allows the needed flexibility to adhere to the 1998 Digital Millenium Copyright Agreement, where a webcaster must identify the title and artist of each song played while not announcing any more than three songs in the scheduled upcoming playlist (RIAA, 2009).

The Megaseg logfiles are saved into the Broadcast machines internal webserver, and are then piped over SSL using a php script to send them to the web server. The audio output of Megaseg is not sent to any specific location but is instead "hijacked" by the next piece of software in the chain, the Broadcast relay software. The software utilised for this is RogueAmoeba's Nicecast.

Software investigated for the broadcast relay component included Icecast, Shoutcast, Nicecast and Quicktime Broadcaster. Nicecast was chosen because of its rich set of features, incredibly easy setup and its ability to communicate seamlessly to a password protected QTSS. Nicecast is effectively a graphic User Interface (GUI) wrapper for the Icecast GPL streaming media server, and as such is capable of streaming directly to the web without QTSS. While Nicecast is very capable of streaming to the web without further software, in the testing phase it was noticed that over 20 listeners placed a noticeable strain on the Broadcast machine's CPU and the bandwidth usage started to impact negatively on the local area network. Further testing showed that using Nicecast to relay a single data stream to QTSS resulted in regaining desired efficiencies in machine and local network performance.

Finally, there was the question of how end users would access the radio stream. It was clear from my research and data-mining of server log files that our growing listener-base were not always using up to date browsers or the latest technology. Further, assumptions had to be made as to the technical skills of potential listeners and a decision subsequently arrived at to provide an in-browser single-click player that did not require the end-user to navigate any complexities with having to download and use 3rd party software to access the web stream. The solution arrived at was a small flash mp3 player that was able to make a call to the QTSS web address as its audio source rather than an .m3u playlist file. Software shortlisted for investigation included Aqua, Cosa, Flamplayer, n04a, Wimpy, JW Player and Flash MP3 player.

The technical data flow is represented below in Figure 1 – Distributed Component Architecture.

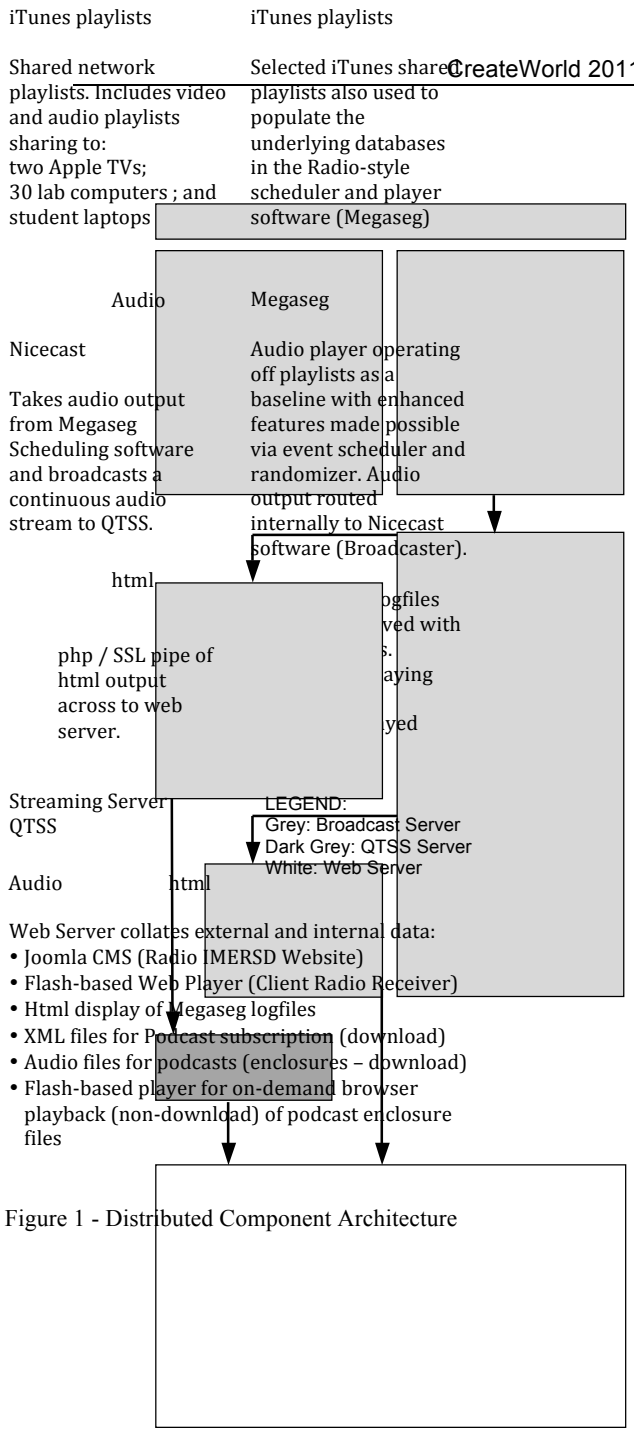

Figure 1 - Distributed Component Architecture

CONCLUSIONS

The Radio IMERSD project has had some success, but is still yet to realise its true potential. As highlighted previously the objectives that informed the structure of Radio IMERSD are: *public exposure*; through *flexible and open access*; to *original content*; profiling *research*; and *learning and teaching*; where the project as a whole is used as a foundation for student learning around the concept of *professional practice* with *industry relevance*.

Successful outcomes to date include:

- Providing public exposure to work, research and learning and teaching contexts at QCGU;
- The establishment of a distributed component architecture that provides easy and open access;
- A broad selection of original student, staff and collaborative work;
- An enhanced overall awareness in students and staff of the existence of complex intellectual properties, and importantly for many, what their rights might include as a performer.

The first three are self-explanatory. The last point, enhanced overall awareness, comes as a by-product of the creation of the blanket waivers. A central component to the use of the waivers is an informed consent session carried out in Orientation week each year for first year students. This session highlights students' rights as performers, composers, arrangers, recording engineers and producers, as well as outlining the basics of intellectual property and copyright as it pertains to them as developing professionals. No research has been undertaken into the impact this has had on the students, however anecdotal conversations with some students demonstrates a much deeper level of respect from these students for the complexities of intellectual property and copyrights.

Longer to gain traction has been the integration of the project itself into the pedagogical landscape. Small groups of students have been involved in the operation and management of the podcasting and web streaming portions of Radio IMERSD however a more widespread connection is only now starting to be realised.

As stated at the outset, one of the more prominent cross-year and cross-disciplinary team activities in the Music Technology area is that of live Concert Recording. A new course has been created for inclusion in the program from 2012. This course is titled *Professional Recording Projects* and will draw on research outcomes from the development of Radio IMERSD (research-led teaching) as well as use the technical infrastructure of Radio IMERSD as a generative practical opportunity for the social construction of knowledge, negotiation of meaning and expanded learning opportunities. Not only will this course embed copyright issues as part of the practical and theoretical aspects of digital music's "new role as a strategic necessity", but it raises closely linked issues for consideration, educates the students to the complexities, and points them toward information on solutions.

The course description for Professional Recording Projects follows:

This course is an elective offering for students interested in the live recording and production of musical works for CD, DVD, film and/or game soundtracks and broadcast contexts. Students will also be introduced to the handling of various rights associated with the creation of professional quality and commercially viable products, including performance rights, copy rights, intellectual property rights, arrangement rights, production rights attribution rights, and how to negotiate these with the various bodies that manage these rights. While the focus will be on Australian organisations such as APRA and AMCOS, international perspectives will also be addressed within this course.

Finally, from a technical perspective, the underlying distributed architecture has meant a level of ease and flexibility in responding to technical issues because issues in the technical workflow are easily isolated and rectified. Further, as one component is updated it can be replaced in the chain without having to modify other components that surround it. This simplicity has meant the project has been remained viable, and therefore sustainable, with a team of one person.

In order to move forward however, a level of interconnectivity that allows students a greater connection with all aspects of the workflow is required. This suggests a move away from a distributed architecture for the submission stages into a purpose built solution, or possibly a software 'wrapper' such as a CMS with a modularised sub-structure that allows a publishing workflow to be fully integrated from start to finish. A concept map for the all-important submission stage is depicted in figure 2 below, the concept map for a rich-media enabled web portal that would feed the front stages of a coherent online process.

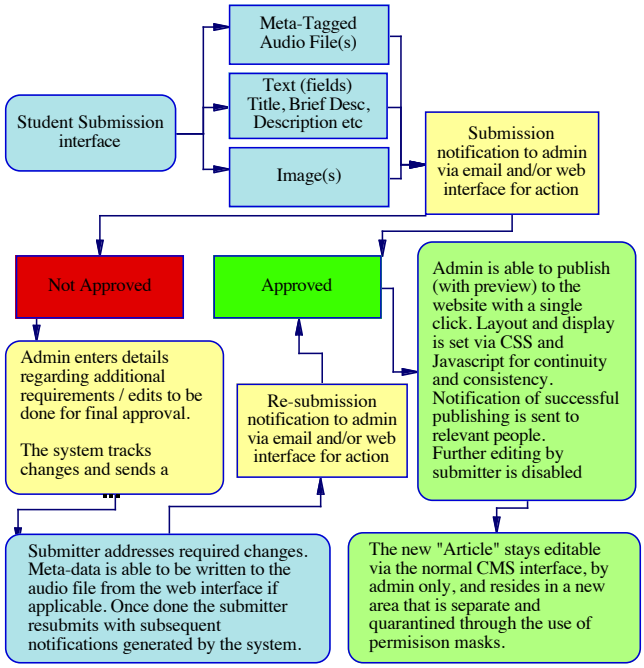

Figure 2 - Concept Map for Submission Portal

ADDENDUM

(name) and (name) gratefully acknowledge the support of the Apple University Consortium in making this research possible through the Innovation Development grant awarding the Music Technology department at QCGU two Apple XServes for experimentation and research purposes.

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“Define <Colon> Pedagogy”: The use of digital research environments in undergraduate teaching

The Research Methods course in the school of English, Media Studies and Art History at The University of Queensland is a cross-school final year course that has recently been redesigned to incorporate a high level of digital resource use with assessment tasks that include the creation of digital objects using software developed through a grant funded project, and Wikipedia entries. In recognition of the fact that digital literacies are increasingly required in contemporary scholarship (and more generally) we believe it is important to give students on the cusp of entering post graduate studies (or employment) the skills to deploy digital era research strategies alongside knowledge of traditional research methodologies.

Apart from a fairly low level use of Blackboard (a university requirement) this course eschews closed commercial teaching and learning systems, utilizing instead research environments and datasets that have been developed through real scholarly research projects. The assumption that students are savvy web users is questionable when it comes to scholarly resource use and creation. The Research Methods course introduces students to the way digital era scholarship is undertaken in the humanities by working with and in scholar-created resources and environments from the fields of literary and film studies, cultural studies, media studies and digital humanities. Students are also given guidance on becoming discerning users of web-based resources while guest lectures from active researchers in both digital and tradional scholarship expand their thinking further.

A key component of this course is working with original archival and manuscript material held in UQ Library’s rich Australian collection. Students learn about preservation issues, copyright, digitisation, methods of presenting and analysing historical material in digital environments, and where archival material fits in research practice. From this hands-on engagement with material objects, which often represent the remainders of lives and careers, students produce digital artefacts that are assessed against a range of criteria. By contributing a group-derived Wikipedia article, with high level scholarship demands, and the students’ work has a lasting

value beyond the duration of their undergraduate education.

This paper will discuss and demonstrate the ways that students have engaged with these creative learning methods over the past two years, presenting the results of student surveys of the course, the assessment items produced, and our own growing understanding of what is and isn't working in a course that blends contemporary Digital Humanities research practice with traditional humanities practice.

Bio: Kerry Kilner is a lecturer in the School of English, Media Studies and Art History at the University of Queensland in Australia. She convenes the Research Methods course and is Director of AustLit: The Australian Literature Resource which supports research and teaching in a wide range of Australian narrative studies. She is interested in the use and creation of open access resources such as Wikipedia in research and teaching.

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Windtraces: Accessible Sonic Art

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Kirsty Beilharz, The Universtity of Technology at Sydney

Abstract

Windtraces is a multi-channel, site specific sound installation which will be exhibited as part of the Sculpture by the Sea exhibit in Sydney in November, 2011. It uses data from meteorological sensors as inputs to algorithmic processes, which generate a dynamic soundscape in real-time. We describe its development from practical, conceptual and artistic perspectives.

Introduction

Sculpture by the Sea is a large-scale art exhibition[1] that takes place each year on the coastal path between Bondi beach and Tamarama beach in Sydney. It is a free event and each year it attracts almost half a million visitors. This year, it includes our site-specific installation entitled *Windtraces*, which is a multi-channel sound installation. It comprises a set of 16 loudspeakers distributed across a steep rock face, emitting sounds generated by algorithmic processes which themselves are controlled by sensor data relating to meteorological conditions at the site. In this paper, we describe the work from conceptual, practical and artistic perspectives. We begin by discussing the Sculpture by the Sea context and the specific site for our installation, and how they have influenced our artistic and technical choices. We then discuss the artistic motivation and historical context of our work in terms of artistic sonification and spatial composition. Next, we give the technical details of the *Windtraces* installation, before discussing related weather-driven installation work.

Context and location

The Sculpture by the Sea project was motivated by the scarcity of "seriously enjoyable cultural activities that are free and not fringe" and Sydney's "need for an accessible visual arts event" (Handley, 2011). With respect to the aim of creating a popular and accessible public art event, the project has undoubtedly succeeded (Stenglin, 2007) and this is evidenced by its longevity, its consistently high visitor numbers and its re-creation at other locations (Scarlett, 2009). In creating *Windtraces*, we aimed to make the connection between weather conditions and sound intuitively understandable to visitors while allowing for great variety in sonic output. This is discussed further below.

One of the reasons for choosing the Bondi-Tamarama coastal path as the location for Sculpture by the Sea, was the abundance of natural plinths in the rock formations nearby (Handley, 2011). However, certain locations are not suitable for locating object-based art works, since they have no large flat surfaces and no destructive attachments to the rock are permitted. One such location is at the north side of Tamarama beach (see Figure 1a), where there is a steep rock formation approximately 11 metres in height and 12.5 metres in length (see Figure 1b). This is the location for *Windtraces* which, rather than being an object-based work, comprises a set of 16 loudspeakers distributed across the site in the crevices and fissures of the rock.

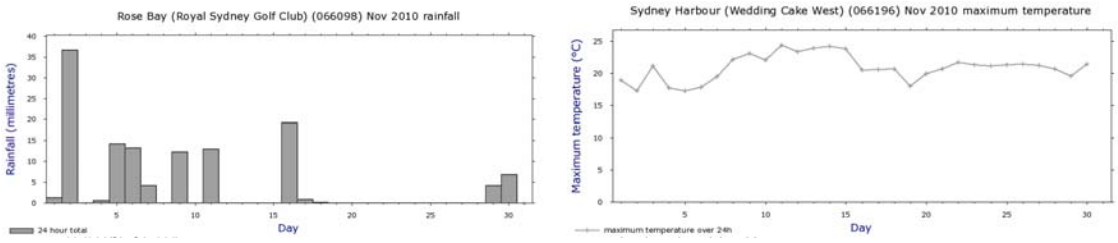
[1] www.sculpturebythesea.com

Figure 1. (left) The location of the Windtraces site and (right) a photo of the site

The site for *Windtraces* is particularly challenging as a location for an audio installation because of environmental noise from the sea, the wind and from human activity. The noise can vary greatly in its type and level, both of which depend on weather conditions and other factors. Of the weather conditions in the area, the founding director of Sculpture by the Sea wrote: "On top of this physical variety is the added effect of the weather, with everything from gorgeous calm days to stormy windswept cliff tops and huge seas" (Handley, 2011). Our response to the variety of weather conditions and their associated noise characteristics, was to use the weather to control the sound produced by the installation. In this way, the natural weather sounds could be used to support the artificial ones produced by the installation, rather than potentially render them inaudible.

Weather conditions at the site

In order to investigate the use of local weather conditions to control sound generation in the installation, we studied historical weather data from locations near to Tamarama beach. Since Sculpture by the Sea takes place in November, we looked at data recorded during November in previous years. Figure 2 shows data obtained from the Australian Bureau of Meteorology, which were recorded during the month of November, 2010. There is no climatological station located at Tamarama beach, so according to availability, we chose data from locations as close as possible to Tamarama: Rainfall data are from the Rose Bay station and temperature data are from the Wedding Cake West station.



(a) **(b)**

Figure 2. (a) Daily rainfall at Rose Bay climatological station in November 2010 (0-40 mm) and (b) Daily maximum temperature at Wedding Cake West station for the same period (0-26°C)

While Figure 1 only shows two of the meteorological measurements used in the installation (see below), it illustrates a number of features of weather data which we have taken into account when designing the way in which it is used to control the sound output of *Windtraces*. First, while large changes are possible from one day to the next (shown particularly by the rainfall data), there can be long durations of consistent conditions. This means that individual indicators cannot be relied upon alone to generate variety. Related to this, we note that meteorological measurements are not

necessarily representative of perceived conditions: two days showing identical temperatures may have been quite different, because of other factors, such as wind, or relative humidity. Another feature apparent from the weather data we studied (but not shown in Figure 1) is that November weather is not consistent across different years. For example, the number of days with more than 5 mm of rain in 2010 was 8, whereas that in 2009 was 2. We have taken these observations into account when designing the ways in which weather data influences sound generation in *Windtraces*.

Artistic Considerations and Context

Windtraces is a sonification work because it preserves a strict, factual relationship between the source data and its representation through a series of mapping processes. The range, values and data trends derive directly from site-located sensors. In addition, one of the most striking features of our Sculpture by the Sea site is its spatial structure: There is a curving, contoured overhanging rock face with reflective concave surfaces, as well as undulating horizontal axes. From our initial conception, the spatiality of the site has been directly tied into the spatial rendering and perception of the work.

The idea of *tracing* alludes to both the spatial tracing of the rock, and also the *Windtraces* of ephemeral weather data. The *tracing* element and time-based calculations allow us to present both an audible revelation of the current state, which is the aural representation of what someone might feel at the site in the environment on their skin, as well as less obvious informative deductions (history and forecast) that rely on information about elapsed events. Part of the immediate *(gestalt)* and engaging understanding depends on the listener 'hearing' what they are 'feeling' as a gateway to hearing things beyond what can be immediately perceived in the environment. Thus, as sonification, the objective is both to make audible the invisible and to offer an informative interpretation. The real-time (live) sonification of data captured by the weather-station located at the site allows an immediacy of representation and rapid responsiveness that aims to make the sonification meaningful and apparent to the transient and general audience who may have no technical experience of auditory display of data, i.e. the dynamic information representation should be interesting and explicit to the lay public audience.

Sonification in the context of public installation

Most typically, sonification is employed by people who have expertise in the field of visual analysis and graphing techniques or in the subject of the data being sonified, or both. We aimed to design sonification which, while having aesthetic and informative qualities, would be suitable for consumption by non-experts in the public domain. In order to achieve this, we took the following considerations into account. The first is contextual to the site. *Windtraces* is installed in a public thoroughfare, which has the advantage of catching many passers-by but also is characterized by an ephemeral and moving flow of pedestrians who may not have much time in which to stop and interpret the representation. Thus, immediacy of engagement from an artistic perspective, and intuitive or *gestalt* understanding of any informative attributes, are requirements. The second consideration is the result of a potentially non-expert, non-analytical audience, for whom the artistic potentials (variation, trends, dynamicism, time-of-day fluctuations, non-repetition, and an insight that the work's sound is site-specific and generated in real-time, i.e. responsive and ever-changing) are the critical features of the data that the *Windtraces* installation aims to convey in a brief encounter.

The infinitesimal variety of individual tastes and reactions are difficult to anticipate in such a situation, however, we have selected rhythm and spatial movement as two

rapidly communicating and intuitive means of mapping that may be easier to assimilate than, for example, fine graduations of pitch-mapping. Accessibility or availability is important for peripheral or ambient visualisation and sonification contexts. *Ambient visualisation* (of which sonification or non-visual visualization is a subset) operates on the premise that the viewer/listener should be able to catch the 'gist' of an idea and immediacy of information without full attentive and analytical thinking. Changes and trends can be observed at the periphery of our attention, which suits the beach-side setting and the possibility that certain people may be positioned alongside the installation for a long period of time, while others are simply walking past. Ambient visualisations/sonifications usually have decorative qualities and lend relatively high importance to aesthetics of the design due to their being interpreted as smart furnishings, intelligent wallpapers, informative interiors, smart building façades, or in this case audible landscaping, i.e. artistic elements as well as highly functional ones.

For both scenarios, the balance between engagement and invasiveness or annoyance is a sensitive one for public contexts. This context also affects our choice of the 'type' of sounds, their rhythm and location more than any kind of melodic representation. We have chosen to use a variety of short, staccato sounds because they effectively convey rhythmic information, they are more easily audible in the presence of environmental sounds, and they are especially suitable for conveying movement when repeated sequentially in different loudspeakers (see the next subsection).

In Windtraces, the spatial movement of sound is controlled primarily by wind-related parameters (speed and direction) whereas the choices regarding the sense of key (tonality) and timbral quality of the staccato sounds are controlled by data from other sensors in ways which are mindful of the generalist audience.

Spatial composition

Post-war, twentieth century contemporary music has many examples of works which integrated sound design with the spatial distribution of loudspeakers in a site-specific context. Edgard Varèse *Poème Électronique* was composed specifically for its first performance the multimedia Philips Pavilion of the 1958 Brussels World Fair. The pavilion consisted of a series of hyperbolic paraboloids tensioned by steel cables. Iannis Xenakis' audio-visual work, *La Légende d'Eer* (1977-78) is a site-specific spatial audio work (Xenakis, 1995). From these early but seminal examples, we have taken the inspiration of site-specific sound *paths* (traces) and a pointillistic speaker distribution following curving contours, which in our case are the flowing natural sandstone rock surface of the cliff-face at Tamarama beach.

In *Windtraces*, loudspeakers are treated as point sources of sound in a spatial configuration, rather than as an array to be audited from a singular privileged position (the 'sweetspot', as occurs in Wavefield synthesis for example). The practical reason for this is that our audience is likely to be dispersed as well as in motion. Though wavefield synthesis has been used in an installation setting in this sort of scenario (Leslie et al., 2009) the most robust (if somewhat restrictive) way of presenting spatial audio is by treating each loudspeaker as a point source: A sound is played from one speaker at a time. In this case, there emerges a composition element in which spatial audio functions as a *gesture* with two spatial attributes: position (location), and motion (the current location of a sound with respect to its previous location).

The *Windtraces* Installation

In this section we give details of the hardware and software components of *Windtraces*. We then describe how instantaneous data from meteorological sensors is used to control the sound output by the installation.

The technical set-up for *Windtraces* is as follows (see Figure 3). Local meteorological conditions are sensed using an Oregon Scientific[2] WMR100N weather station with its standard sensors and an additional solar radiation meter (Oregon Scientific UVN800). The weather station is connected to an Apple Mac Mini. The Mac Mini is running three pieces of software concurrently. The first is Weathersnoop[3], which is a commercial program for collecting data from a connected weather station. The second is the Windtraces generative software (WGS), which controls all sound generation and spatialisation in the installation. The third piece of software is an instance of the Windtraces synthesis software (WSS), which synthesizes eight channels of audio, as directed by the WGS. A second instance of the WSS is run on a second Apple Mac Mini, connected to the first by Ethernet. Each Mac Mini is connected to an 8-channel sound card, so that 16 channels of audio are output in total. These are amplified by a set of three 6-channel amplifiers (Ashly Powerflex 6250; 2 amplifier channels are unused) and output by a set of 16 JBL Control 25 weather proof loudspeakers. In the following subsections we discuss how the WGS and WSS modules use the sensor data to generate sound.

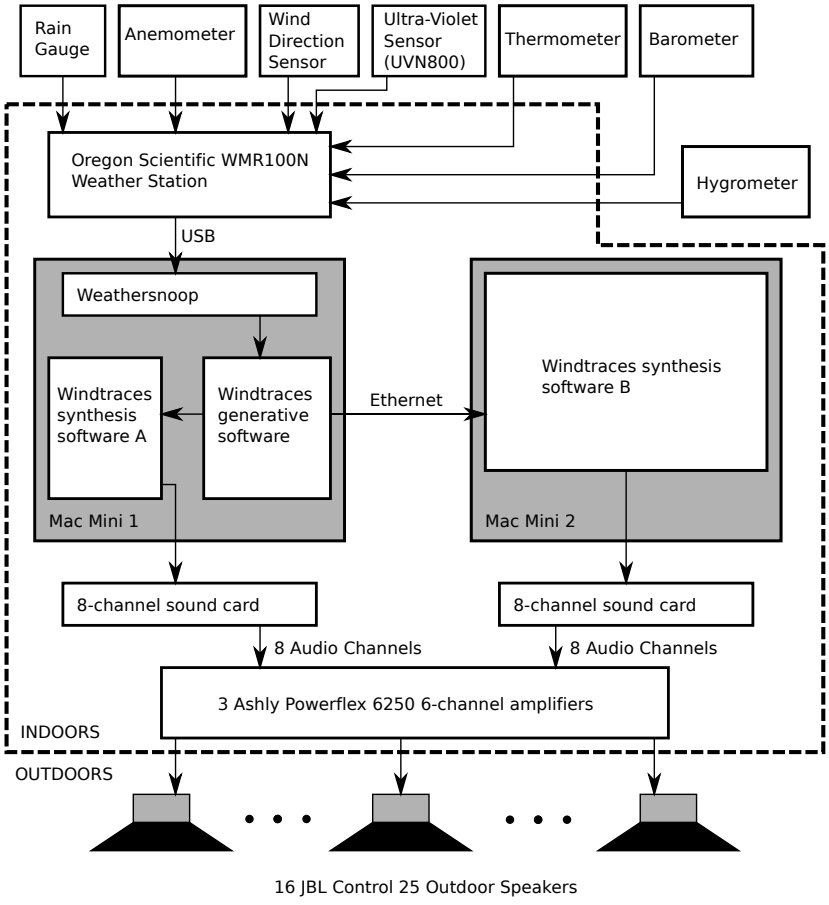


Figure 3. The hardware and software infrastructure for Windtraces.

[2] www.oregonscientific.com.au
[3] www.tee-boy.com/weathersnoop

Mapping from weather data to sound material

The WGS and WSS were developed using the Max interactive platform[4]. The WSS simply plays back short recorded according to instructions from the WGS. The instructions relate to timing, choice of sample, processing of sample and the loudspeaker from which to play it. Timing and loudspeaker choice are controlled mainly by wind-related parameters (see next subsection).

The sample and audio processing parameters used are chosen by mapping data related to daily and instantaneous rainfall, instantaneous ultra-violet radiation intensity, local temperature, pressure and relative humidity. In order to draw concrete connections between sounds and weather conditions, we calculate perceptually-informed quantities from this data, such as heat index (Steadman, 1979). This quantity is more closely related to perceived temperature than a simple temperature measurement. In addition, we use numerically-derived, categorical representations of weather conditions ('hot and sunny', 'windy and cloudy') to choose between different collections of sound material. This ensures that different conditions result in clearly distinct sonic results.

Spatialisation

In *Windtraces*, the movement of each sound across the rock is controlled by a finite state grammar (see, e.g. Roads 1979). As mentioned above, the loudspeakers are located in the crevices in the rock surface (Figure 4a). These crevices form natural contours and it is the play of the wind in these contours that we hope to evoke with the spatial movement of sounds. Thus, when a sound is introduced, it is played from a particular loudspeaker. It is then played from a nearby loudspeaker, and then another, so that its movement follows a path around the rock. These paths are probabilistically chosen by a finite state grammar. A representation of the grammar is shown in Figure 4b. Each state corresponds to a particular speaker, and it is connected to one, two or three other states. There is a discrete probability distribution associated with each state, which describes the probabilities of subsequent states.

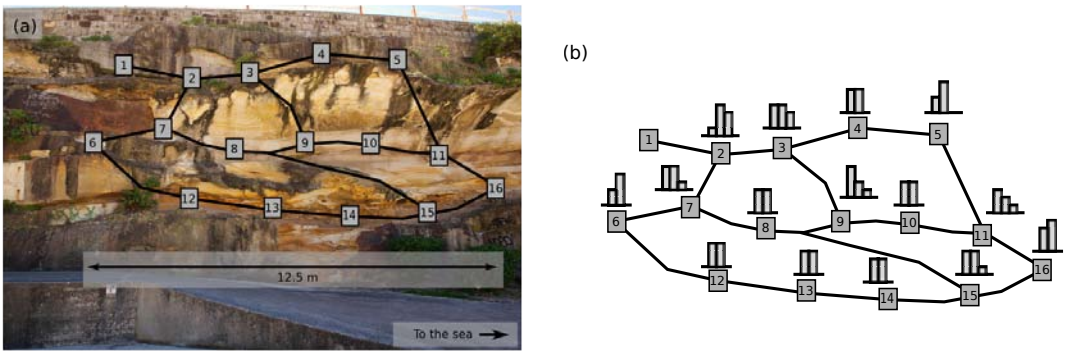


Figure 4. (a) Speaker locations on the rock surface, and (b) a finite state machine showing the correspondence between states and speakers, and an example set of probability distributions.

Each wind direction is mapped to a set of probability distributions. For example, when there is a sea breeze (i.e. coming from the right hand side of the picture in Figure 4a), the probabilities are configured so that sounds tend to originate from loudspeakers on the right and move left.

[4] www.cycling74.com

The wind speed is mapped to two control variables. First, it is mapped to the interval between the time that a sound is played from a speaker, and the time that it is played from the next speaker. Second, it is mapped to the speed with which new sounds arise.

From preparatory studies using this algorithmic control and speaker configuration, we have found that a variety of different types of movement can be evoked using different time intervals and sets of probability distributions. It is possible to create clear wave-like motions, going from one side the other, as well as complex scenes with many sounds following their own random paths around the network of speakers.

Discussion

A number of recent works have featured data from meteorological sensors. *Variable 4* (Bulley and Jones, 2011) is an outdoor, weather-driven sound installation that has been presented in a number of locations. It uses the local weather conditions to control a "conductor process" which navigates through a two-dimensional grid of musical states, each defined by harmonic and tempo-related attributes. Low-level algorithmic processes, such as Markov chains and L-systems, are used to generate note-level musical material.

The *Weather Tunnel* installation exhibited at the Translife 2011 New Media Art exhibition (Melvin, 2011) housed a number of installations that used weather-related sensor data. It included *Weather inflections*, an interactive audio installation that allows a user to interact with historical meteorological data gathered at Perth, Australia. Additionally, it housed the *Electromechanical Solenoid Orchestra and Weather Ensemble* uses a complex array of actuators and solenoids to create music, based on real-time data from globally distributed weather sensors.

Like *Variable 4*, our work uses real-time meteorological data with sensors located at the site of the installation. However, rather than to produce weather-influenced generative music, our aim is to produce sound whose relationship to the local weather conditions can be intuitively understood by the listener. One of the main aspects of this relationship is the connection between wind behavior and the pointillistic movement of sound between loudspeakers, which are located in the natural fissures and crevices in the rock.

Conclusion

In this paper we have presented the design of *Windtraces*, a site-specific sound installation that will be exhibited on Tamarama beach, Sydney, as part of *Sculpture by the Sea 2011.* We have aimed to make the work intuitively understandable, in keeping with the themes of the exhibition, and dynamic, so that a variety of sonic experiences might be had by a repeat visitor to the installation, according to the weather conditions.

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Spatializing Music at the Academy

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Abstract

This paper outlines the technical, historical and aesthetic approaches to the electronic and electroacoustic production of spatial music currently utilized in teaching and learning at WAAPA Composition and Music Technology, Edith Cowan University. A distinction is drawn between 5.1 and other surround sound industry standards for DVD Video production and the compositional concept of spatial music as it has developed in electronic music over the 20th century. The entertainment industry notion of surround sound is generally targeted toward multichannel soundtrack production for cinema and home entertainment audiovisual systems, along with a growing market for the multichannel music and gaming DVD. Spatialized music composition on the other hand has developed from acoustic and multichannel electroacoustic performance as well as sound art installation. The modern composer must creatively negotiate the aesthetic and practical differences between these entertainment industry and new music approaches in an increasingly multichannel world. With this creative innovation in mind, several multichannel models will be examined that extend the notion of the stereo field of perception as it applies to contemporary music practice.

Using iPad2 to assess students' live performances and actively engage students with tutor and peer feedback

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Abstract

Assessing student live performances can be challenging because markers need to make quick and often complex judgements about the learning. This is further challenged if multiple markers are involved and moderation of marks is required between markers. Maintaining fairness and validity can be a significant issue.

Ensuring a quick turnaround time for feedback to students is difficult because moderation practices usually require the sharing and review of performance videos by each marker. In addition, compiling marks, sorting and distributing marks and feedback to students often delays this process.

Imagine a digital tool that streamlines this assessment process by enabling each marker to review videos of performances online shortly after the performances have finished. In addition, the technology automatically sorts, collates and sends the marks and feedback to individual students freeing up time for the markers to engage with the professional aspects associated with quality assessment.

Literature is abundant with references of digital technology which is used to automate scoring and marks (Clarke-Midura & Dede, 2010), however, use of digital technology in this project does not replace the marker. Instead, it provides the marker with a tool with which to conduct and easily record rich observations of complex learning and it does so in a paperless, highly efficient and engaging way.

This paper describes a two phase, qualitative, action research project that trialled the use of an innovative, digital technology supported, assessment tool designed to improve the efficiency and effectiveness of assessment and moderation of live performances. The digital assessment tool enabled students to engage with the assessment and feedback from tutors and peers multiple times. The project was initially trialled with 170 Bachelor of Education students (in phase one) and then 200 (in phase two) enrolled in an arts education unit in the third year of their course.

Keywords – digital assessment, iPad2, peer assessment, cloud

Introduction

Our students are Bachelor of Education pre-service teachers. When they graduate, they will teach across all the curriculum areas and work with children aged from 4 – 13 years. The students are required to study visual art, drama and music in the third year of this course. They are assessed in a range of ways, one of which is through short dramatic live performance which they prepare and present collaboratively with a group to showcase their artistic skills and learning.

Ensuring that the assessment of a large number of groups is effective and efficient while underpinned by the principles of being fair, valid and consistent is a significant challenge. This was particularly so because it involved three markers (who were the tutors) marking the same performances simultaneously. Each marker assessed against the same criteria (creativity, skills, group work) but within a different art form (art, music, drama) which in turn has its own content.

Performance based assessment is specifically chosen for these units as it is best suited for assessing our students' complex intellectual and psychosocial knowledge and skills (Clarke-Midura & Dede, 2010). The challenge of capturing deep learning and recording the required evidence that has occurred is particularly problematic where the performances are short and ephemeral; such as a speech, a song, a dance or a play. It

is easy for markers to get distracted by the need to write/type to record information about the learning *in situ* (often in low-light conditions) or the need to communicate with other markers to discuss immediate impressions. These types of activities during performance often distract both markers and performers and increases inaccuracies in marking because the markers have to frequently take their eyes off the performance.

The challenge of providing timely feedback to students after the performances is crucial as research shows that formative feedback soon after the performance is far more effective than if it is delayed (Wiggins, 1993). The challenge of giving feedback to large numbers of students in a relatively short timeframe was significantly delayed by the 'behind the scenes' process we had. This process included the scheduling of face to face moderation meetings with markers, manual sorting and amalgamation of assessment records from the three markers, as well as printing and distributing feedback to students. Transferring individual student's marks from spreadsheet records onto marks submission forms created 'busy-work' type of workloads for the markers which took time away from the more professional work associated with assessing which markers perceived as being essential to provide a higher quality of marking and feedback.

Quality of feedback is crucial (Earl, 2003) if it is to enhance learning. Yet, like many educators, we found that despite our best efforts, many of our students did not fully engage with the feedback that we carefully crafted for them. Instead, they seem focused on the final mark (McGuire, 2005). Students told us that they felt external to the assessment process because it was directed by the markers. Wren, Sparrow, Northcote and Sharp (2009) found that higher education students expressed greater anxiety and dissatisfaction with the assessment when they felt external to the assessment process.

Aims of this study

We sought to develop a more efficient and effective method of assessing performance-based learning where multiple markers and a large number of student groups are involved. Wireless access to marking keys during the performance and videos of performances embedded into each group's marking sheet available immediately afterwards and during the moderation process, offers the possibility of a more reliable and instant access to each marker's comments and results. Online communication between tutors during and after the performances can enable the assessment and collation of marks to be an expedited process. Marks and feedback can be distributed back to students with ease and in less time.

This new and innovative approach to assessment can also contribute to student learning by involving the learners in assessment *as* and *for* learning. This can be done by having them analyse videos of previous performances and explicitly discuss and compare the quality of learning evident in these performances. By analysing previous performances, students are also clarifying what is expected of their own performances. This is also relevant for when they partake in group based peer marking and moderation of live performances.

This effort for 'digitalising' the process of assessing performance is a two phase study. We have now completed both phases.

Phase one research questions were:

- To what extent can the marking of student performances be streamlined by allowing each tutor to instantly see each other's marks and comments at the time of marking (during the performance) and to enable tutors to communicate with each other via the web, rather than in person during the performance;
- How effectively can the moderation of performances be conducted via the web so that tutors do not need to have face-to-face meetings but rather review and modify their marking by communicating with each other via the web at times suitable to each tutor;
- To what extent can the feedback process be made more educative by embedding the video of each group's performance into the marking key so that students can view their performance and engage with the tutor's marks and comments which are placed directly beside the video;
- What is the impact on turn-around time for feedback and marks for the 'digitalised' process which includes having the marking keys and videos emailed to students?

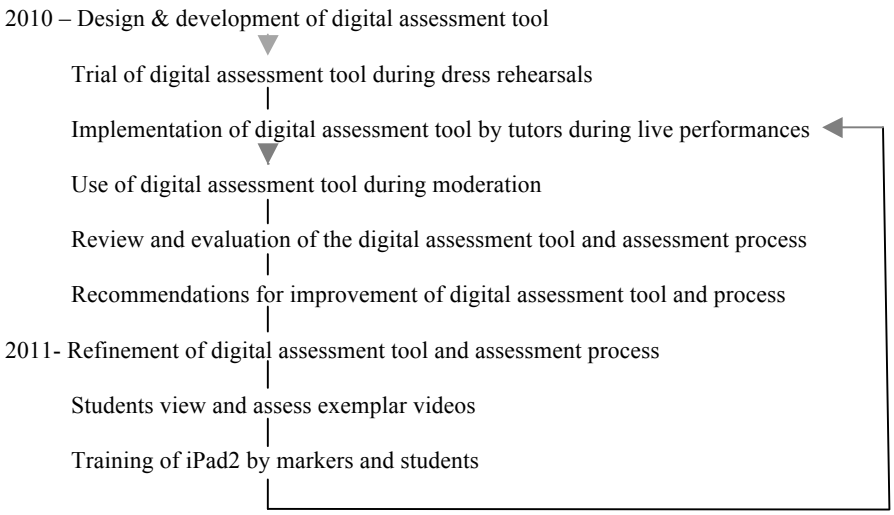
Phase two of research questions were:

- To what extent can mobile technology be used by tutors and students to enable them to safely (without cables) access best viewing points around the room during performances;
- To what extent can peers be engaged with the assessment process by being included in the live marking and to what extent is it technologically feasible to make their comments and marks instantly visible to tutors during the marking;
- How beneficial is it to enable the access and sharing of recorded videos to streamline the assessment process?

Methodology

We employed qualitative action research. Action research is most suited to this project as it requires the teacher/s to be the researcher/s, working collaboratively in a partnership with one another, the students and technical staff. All were to engage with critical analysis through reflection and to systematically collect evidence to bring about an immediate, innovative change to their practice to enhance learning of students (Cohen, Manion & Morrison, 2011; Wisker, 2001). A cyclical timeline was developed which involved the design, trialing, evaluating and improving the assessment tool. The project was evaluated throughout the semester with the coordinator, tutors and students being interviewed individually and/or through focus group discussions. The students also completed a voluntary online survey at the end of the semester.

Action research cycle over two years



Participants

Pre-service teachers
Phase one: 170 education students in the third year of a four year program in 2010.
Phase two: a new cohort of 200 third year education students in the same program in 2011. The students' performances were assessed in groups of 5 or 6 students. There were 28 groups in 2010 and 36 groups in 2011.

Marker/Tutor participants
The markers in this study were the tutors in the program. In 2010 the three tutors each taught a different aspect of the arts (music, drama and visual art). In 2011, the music and visual art tutors who taught in 2010 were teaching again, but the drama tutor was new. However, the previous drama tutor (although teaching elsewhere in 2011) was still involved with the reflective practices of this project.

The internet based assessment tool

Through the two phases of the project's action research, we were able to design, develop, trial and refine an internet based assessment tool. Reflecting upon and learning from our experiences in phase one of the project, as outlined in 'Improving marking of live performances involving multiple markers assessing different aspects' (Wren, Campbell, Heyworth & Bartlett, 2010), we came to the conclusion that we needed to be able to position ourselves around the performance room to gain best views of each performance for greater assessment accuracy. We found that the iPad2 provided us with an opportunity to trial portable technology. It also enabled incorporating student peer assessment. The touch screen technology of iPad2 enabled tutors and peers to quickly record information by tapping the screen to highlight a box on a rubric and also copy/paste comments from a comment-bank eliminating the need to take eyes off the performance for relatively long periods of time during which time a key aspect of a performance might be missed. The marking key also provided a space for each of the markers to type in additional comments if needed which, communicated feedback to the learner that was specific and critical to their point of need. Quality and precise feedback enables better communication about the learning (Absolum, Munro-Keene & Phillips, 2009) and enhanced motivation towards the learning (Denton, 2001). These comments were generally quickly captured immediately after the performance and refined afterwards.

The Internet-based assessment tool functioned as a password protected marking key with criteria specifically based on the unit outcomes, which were made explicit to students throughout the assessment process. Where the links between the learning and expected outcomes are made explicit to learners, the quality of learning is improved (Brunvand, 2010).

Each marker had instant access to all running totalled marks throughout the marking process. Information was automatically saved so they could also instantly access comments from other tutors and the peer group. In addition, at the tap of a finger, a marker had access to the whole cohort data spreadsheet where they could view each of the assessment criteria marks as well as total marks. This enabled individual markers to compare how they are marking from group to group and in comparison to the other markers. Access to these spreadsheets was usually made during the time immediately after the performance and later during moderation more so than during the performance.

The digital assessment tool imports the names of all students from the central university system and groups them according to their predetermined group number. It then instantly allocates the group marks to each individual in that group. The spreadsheet is downloaded and copied into university spreadsheets in the matter of minutes ensuring no human errors are made in the transfer of marks.

The peer groups (of about 5 individuals) sat together when assessing the live performance. They were familiar with the rubric content from previous work and could see it on the iPad2 while watching the performance. Groups chose to either share the responsibility of recording on the rubric by passing it around or they selected a leader to so. The peer assessing was in itself an assessed task. We needed a record of attendance and this was done simply and quickly by each group holding up the iPad2 and photographing themselves. The photo instantly embedded in the rubric alongside their names.

The students were not at any stage able to see the tutors' assessments but the tutors could see theirs. Having the tutors able to see the peer assessments sometimes gave the former insights into aspects that might otherwise have been overlooked. In a few instances, it alerted us to investigate these aspects further during moderation.

The tool enabled markers to begin the moderation process in the short breaks between performances. This was done via a confidential markers' chat box located on the digital assessment tool. As markers were frequently in different parts of the room, comments were posted by markers and instantly accessed by the others. This not only started the moderation process but recorded immediate and prominent observations which were recalled at a later moderation time. In addition, a few times during performances, markers could alert each other via this chat box to information about the group as was necessary.

The process of assessment using the digital assessment tool

As iPad2 technology was new to many, training on how to use the digital assessment tool on the iPad2 was scheduled for students and markers. We conducted 'dummy assessment runs' to test the assessment tool on dress rehearsal performances.

The assessment criteria measured the students learning in the arts units e.g. their use of 'creativity, artistic skills, group work and collaboration'. An elaborated explanation for the assessment criteria for music, drama and visual art was given to students two months before the performance. It explicitly detailed the evidence of learning at various levels of achievement. The students were provided with two 2010 video exemplars of performances of different standards with the permission of those student groups in the videos. This was done so that students had the opportunity to identify and make a judgement about the quality of learning these performances showed. They assessed the videos using Microsoft PowerPoint incorporating Keepad 'clicker' technologies (LUL Technology, 2011) during the lecture time.

For example: *How well did you understand the content and purposes of the performance?*

1. Unsatisfactory; 2. Satisfactory 3. Commendable and 4. Exemplary.

The process of assessing video performances engaged students in discussion about the criteria and assessment requirements. Seeing the trends and engaging with the tutors' commentary regarding expectations and assessment process enabled this assessment to be made explicit and educative.

The students' peer assessment rating scale on the iPad2 required the students to consider a different set of criteria to that of the tutor/markers. Their focus was less complex and more targeted at a specific set of outcomes. An example is shown below:

Student rubric			
The content and purposes were difficult to understand	The content and purposes were only somewhat understandable	The content and purposes were clear and understandable	The content and purposes were exceptionally clear and easy to understand
How well did you understand the content and purpose of the performance?			
Unsatisfactory	Satisfactory	Commendable	Exemplary
How convincing was the performance?			
Unsatisfactory	Satisfactory	Commendable	Exemplary
How well did the performers maintain your focus and engagement?			
Unsatisfactory	Satisfactory	Commendable	Exemplary
How well did the performers use all the arts aspects of visual, musical, sound & dramatic?			
Unsatisfactory	Satisfactory	Commendable	Exemplary

Rating scale used by students to assess peers' performances in 2011

During the two performance days, performances and peer assessments were scheduled so that every group had the opportunity to perform one week and peer assess on the other. The tutors assessed all groups on both days. Each video was then immediately separated from the rest and labelled its group number. At the end of the day, each video was compressed and embedded into the marking key. Markers had access to the password protected marking keys with the embedded videos within a short time. Markers moderated online at times convenient to each, over one week. They were able to communicate with each other via the chat box, amend their own marks and comments and view each other's marks and comments.

The process of embedding videos and converting the documents to PDF was done manually. However, collating marking keys from peers and tutors and emailing them to relevant individuals was automated using FileMaker Go (Filemaker, 2011) and this step required little time overall.

True to the nature of action research, the tutor-researchers engaged with ongoing reflection throughout the project cycles by discussing the research processes such as the intervention and the gathering of data. This engagement was done formally and informally, both in person and via email and phone. Notes were taken at these meetings and used to inform future actions.

Student surveys

The students were asked to anonymously complete a survey at the end of their peer assessment task and prior to receiving their marks and feedback. The survey asked questions about the whole assessment process; the use of exemplar videos to make the assessment explicit, the use of iPad2 for group peer marking and if they could see the application of the assessment Internet based tool in their own teaching practice with primary school children.

Results

Streamlining the assessment process:

The process of marking was streamlined because the Internet based tool automatically combined data bases from each tutor. Markers could quickly view how others were marking, what the group feedback and marks looked like and how the group being marked compared with other groups of their cohort. The whole cohort spreadsheet was accessible without delay at any time during and after performances. The data recorded by each tutor was automatically saved to a server and easily accessed from anywhere.

As well as the 'student view record' specifically designed for the students in their groups, the tool also provided a 'tutors view' of each record for drama, art and music. In this space, each tutor created their 'bank of comments' prior to and during the marking process. These comments were inserted in instances where the same comments applied to multiple groups.

The assessment tool enabled the streamlining of the process as it was paperless; busy work associated with preparing and distributing student feedback was eliminated.

As markers, we found that assessing 'in the cloud' on the iPads was highly satisfactory. We all liked the fact we could view each other's marks and comments at any time. We found that, for most part, we only looked at how each other marked after we had marked on our own. We kept notes about points that needed to be referred to later, particularly if the student peer markers noticed something we had not. We felt reassured that we could easily access and review the videos along with our assessments at any time and any place. We only reviewed the videos or parts of videos we felt we needed to. Doing so, did not significantly add to the time we spent assessing, though, as commented, the video touchstones increased our confidence in marking.

Typing on the iPad was a little cumbersome (one tutor had access to a wireless keyboard) but in a short time we got better at it. Several times the wireless connection was cut and it was reassuring that our work was being automatically saved.

Moderation via the web

The moderation process was highly effective as, in both phase one and two of the project, it provided the convenience of not having to arrange a face to face meeting. Moderating via the web provided us with the opportunity to engage with the moderation process on multiple occasions as we each logged on and reviewed the marking for varying periods of time when it was most suitable for individuals. As a result, all tutors felt that the moderation process was far more comprehensive than previously where we had limited times in which we could meet. The tutor chat box provided a confidential and silent method of communication between tutors during performance so it did not distract performers. It saved our comments to jog our memories later, so questions that arose *in situ* could be researched and addressed later.

Feedback to students

Majority of students, who responded, all reported that they liked their feedback returned to them electronically. They felt that "it is an incredible use of technology" (Student correspondences, 2010) and that it is unique and easy to access on and off campus.

Most of these students reported that they engaged with their feedback multiple times. Miels (1999) emphasises the positive effects and the value that is added to the learning when students are given multiple opportunities to view their videos.

The most common comment received, referred to students seeing value in being able to watch their own performance from the audience perspective and have the tutors' feedback beside the video for a quick reference. The video recordings of each performance provided visual evidence of the learning. For some students, this challenged or confirmed personal perception of how evident and explicit they had showcased their learning (Romano & Schwartz, 2005). The use of videos is common in performance-based assessment and research confirms their benefits to reflective and higher order learning (Brunvand, 2010; Ladson & Billings, 1998; Song & Catapano, 2008; Romano & Schwartz, 2005; Miels, 1999; Rich & Hannafin, 2009).

Some students reported that they shared their feedback with peers in other units as well as with family. For example,

> *The rubric and video were a fantastic way to present our marks. It was good to see what we looked like from the audience's perspective as it is so different when you are up on stage, also it is nice to have something to show for your work. The family all had a good laugh too!* (Student correspondence through survey, 2011)

Several students saw further potential of this electronic feedback and planned to present it as evidence of learning in their electronic resume. In phase two of the project, the students were surveyed on whether they could see themselves using this assessment tool in their own teaching. Over 90% indicated that they saw it as useful to them in multiple of ways. Some students provided a number of creative ideas which went beyond the arts. This level of engagement with their feedback is significantly improved. Prior to this project, evidence indicated that fewer students engaged with their tutor's feedback, with emphasis and interest mostly on the final mark.

In the subsequent arts unit, next semester, students will be encouraged to use this feedback from tutors and peers to inform their own future learning goals. Constructivist theory underpins the learning in this course and using assessment *for* and *as* learning is the process by which students continuously inform themselves about their own learning progress (Stiggins, 2005). A shared view by many students is summed up by one below.

> *The embedded video was a very convenient and innovative way to organise the assessment information. It was the first time I had seen it used in a unit and I was quite impressed. The feedback was relevant and comprehensive and having the video itself there to view at the same time, was extremely beneficial. The provision of the video will also aid the ability of our group to assess ourselves and reflect on our performance in more detail.* (Student correspondence through email, 2011)

Mobility of technology

In phase two of the project, the mobile technology allowed the tutors freedom to move to vantage points around the performance room, where they had greater access to view the performance. The tutors could sit among the audience members rather than as judges at a fixed place in the drama room. Some students reported that they felt nervous seeing the three tutors marking so being able to 'blend' in with the audience may have eased some nerves.

A problem that arose from this was that the wireless connection was stronger in some parts of the room than others. Walking into a dark spot meant that the connection was lost and time had to be spent in re-connecting and logging back on. These dropouts happened several times to several markers.

Sitting among the audience members often seemed to invite prying eyes from those around to see how tutors were marking. Tutors reported feeling as if they had to hide their iPad2 screen while marking.

Peer marking

iPad2 enabled the students to take a group photo of themselves, which was embedded into their peer marking layout on FileMaker Go, as proof of attendance at the peer assessment task. As marks were associated with this, it meant that tutors did not have to take attendance records. The photo was only available to markers and not the performing groups, although the performers could see the peer marking group during performance. There were extensive discussions (within another unit where students were learning about assessment and evaluation) about how to give constructive, honest and useful feedback to learners. This was their opportunity to practice this skill in an authentic setting.

The students largely reported that the iPad2 was a useful tool. However, there were a number of problems with the assessment process. Firstly, the wireless connection was severed several times when students walked around with the iPad2. Secondly, some students held onto the iPad2 and did not give an opportunity for other students to use it. Thirdly, some of the text on the screen was too small for all group members to see it at the same time. Some students suggested that 2 or 3 iPads per group would have been better. A few students reported that they were very confident with using iPad2 and some felt that they needed far more training.

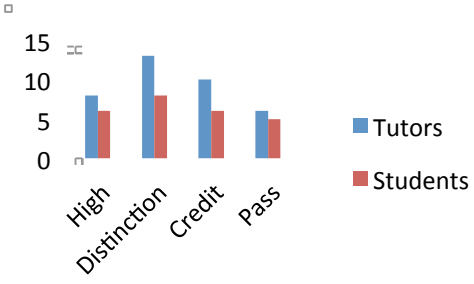
> *I don't feel that the 5 to 10 minute introduction conducted in one tute was sufficient. As the technology becomes more familiar, I think this will provide a valuable tool to use in peer assessments.*
>
> *I'm still getting used to all this iPad technology myself, but as we are now living in our technological age when going out into schools we are soon going to be faced with it, so, to have a glimpse of it now was very helpful. From a marking point of view is extremely quick and easy to use.*
>
> *I'm not sure if it is because we were unfamiliar with the iPads but I actually found that they made it difficult to peer assess. Since the iPads were difficult to use, we weren't able to get much feedback to our peers as was difficult enough to write and say a few words.*
>
> *The iPad was clear and easy to follow. We just had to click the buttons and then write a comment-it was very effective in the way of collecting feedback; it just took some groups a long time to do it.*
>
> (Student correspondences through survey, 2011)

The survey response regarding receiving peer feedback embedded onto their marking key was positive. Many students reported that they appreciated their peers' feedback about their performance, particularly as they had all watched each other's performances evolve as they worked side by side throughout the semester.

With past peer marking tasks, we often found that peers' marks were mostly generous, particularly if they were not anonymously given. With this assessment process, however, we found the peers' marks comparable to ours. It may be that the exemplar marking and extensive discussion about giving feedback supported this. This is an area of this research which needs further close study.

It is interesting to note that the final peer assessments matched our assessments as follows:

(1) Table showing similarity of grades awarded for performances by tutors and peers.



The assessment process

The whole assessment process included the students through participation of peer assessment, assessment of exemplars, and their feedback contributions to surveys and other forms of communication, such as email and personal conversations. A large number of students felt strongly that the process of using exemplar videos, although valuable, was somewhat compromised when they were asked to assess last year's performances on this year's criteria (which were marginally different). The singular focus of these few students on the criteria differences meant that they may have missed the benefits of exemplar marking to their own learning.

> *Viewing the previous videos was a good idea, however as the criteria was different in some aspects I wasn't able to draw much inspiration from them. In a way, it helped me to see if we were marking the same as the tutors and what to expect when we mark.*

A moderate number of students felt they needed to view more performances**.** A few students did not know how to use key pads**.** Most indicated that more time to discuss the results would have been beneficial.

Conclusion and Future Directions

The *Horizon Report* (2007) states that "the environment of higher education is changing rapidly"(p. 3) and that "higher education is facing a growing expectation to deliver services content and media to mobile and personal devices." (p.5).

This action research project enabled us to use technology as a tool to improve the way in which we assess our students when the capture and evidence of complex learning is required. Our students tell us that they learn better when assessment is clear and explicit, they know what evidence is being collected by the markers and they are involved with the assessment process. Modern mobile technology assisted us in involving them in a practical way.

Assessment can be a time consuming, cumbersome activity where 'busy work' is required to sort, collate and distribute feedback and marks to students. Using technology to streamline these tasks frees up valuable time and energy for the markers to engage with a more comprehensive marking and moderating activity. Their comments suggest that this technology-enabled process gave the markers a greater sense of satisfaction with the overall assessment process. In addition, being able to moderate anywhere and anytime meant that markers moderated on short but multiple occasions, rather than just once or twice as with face-to-face meetings. This gave markers a time to reflect and incubate ideas for more critical and comprehensive feedback. This did not seem to add time to the process. It did engage the markers more because they felt they were being more productive.

The students in our course are generally quite familiar with some technology such as accessing emailed attachments. The convenience of receiving their feedback and marks via email, particularly a week after semester's end, meant that they did not need to travel on campus to collect their marks. This promoted a greater engagement with feedback as did the embedding of the video of their performances.

Many people are visual learners (Gault, 2005) and our experience indicates that technology can help make learning and assessment stimulating because it allows easy access to images, video clips and sounds which can illustrate or consolidate key points. Therefore, other technologies we incorporated into this study, including the use of Keepad Interactive clicker technology, afforded increased interactivity, allowing for individual participation and instant feedback on assessment exemplars in the lecture theatre. In addition, with new and easier ways for lectures to be recorded and turned into podcasts, there is potential here to meet an increasing demand for online course delivery and assessment (Sprague, Maddus, Ferdig & Albion, 2007). New technologies offer efficiency and flexibility that will benefit student learning into the future.

The assessment, although developed over two phases of action research, needs further development in a number of areas. Chiefly, we need to (1) reassess the amount of training students require to use iPads, (2) check wireless connection in the performance room to ensure it does not cut out, (3) increase the amount of time each group has to peer assess and (4) discuss with students the value of marking exemplar videos so more see the benefits to their own learning.

The web based tool was refined in phase two and still requires further refining to reduce the time needed to resize and separate videos.

Implications

The implications of our findings are that the digital assessment tool enables the capture of student learning when the nature of that learning is showcased through ephemeral performances such as talks, speeches, plays, skill demonstrations and presentations. The streamlined marking process utilises the technology to do the manual tasks associated with marks and feedback recording, collation and distribution to students. This frees the marker to invest their time in making professional judgements about the quality of learning. The feedback students receive is educative and engaging.

This technology and assessment process could be used in a variety of education settings from the youngest students to adults, across a range of learning areas. We see a future use of this assessment tool with a range of educational and training context used inside and outside classrooms, where students are required to demonstrate complex learning through practical based or performance assessment and where assessment is designed to be educative.

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Dynamic EEG Mapping as artistic expression

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Abstract: Use of encephalographic (EEG) signals of brain activity can generate dynamic representations of thoughts and emotion when experiencing and creating artworks. EEG responses were produced in reaction to artworks and a recursive reaction to the dynamic representation of the artists own EEG response. These were used to amplify artistic experiences and provide a complementary visual experience in which the observer's neural reactions to an artwork formed an additional component of the work. Subconscious reactions were made visible and a complex interplay of the observed artwork, reactions to that work, reactions to reactions to that work, and the visual EEG representation itself as an artwork, combined to produce a complex and nuanced artistic experience. The attitude of 53 primary preservice arts education students to arts education was surveyed using the Teaching With the Arts Survey (TWAS) instrument pre and post use of EEG visualisations during arts education studies, and compared to two 53 student control groups in the same course. Improved attitudes to the incorporation of arts education into teaching was shown as a result of using EEG displays to make explicit the effects of holistic artistic experiences.

Introduction

What is the essence of arts education? Dewey (1934, 1958) situated arts education as experiences to be found in everyday life, with the processes and their aesthetic qualities identifying an experience as artistic, and a teacher "measured by his ability to foster the attitude of the artist in those who study with him" (1993, p.288). For Vygotsky (1971) "Art is a method of experiencing the making of a thing, but what is made is of no importance in art" (p.57) and Weschler (1982, p. 186) art exists "not in objects, but in a way of seeing".

Art education in schools, particularly in the primary years, is often focused not on artistic experience but on skill development, artefact creation, and knowledge acquisition. "Learning the words to a song and singing it along with a recording is not necessarily more artistic than arranging leaves on a paper for a science experiment" (Oreck, 2006) with the often unexplored artistic experience characterised by 1. attention to form and qualities (Beardsley, 1970); Osborne, 1991); 2. connections to feelings, memories and personal experiences (Goleman, 1995; Vygotsky, 1971) 3. a sense of wholeness or completeness of experience (Jackson, 1998), 4. the ability to use multiple forms of expression (Eisner, 1994), and 5. the transformation of a symbolic object or objects (Gardner, 1993). Greater focus on these characteristics permit a more holistic approach to arts education rather than the study of separate skill based disciplines (Oreck, 2006).

Such an approach is dependent however on teachers' attitudes to the teaching the arts and their preparation for arts education. Teacher disposition to include arts education in their teaching has been found to be largely shaped by childhood experiences and formal training in the arts (McKean, 1999) with "only those few teachers who have artistic backgrounds... having a realistic set of schema's and paradigms for teaching the arts" (Stake, Bresler & Mabry, 1991, p. 318). This presents challenges to teacher education programs preparing teachers to include arts education in their curricula where aspiring teachers often have very limited arts education and artistic experiences.

Compounding the situation further, encephalographic (EEG) brain activity patterns of artists and non-artists show a significantly higher phase synchrony in beta and gamma bands when observing and creating artworks (Belkofer & Knonopka, 2008) and this has been attributed (Bhattacharya & Petsche, 2001) to an ability to see concepts and detail in an artwork and create complex internal representations of such works. This suggests that prior arts education may explicitly allow students to experience art far more deeply than those without a comprehensive education in the arts and highlights the recursive importance of artistic experience in arts education. Without experiences of the arts it is difficult to appreciate artistic experiences, not just logically, but physiologically.

Use of EEG analysis in art therapy is also identifying how our artistic experiences are physiologically received, processed, stored and retrieved (Belkofer & Knonopka, 2008). The emotional impact of such experiences being the result of "dynamic processes created within the socially influenced, value appraising process of the brain" (Siegel, 1999, p. 123) and increasingly identifiable and measurable. EEG measurements are being increasingly used as the basis of interactive artworks (iMal, 2011), using audience biofeedback to generate dynamically responsive artwork from neural activity. All areas of the Arts have been explored using EEG technologies as a medium of interaction, expression or interpretation, visual arts (Matsunaga & Genda, 2005), music (Haill, 2011), dance and drama (Duenyas, 2011). Less use has been made of EEG signals and visualisations themselves as artistic works but examples exist (Smith, 2011).

Study

It was hypothesised that the attitude of aspiring teachers to arts education may be correlated with their association of the importance of artistic experience to student learning - changes to a learners brain. Students used EEG displays of their brain activity while engaging in artistic experiences to directly see how their brain responded to the experience.

A randomised controlled experimental design was used, involving an independent variable of three groups - two control groups and a treatment, with a dependent variable of attitude to the teaching of the Arts. Subjects were randomly assigned to the three groups.

The sample (N=159) comprised students (ages 18 - 37, with a mean of 23) studying to become primary teachers at an Australian university. Their attitude to arts education was surveyed pre-

post using the Teaching With the Arts Survey (TWAS) instrument (Oreck, 2011). Students (n=53) in the treatment group used EEG feedback during artistic experiences to identify if such reflective feedback improved student attitudes to arts education and this was compared to two control groups (each n=53) in the same course of study. TWAS uses a 5-point Likert scale and was comprised of 15 demographic, 8 frequency of use in arts education of dance, music, drama, and visual arts, and 25 attitude to arts education questions. Based on the previous Arts in the Classroom Survey (Oreck, Baum, & Owen, 1999) the TWAS has been validated in several multi-year studies on attitudes to arts education (Oreck, 2011).

The eight frequency of use items describe two general types of arts activities in each of dance, music, drama, and visual arts - 1. active participation in, and 2. exposure to the arts.The 23 attitude items encompass five general constructs identified as important contributors to the implementation of creative and artistic teaching techniques (Gable & Wolf, 1991; Isaac & Michael, 1997) and influencing teaching practices: 1. motivation: sense of importance of the arts in the curriculum and awareness of student needs; 2. concerns: personal, task, and impact; 3. self-efficacy: confidence in facilitating arts activities; 4. self-image: sense of self as creative and artistic individual; and 5) support: sense of autonomy and support from systems for creativity and innovation.

The 65 students in the treatment group each experienced the use of EEG generated neural activity displays while observing and participating in dance, music, drama, or visual arts artistic experiences. Usage ranged from 3 to 6 minutes with a mean of 4.2 minutes, with 1 to 3 experiences per student with a mean of 1.7 measured experiences. Measured experiences included 21 for dance, 42 for music, 10 for drama, and 16 for visual arts. These occurred over a 7 week period of instruction of these art-forms in primary years education.

EEG data was collected at 128 Hz using Emotiv Epoc wireless EEG headsets collecting 14 data channels with two bipolar reference electrodes, spatially organised using the international 10-20 system. This data was immediately displayed in real-time to participants as a heat-map of overall frequency intensity at each of the 14 sensor sites over-layered on a plan diagram of the participants head. In addition, a bar graph display of site F8 (Front Right of the pre-frontal cortex) previously associated with artistic response (Bhattacharya & Petsche, 2001) was displayed showing a sub-band histogram display of Delta, Theta, Alpha, and Beta signal intensities at this site.

The subsequent display provided visual feedback to participants of their neural activity in response to a range of artistic experiences. Students used their brain activity to generate dynamic representations of emotions and feelings as artworks. Works were produced from emotional stimuli, reaction to existing artworks and forms (images, music, dance and tactile examination), reaction to existing EEG artworks, and recursive reaction to the dynamic representations of the artists own EEG artwork.

The stated intent was to encourage participant reflection and appreciation of Arts activities as holistic artistic experiences that make changes to their brain depending upon their emotional

and cognitive responses to the experience. Visual reference to EEG visualisations during these experiences provided a process of explicit reflection on the experience that in turn was made visible, prompting further recursive feedback.

Results

Applying a null hypotheses that there is no correlation between the application of EEG displays during artistic experience (Treatment) and subject attitudes to the teaching of the Arts, a one-way analysis of variance (ANOVA) between the three groups was conducted (Table 1) to explore the impact of EEG display on subject attitude to the teaching of the Arts, as measured by the Teaching With the Arts Survey (TWTA). Subjects were divided randomly into three groups. There was a statistically significant difference at the $p < .01$ level in TWTA scores (Table 2) between both control groups and the treatment group and no significant difference between control groups. Post-hoc comparisons using the Tukey HSD test (Table 3) indicated that the mean score for Control Group 1 (M = 3.89, SD = 0.58) was significantly different from the Treatment Group (M = 3.96, SD = 0.62). Control Group 2 (M = 3.64, SD = 0.65) was also significantly different from the Treatment Group (M = 3.96, SD = 0.62) but did not differ significantly from Control Group 1 (M = 3.89, SD = 0.58). This results rejects the null hypothesis that there is no correlation between the application of EEG displays during artistic experience (Treatment) and student attitudes to the teaching of Arts.

Table 1. Data Summary

	Samples			
	Control Group 1	Control Group 2	Treatment Group	Total
N	53	53	53	159
Σ_X	191	193	210	594
Mean	3.6038	3.6415	3.9623	3.7358
Σ_{X2}	719	725	852	2296
Variance	0.59	0.4267	0.3832	0.4867
Std.Dev.	0.7681	0.6532	0.619	0.6977
Std.Err.	0.1055	0.0897	0.085	0.0553

Table 2. ANOVA Summary

Source	SS	df	MS	F	P
Treatment [between groups]	4.1132	2	2.0566	4.87	0.009511

Error	43.8868	104	0.422		
Ss/Bl	28.9057	52			
Total	76.9057	158			

Table 3. Tukey HSD Test

HSD[.05]=0.3; HSD[.01]=0.38 M1 vs M2 nonsignificant M1 vs M3 P<.05 M2 vs M3 P<.05	M1 = mean of Control Group 1 M2 = mean of Control Group 2 M3 = mean of Treatment Group

Conclusion

Amplification of artistic experiences through EEG augmentation provided a complementary visual experience in which the observers' neurological reactions to an artwork formed an additional component of the work. Subconscious reactions were made visible and a complex interplay of the observed artwork, reactions to that work, reactions to reactions to that work, and the visual EEG representation itself as an artwork, combined to produce a complex and nuanced artistic experience that was readily identifiable as such to students. The attitude of aspiring primary teachers to arts education was improved and EEG feedback was identified as an effective means of changing student attitudes by making them more explicitly aware of the influence of holistic artistic experiences on student learning.

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