

THE EDUCATIONAL AFFORDANCES OF GENERATIVE MEDIA IN ARTS EDUCATION

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Abstract

Network Jamming systems provide real-time collaborative media performance experiences for novice or inexperienced users. In this paper we will outline the theoretical and developmental drivers for our Network Jamming software, called jam2jam. This software employs generative algorithmic techniques with particular implications for accessibility and learning. We will describe our methodological approach and how theories of meaningful engagement have directed the design and development of jam2jam and describe the emerging educational affordances that have been revealed. In particular we focus on the interactional and relational opportunities and how these can be operationalised for learning and community development. We illustrate the paper with examples from our iterative testing cycles and show how these have informed the evolution of jam2jam's theoretical drivers, computational design and our awareness of its educational affordances.

Keywords - Jam2jam, generative, music, media, performance, computer, meaningful engagement.

1 INTRODUCTION

The qualities of arts experiences that connect people with each other and cultural practices that connects us with a set of beliefs or with a community and place is well understood if not widely evidenced.

In particular, the qualities of experience in creative group activities or ensemble performance are transferable across time and place and are used widely to transmit cultural values. Our research suggests that these qualities persist in digitally mediated creative activities, and that generative computational systems can enhance performing arts activities involving digital music and image.

This paper focuses on the educational affordances of generative media systems as evidenced by field data drawn from the Network Jamming project [1]. The Network Jamming project has created generative media performance systems that enable access to a unique kind of music/media ensemble performance with very little requirement for musical/media knowledge or skill. These computer-based systems further offer the possibility of unique interactive relationships between artists and with creative knowledge through collaborative performance. Interactions with the suite of software programs created for this project, called jam2jam, are central to this project.

Evidence from our research suggests that collaborative performance with generative media is transformative and meaningful. In this paper we discuss these ideas in relation to an emerging theory of meaningful engagement that has evolved alongside the development of the jam2jam software. Primarily, we focus on demonstrating how a deeper understanding of these interactive experiences can lead to applications that may be of educational and social benefit.

Since 2002 we began research and development of generative software for use in schools and communities. This research has grown into a project at the Australasian Cooperative Research Centre for Interactive Design (ACID). The Network Jamming project has extended the research and application of these systems to eight countries and developed a suite of software and hardware applications that provide a range of access to these experiences. Generative music and art are a relatively new phenomenon that uses procedural invention as a creative technique to produce music and visual media. In the Network Jamming project we have designed visual or physical interfaces for jam2jam that allow participants to control the elements of sounds such as pitch, timbre, note density, volume tempo and duration, and the visual effects such cross-fade, blur, saturation, and so on. Fig. 1 shows a still image of one of these interfaces; a version called jam2jam AV.



Fig. 1: The jam2jam AV interface.

Using jam2jam, participants can affect changes in the music and visual content in real time by manipulating the on-screen icons. In the centre of the screen are instrument and video icons that can be dragged around to change two specified parameters with one on each of the horizontal and vertical axis. Icons around the edge of the screen allow the selection of generative parameters and icons in the corners control global settings such as: play, stop and record. Manipulation of icons can be done using computer mouse and keyboard, via connected physical controllers, or via the Internet and a local area network. Control can be shared amongst a group of local and/or remote players who can improvise and perform live to an audience and record their performances for review and reflection, or for sharing with peers, family and friends on their computers and mobile devices or via the Internet.

Generative media performance systems, such as jam2jam, present an opportunity for users to leverage the malleability of computational data to make sense of complex media forms through interactive and collaborative experiences. These kinds of systems present a range of interactional affordances that can facilitate new kinds of relationships with media production and with other participants. Early on in our research it was clear that jam2jam systems had the potential to provide access to collaborative ensemble experiences to users with little formal musical or artistic expertise [2]. Participants in these studies ranged in age from four to sixteen years old, and extended to those who were physically and mentally disabled, and those labeled as 'disengaged youths' [3]. These studies have been carried out in schools and community settings to examine both the pedagogical value and social effects. It was clear from participants' reactions in these studies that playing in groups with jam2jam was fun and entertaining and in many cases this was sufficient, however, we were also interested to look more deeply at the qualities of these experiences and the educational and social affordances that presented.

Performance, improvisation and collaborative experience are difficult things to observe and document clearly, as is measuring meaning and engagement. Digital technologies, however, present opportunities to capture both qualitative and quantitative perspectives and provide a range of lenses on phenomenon. In this research we have sought to develop an approach to methodology that considers the iterative nature of user led design, the co-development of pedagogy as a discourse and develop a theoretical model for meaningful engagement.

1.1 Developing methodology. How have we researched Generative Media?

For this project we have developed a hybrid approach to methodology we call Software Development as Research (SoDaR) [4]. The methodology blends aspects of software development [5] extreme programming [6], action research [7] and naturalistic enquiry such as grounded theory and case study. Common to these is the iterative nature of cycles of reflection that inform changes for the next stage.

The SoDaR approach has four stages:

1. Identification of the opportunity for which software development is required and establishing an appropriate approach to take advantage of that opportunity,
2. Design and production of the software,
3. Implementation of the software via application in a naturalistic setting, and
4. Evaluation of the effects of the application and subsequent refinement of the approach and design.

The learning opportunity identified for our Network Jamming research involved examining the cooperative and performative qualities of music/media making. The SoDaR approach enabled us to provide novel opportunities for creative expressions and examine the phenomenon in new ways. We established a cycle of design, application, and observation. In practice we designed a graphical interface and computational engine that facilitated ensemble performance with computers. In recent versions this has been greatly facilitated by using the Impromptu development environment designed for live coding [8]. Working with music and media teachers and artists we designed a range of interfaces that were then tested with children in community music settings. These settings ordinarily comprised 5-12 Apple computers, various physical controllers and a workshop facilitator who took the participants for a one-hour session of improvised activities leading up to a performance to peers and family and a recording.

These sessions were recorded on video using a multi camera set up that captured the individual users face, the interaction in the room and the activity on the computer. Two or more sociological observers were also in the room and stimulated recall data was gathered after each session. In these interviews the participants were able to discuss their experiences with the work and a jam2jam computing system was present to assist descriptions. Data from each session was transcribed and coded using a video analysis system (most recently Transana [9]). An analysis report provided feedback to various stakeholders; results informed software development and design, pedagogical/experience design, and the development of theory about around the qualities of meaningful engagement that users experienced.

The Network Jamming research project has an international reach. At the time of writing, these jam2jam sessions have been replicated and evolved in four locations in Australia, in Illinois and Massachusetts in the USA, Malmo in Sweden, Cambridge and Manchester in the UK, Hong Kong and Auckland in New Zealand. The settings for these sessions have included schools, universities and community spaces. Each location has adapted the methodology in accordance with their own cultural and contextual conditions and shared the distillation of their data through conferences and international symposia. As well as short workshops with participant numbers ranging from 40 to 1000, there have been extended trials examining long-term engagement over a school semester with participants ranging from 4-30, and a public installation at a science museum that ran for two months. Over the eight year period of research we have moved from immediate and large numbers of participants used to gauge initial engagement to focus on refining the processes through smaller case study groups conducted over longer periods of time.

Within this process of iterative cycles of research we have developed an observational tool we call the meaningful engagement matrix which reflects the theory of meaningful engagement that has implications beyond its current setting with computers.

2 INTERACTIONAL AFFORDANCES

In conjunction with the development of the jam2jam software systems and associated experience design, has been the building of a theory of meaningful engagement that describes the range of experiences that participants have during creative activities such as performing with jam2jam. The

meaningful engagement matrix and the associated observational descriptions presented in fig. 2, enable us to examine how a participant is responding (mode of engagement) and how they find the experience rewarding (the location of meaning). This has provided both a useful 'language' to discuss interactions and a way of feeding back information about software and experience design. Essentially the matrix can help us understand whether an activity is sufficiently open in its approach and is likely to be enabling and expressive.

	Appreciate	Select	Direct	Explore	Embody
Personal					
Social					
Cultural					

Modes of Creative Engagement

- Appreciate – attending carefully to creative works and analysing their representations
- Select – judging aesthetic value and appropriateness
- Direct – leading creative activities
- Explore – searching through creative possibilities
- Embody – being engrossed in fluent artistic activity

Locations of Creative Meaning

- Personal – intrinsically enjoying the activity
- Social – developing relationships with others
- Cultural – feeling that actions are valued by the community.

Fig. 2: The Meaningful Engagement Matrix

Analysis of data from Network Jamming sessions suggests that students move between the modes of engagement fluidly as represented in Figure 3. They explore, and then gain confidence from this knowledge to confidently act by presenting new expressive materials directing activity, selecting, appreciating and then embodying the understanding so that they can improvise in feelingful ways. These activities are open when they provide the opportunity for participants to explore on their own, share with a peer in an ensemble activity and perform to a wider group. Open activities provide interactions that can lead to the different meanings articulated in the matrix. The theory of meaningful engagement has emerged from the need to describe and codify how users experience creative engagement with music/media performance and the locations of meaning. In this research we observed that the musical metaphors and practices of 'ensemble' or collaborative performance and improvisation as a creative process for experienced musicians, could be made available to novice users. Potentially, what becomes available to these novice users is the (normally elusive) high-level collaborative interactions and communication of aesthetic forms that are involved in a group improvisation. Non-verbal collaborative skills and expressive performance have the potential to provide access to new and deeper levels of understanding. Added to this, when working with digital media, the experiences also provide an opportunity for making sense of contemporary media in the world today through collaborative creative engagement rather than passive consumption. It is this aspect of facilitating relationships through virtual creative activity that is at the centre of these learning experiences. What the jam2jam software provides is a safe place for creative exploration to occur that is also challenging and gives immediate feedback and opportunities for flow, whilst documenting the experience so that participants and others can evaluate its worth.

Mapping Spiral Graph example of Student A

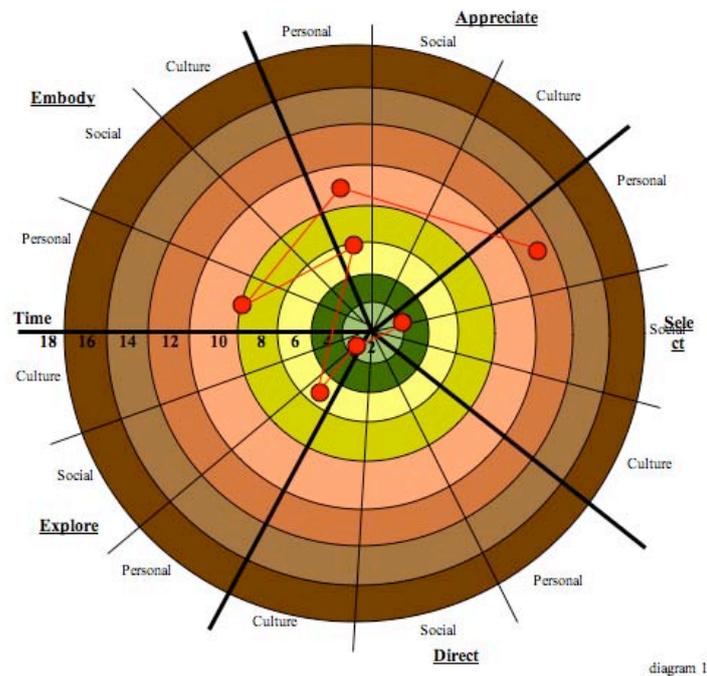


Fig. 3. Meaningful engagement pathways

What has emerged from a theoretical perspective is an interesting analysis of constructionist and experiential learning that formalizes notions of doing as a way of knowing [10]. Whilst student centered, group learning, discovery and experiential learning have been influential theoretical models since the 1970s in education their implementation and uptake have not necessarily replaced static mimetic teacher controlled activity [11]. Part of the problems in uptake of such approaches for teachers is the chaotic appearance of such learning and the difficulty in assessing student achievement and outcomes. In music education, for example, improvisation in groups (as required to some degree with jam2jam) is a riskier activity for both students and teachers than playing a notated score in a large band. The technology of the notated score enables a sense of control over what is to be learnt, and provides a benchmark for achievement of the musical aims. To the observer outside this classroom the appearance is one of control and clear direction and the teacher's esteem about the nature of their relationship with the students and the educational value is well defined by the musical practice of band directing or conducting.

On the other hand, a lesson based on improvisation with groups of children exploring timbre, dynamics, free rhythm and pitch presents multiple opportunities for understanding these critical key concepts of musical knowledge, but can often appear chaotic. In the hands of experienced teachers this kind of discovery learning is incredibly valuable to developing musical understanding and is an authentic reflection of many real world musical experiences, particularly in folk, jazz or popular music genres [12]. The assessment of such work is also less easy to establish, although criteria referenced approaches can provide inclusive and democratic assessment solutions. We have observed that the risk of a more explorative experience design is often avoided or done in a very limited way, simply because of how it appears to those who judge teachers competence by their control rather than by their educational outcomes.

Whilst undertaking the Network Jamming research we have become increasingly aware of the capacity of computers to provide a framework around chaos. It can provide a way of documenting what was done through recording and data capture, the optional use of headphones can provide a 'quiet space' to learn music. The image of computer technology as authoritative and serious also contributes to the esteem of students and teachers alike, who appear to be engaged with 'serious' and more easily justifiable educational activity (even as it appeals to students because it is like playing a game). Network Jamming activities provide a number of affordances to assist the widespread use of transformative experiential approaches to learning without the risk of reducing teachers' esteem.

Music education philosopher Wayne Bowman suggests that children have a natural tendency to explore musical ideas that are within their cultural experiences but that musical behaviours are “almost universally recognizable.” Therefore, he suggests, “music is both universal and culture-specific at the same time: universal in terms of the way its musical sounds and gestures articulate with the body; yet culturally specific in many syntactical, formal, timbral, or technical respects” [13 (p.24)]. In keeping with this point of view, we suggest that the behaviours and experiences that can be represented on the meaningful engagement matrix can be applicable in a wide range of musical circumstances and genres and across many social and cultural contexts.

3 RELATIONAL AFFORDANCES

Creating relationships between people that are based upon symbolic interactions (as against linguistic or physical interactions) are interesting because they concede that a kind of common ground and a system for the relationship exists. Creative arts and transforming media can provide the basis of this transaction. Generative media performance can be a bridge between, to and from individual’s culture and community. Just as the practice of a traditional ensemble provides a framework for how to behave and relate creatively, network jamming emulates these kinds of relationships but adds accessibility, networked interactivity, and media creation. Media works embody a particular set of cultural values, often expressed as a style or genre, and contain expressive dimensions that both maintain an affinity for the style and culture. Network Jamming allows exploration of a participant’s relationship with a culture and, indirectly, the community that upholds it. The generative systems in jam2jam also embody stylistic values in the algorithmic transformations available and allow improvisation within those parameters.

The relational affordances of collaborative media performance with generative media include access to high-level personal, social and cultural experiences. These activities facilitate interactions with self, as reflected in control of the generative system, with others, through collaboration and mediated interaction, and with the community, through creation of culturally relevant creative products, live performances, and sharing of outcomes and openness to accolades and critique. Within the creative process of collaborative improvisation lay a series of modes of creative engagement that move from appreciation through exploration, selection, and direction toward embodiment. The expressive sounds and visions made in real-time by improvisers collaborating with jam2jam are immediate and compelling. These generative media systems let novices access these experiences with simple interfaces that allow them to make highly professional and expressive sonic and visual content simply by using gestures and being attentive and perceptive to their collaborators. These kinds of experiences present the potential for highly complex expressive interactions with sound and media as a performance, and a complex set of interactions with others both locally and over the Internet.

The following case study vignettes present illustrations of relational affordances that focus on the different locations of meaning outlined in the Meaningful Engagement Matrix.

3.1 Personal Meaning: Dancing Fingers

In this vignette a 10-year-old Indigenous Australian elementary/primary schoolboy was engaged for 45 minutes with jam2jam.

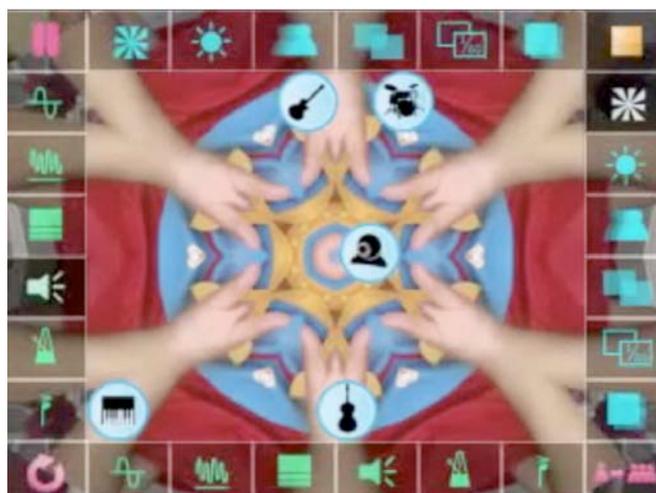


Fig. 4. Finger choreography video snapshot

He began by simply exploring the interface and making a hip-hop groove with the instruments he liked. Entranced by the effect, he rocked his head to the beat. He then shifted focus to the music and discovered the webcam and the visual transformations. The webcam allows participants own face to become the video source material. He turned on the kaleidoscope effect, which has proven to be one of the most engaging visual elements. With this combination he noticed that he could put his hands near the camera and create finger choreography and pulse to the beat he had made. Each time he found a new movement he liked it was integrated it into a routine, until he had a repertoire of moves that became progressively longer. Music served as a framework for time and the activity structure. In the recordings from the room, showing his face and the computer, we could clearly see how engaged he was in his visual and kinesthetic exploration with jam2jam. His actions moved through cycles of exploring that lead to control and sequencing of patterns. The length of engagement and the development of visual and kinesthetic thinking showed he was developing understanding and sophistication, but what was he learning? We realized that the potential for engagement was multi modal, as was the potential to developing skills in gaining control over a finger choreography performance as represented by the still image in Figure 4.

3.2 Social Meaning: Rapping about Bullying

A group of elementary/primary schoolgirls were engaged with the activity of making music and media presentations about bullying.

In these vignette groups of 25 primary/elementary school students aged 11 worked with two secondary music specialists to produce recorded performances of songs that addressed the social issue of 'bullying'. Students worked in groups of 3-4 around Apple iMac computers and, also, on the floor to develop lyrics and a song structure with their teachers. Students moved between improvising with jam2jam in their groups to create a groove for their lyric and song melody construction, during a six-week period meeting for two hours each week. They spent time identifying and deconstructing rap song structures and trying their drafts against the recorded jams. When the song structure and lyric was completed the students then found photos or made posters using Photoshop to include in their performance (See example in Figure5). Each group did a number of rehearsal performances then recorded the vocal part over the audiovisual jam as a live recording. In this case the social aspects of music making were most apparent. Both the activity of collaborative songwriting and the ease of access and capture provided by the jam2jam technology resulted in very mature musical and lyrical development. The process of drafting and redrafting lyrics adding a literacy dimension to the task that was unexpected. The work was presented to their parents and peers at a performance evening, which was affirming and added to the sense of worth students felt with their achievement.



Fig. 5. Collaborative expression video screenshot

What was interesting about this experience was how the computer became 'invisible' in the process of learning, no longer a tool for contemplation but an instrument for playing. The fluid movement between media and spaces was quite profound; they shifted between pen and paper for lyric writing, drawing and digital photography for image making, and computer and floor space during highly engaged

discussions. It was the musical activity of songwriting and performance that was the engagement trigger and the jam2jam system provided access to a high quality output. One participant confided in us that 'bullying is not really a problem at our school' but, nevertheless, she loved writing songs. Parent's recognition that their children could produce a song and video clip was a source of pride and many asked how they could continue engaging their children in this way.

3.3 Cultural Meaning: Lockhart River Creative Exchange

A group of Indigenous Australian primary/elementary school students collaboratively remix digitized images of artwork made by Indigenous adults from a remote region while jamming along with music. Videos of the children's jams are sent back to the adult artists.



Fig. 6. Permission to be playful

In this project we partnered with the Health Information Technology Network (HITNet). This organization focuses on health in Indigenous Australian communities often in rural, regional and remote locations. In this project we were given permission to use a series of artworks created by mental health patients from the Lockhart river region of far North Queensland in Australia. We digitized the paintings and imported them to jam2jam. We then worked with a group of Indigenous young people in an urban Brisbane school. Students at this school aged 11 were given a workshop experience where they were able play and improvise with this version of jam2jam that used the art images as visual material that could be mixed with images captured on the webcam. Their response to the paintings was an immediate sense of pride in their Aboriginality. They also expressed a real pleasure in being given permission to play with the images and add music (See Figure 6 that merges art and webcam images). All kinds of dancing and performances occurred in front of the webcam and students engaged with each other 'around' the computer rather than always 'with' it. The result was a series of videos where the artwork and the student's own expressive performances merged in a unique way. These music videos were then sent back to the adult artists and projected at an exhibition in the city of Cairns. The response from the artists and the other viewers of the videos were quite moving. There was a clear sense that a transaction and communication had occurred through the artworks that travelled between the two locations. The artists also commented that usually someone walks past a painting or perhaps buys it, but in this case interacting with the painting facilitated a relationship between artists and jammers that was more profound. The educational implications of embedding cultural materials into generative systems with the permission to be playful with them are quite extraordinary and, as yet, under explored.

3.4 The Education of Character

We hypothesize from these observations and descriptions that each personal, social and cultural experience effects some kind of transformation of self and a desire to continue with or sustain the activity. Whilst deep and diverse modes of engagement are demonstrated in these cases we are still uncertain of the consequences of these experiences or how best to capitalize on them or indeed how to evaluate their worth. We know that the participants are learning something but what are they learning? Will it last? And is it of any use?

So this is where we are with generative media systems and the relationships they afford. We know the activity is intrinsic, we know it is engaging; we know it is meaningful - we can even identify and describe it. We know that something is being learned and a relationship is being enhanced. But how can we determine its nature and value for the design of these experiences and to benefit human and cultural capital? If, as Csikszentmihalyi, suggests, our challenge is to be more expressive with creative making tomorrow than we are today and to learn how others are expressive, then our goal is simply how we make sense of experience and reapply it to our next experience to remain in flow [14].

4 CONCLUSION

We have discussed how generative digital media systems can be the basis for interactive and collaborative software that leads to meaningful and engaging experiences in the arts. We have outlined our experiences with the jam2jam series of software and described what can be achieved. We have found that generative systems have two particular educational affordances: interactional and relational. In terms of meaningful engagement we have suggested that meaning that leads to extended interaction requires structured opportunities to explore in personal, social and cultural ways. We documented the observation that engagement within these activities tended to move from explore mode to and from other modes of engagement fluidly but regularly.

Social and cultural meaning provide access to important interactional affordances which provide engagement with rich creative experiences by scaffolding participants toward meaningful media production outcomes; they can also provide productivity enhancements for experienced users by absorbing the responsibility for some details or features allowing attention to move on more quickly to other important creative decisions. This paper has focused on the accessibility of generative media systems, as this has most potential for educational and social applications.

Our jam2jam software includes other features, beyond parametric control of generative procedures, designed to provide meaningful engagement with arts activities. These include the integration and synchronisation of music and visual elements, the realtime networking within and between systems that facilitate group performances, and the recording of sessions allowing reflection and sharing. This enables performances across the Internet in multiple locations which raises further questions about the nature of ensemble relationships in non- present environments.

Relational affordances provide interactions with self, as reflected in the control of a generative system, or as mediated creativity with others. The relational affordances of network jamming also provide interactions with culture through public performances and the creation and sharing of relevant creative products.

We have described how the Network Jamming project has developed methodological processes and resources to support the interrogation of generative media performance systems in educational and community settings. In particular we have outlined the theory of meaningful engagement that maps the territory of interaction and value in creative activities and we have described how the network jamming activities facilitate these experiences. We hope that our methods, experiences, and insights may be of value for others exploring the deployment of technologies for learning and social development. What we present here provides a framework and methodology that allow us to be more critical and engage in a discourse about meaningful engagement as mediated by new technology. Generative media systems provide both a mirror and a lens on the future of learning and teaching relationships.

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