Interacting: Art, Research and the Creative Practitioner

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We live in an age when interacting is an everyday phenomenon. The word ‘interaction’ is used to express many kinds of interplay between people and artefacts, even events, and has become part of our daily vocabulary. Interaction implies a two-way process, in which we expect to give, as well as to receive, an expectation that is fundamental to the kinds of interactive experiences we are likely to encounter throughout our lives. Digital technology has opened the door to opportunities for expanding interaction of many kinds, including artworks. It is an open door because, for some time now, the public have had expectations of interactivity in galleries and museums and, indeed, in the street. That expectation sometimes borders on a sense of entitlement to touch, to speak to or move about art works in a manner which audiences of the past could only have dreamed of. “Please do not touch” as the nearest sign to an artwork can still be found in many exhibitions especially because of the high value placed on historically significant works, but, nevertheless, a perceptible change has taken place in the world of the museum visitor. Today we are often invited to touch, tread on, write on or make contact with the artwork in any number of other ways. People visiting galleries and museums are no longer ‘viewers’; those formerly known as ‘the audience’, are often ‘participants’. Taking an active part in an installation is no longer unfamiliar: indeed, people have entirely different expectations of what is possible. In October 2010, the Tate Modern in London was forced to close access to Ai Weiwei’s Sunflower Seeds because the enthusiasm of the crowd’s interaction with the work had produced dust potentially damaging to health. Many people were outraged. Denied the opportunity to run, roll about and jump through the installation of millions of tiny porcelain sunflower seeds on the floor of the Turbine Hall, a hint of mutiny could be felt in the air. The right to interact was being thwarted.

In Budapest this year, visitors to the Labor gallery obeyed the invocation by the artist Stephen Scrivener to sit, to view, to touch and rearrange objects, and, although not asked to do so, sometimes put everything neatly back together again. As this and the incidents in the Turbine Hall reveal, interacting can evoke very different kinds of responses.

Figure 1 Notice in "British Art Show 7: in the days of the Comet" Hayward Gallery London, Feb-April 2011, photograph by Ernest Edmonds Figure 2: DO TOUCH DO: Csepel Works by Stephen Scrivener, Labor Gallery, Budapest, Mixed media installation, 2011, photograph by Szabolcs Süli-Zakar
**Interactive Art and the Active Audience**

Since the 1980s and the advent of the personal computer, the majority of interactive artworks have employed digital technology and there are many names used to describe art that involves the use of computers. Common ones are New Media Art, Digital Art, Computer Art or even Information Art. In an extensive discussion of the various types of computer-based art, Boden and Edmonds identified eleven categories, one of which was Interactive Art. The categories were based on the various ways that computers and procedural processes are used in making or within art works. In interactive art, for example, a computer is frequently used as the controller of the interactive process, the definition of that process being specified by the software that is an integral part of the artwork. The labels given above are often interchanged and certainly overlap in terms of the categories that they represent, but none of them specifically refer to interaction, whilst not excluding it. Interactive Art, however, is more specific than just using computers, or digital technology. Moreover, it may not use computer-based technology at all, as was the case with Ai Weiwei’s Sunflower Seeds in the Tate Modern turbine hall.

Making art and experiencing it are usually thought of as quite separate things done by different people. In the past, we might have said that ‘making’ is the prerogative of the artist whilst viewing it that of the audience. In many ways, the phenomenon of ‘interactivity’ has transformed longstanding notions of what it is to be a creator and a consumer. Interactivity can be seen as a spectrum from simple action and response to an immersive experience. Nowadays we have many options for interaction: we might be invited to determine the next events in a television commercial narrative by going online to make our preference known. Alternatively, we might take part in an installation that evolves visually according to our movements. An interactive artwork can affect the audience in a variety of ways. Direct influence is the most obvious and easily recognised: the audience is provoked, encouraged or tempted to respond or take an action there and then: to touch, scream or move something. Indirect influence is less easily discerned and has more subtle effects: the interaction changes the inclination or propensity of the audience to think or behave in certain ways. It could be said that interaction challenges the audience to move from being mere viewers to active participants.

Challenging the audience is an inherent aspect of what we might think of as the avant-garde in the arts. In the interactive arts, challenge takes many different forms and the intention is often to transform the audience from viewer to active participant. By ‘active audience’ we refer to situations where the artwork is changed as a result of actions by, or changes of state in, the audience. Active audiences might just look or listen to the work
but at least from the artist’s viewpoint, they will not become engaged with it or will not experience it unless they become involved in some form of direct interaction. They might become involved in a form of enquiry and experiment, they might play with it or they might simply observe changes that seem to relate to their own behaviour. The active audience is one that may play no part in the initial conception of the artwork but who, nevertheless, by their actions, movements, speech, or mere presence, affect the ‘performance’ or ‘expression’ of the work. In a sense, they complete the creative process.

The relationship between audience and artworks is undergoing an evolution that is transformative. Actions such as waving or speaking to an artwork are no longer surprising. Some artists exploit the residual novelty of such interactions, whilst others have moved on to less simplistic ways of bringing interaction into their creative works. The experience of the active audience may be varied, depending largely on the kind of artwork and the artist’s intentions: for example, it might be that an experience of pleasure and fulfilment is evoked. Equally, however, it might be an experience of frustration and lack of control. The full gamut of experience is available and might be evoked by different forms of interaction and different responses that the art system might exhibit. Where biofeedback type systems are employed, the experience might be one of self-realisation at a physical level. Where unexpected, even shocking, images result from audience action, the experience might be very disturbing. In interactive art, the strength of the experience can be heightened by the fact that the audience feels, at least in part, responsible for events. In that sense, the participants are necessary partners in creating the interactive artwork.

Practitioner researchers in the interactive arts are developing new approaches to the generation of knowledge about audience interaction. There are different perspectives arising from values and needs driven by distinctive cultures in the creative arts: for example, the different interests taken by artist, researcher and curator in the evaluation of audience experience can coexist and interrelate. This coexistence can lead to outcomes that serve different purposes. The artist will be primarily looking for things to change in the work, the researcher might be trying to understand audience behaviour and the curator might be seeing how best to present the art. In order to achieve this, creative practitioners are developing new approaches that bring together art practice and research methodologies. These initiatives spring from a synthesis of different forces that together make up the historical foundations of interactive art.
Interacting Influences: Ideas, Works, Technologies and Events

The layers of formative influences that have shaped the development of interactive art and practice-based research draw upon seminal ideas, pioneering art systems, key advances in digital technologies and landmark cultural events. When viewed across the different layers, the timeframe is not chronologically linear. Ideas take time to transfer across disciplines and the potential of new technologies for creative work is not always immediately recognised and exploited. Systems theories and related areas such as cybernetics, artificial intelligence and virtual reality are being rediscovered and a younger generation of artists are finding inspiration in the participative art of the 1960s and the first attempts at collaboration between artists and scientists and engineers represented by the pioneering Experiments in Art and Technology (E.A.T.) in 1966 and the Cybernetic Serendipity show in 1968. Likewise, in 1983, Donald Schön proposed the concept of 'reflection-in-action' based upon observation of professional practitioners at work, but it was not until the late 1990s that this extended into other fields such as human-computer interaction and design. Today his thinking is not only influential in creative arts research but is being reformulated and extended as a result of finding new ground in which to grow. At the same time as discovering Schön, practitioner researchers are looking further back for action based methodologies and discovering that the writings of John Dewey and Kurt Lewin are a rich source of inspiration and action for creativity.

Whilst it is beyond our scope to discuss all of these interacting influences, the timeline provided on pages $$ gives an overview of that history. The first part of this historical timeline, which is based on an earlier one by Nicholas Lambert, summarises the development of computer-based art from pre 1900 influences through to the evolution of a variety of different forms of digital art. The second part extends the coverage to include the 21st century work relevant to this book. It shows when the works discussed in the book were made, when key publications came out and exhibitions held and when the relevant technological advances occurred.

The Aesthetics of Interaction

The art that forms the basis of this book is interactive and primarily digital. The contributors are artists who talk about their creative practice and other professionals contributing to or studying that practice. This is not a book about art criticism or cultural theory, written by observers of art, in which the finished art object dominates. It is a book about making, and thinking about making, art and the research described is concerned with understanding and advancing interactive art from a range of practitioner perspectives.
The contributors to this book are also part of a community that is establishing a discourse about the aesthetics of interaction, one that is firmly based on the practice of interactive art. We need to be able to see what happens and how artists and audiences respond before being able to provide enlightening interpretations of the nature of aesthetics in interactive art. As will become clear from the contributions in this book, discussions about art making by practitioners often tends to concentrate on the practical matters of making and evaluating. Aesthetics are fundamental to what is going on but are often only implicitly referred to.

It might be thought that a book with interactive art as one of its main themes would often refer to aesthetics. In point of fact, the term hardly has a mention. Now why is that?

The painter Barnett Newman famously said, “Aesthetics is for the artist as ornithology is for the birds.” It is not that Newman, or any other artist for that matter, is not interested in, or knowledgeable about aesthetics, it is just that such knowledge does not usually seem to inform the making of art in an explicit sense. So it is quite normal to find that artists’ discussions are either about the practical matters of doing or, at times, about broad theoretical issues that simply provide a context within which they work. Which is not to say that aesthetics is uninteresting to them. The aesthetics of interactive art have not been debated all that much and still need to be developed. As Margaret Boden put it, “...there’s no established aesthetics associated with…” interactive art.

The word ‘aesthetics’ is often used to identify an artistic position, a collection of preferences or attitudes, or a style, for example as in ‘minimalist aesthetic’. Is there a unique or single ‘interactive aesthetic’? Probably not, because interaction can occur in any number of different ways or styles, but it surely is the case that it can exhibit, for example, a minimal aesthetic within the interaction. The actions and the feedback can be designed to be minimal or florid and ornamental, for example. Thus, we apply aesthetic concepts to “the nature of interaction itself” and not just to the appearance of the objects that facilitate it, the appearance of the structure that the artist makes. Examples of the properties that Boden identifies as pertaining to aesthetics of interaction are predictability, control, ‘attributability’ (to what extent is the audience able to detect that they are causing change, for example) and the speed of feedback (‘response time’ in computer terms). The quality of the interactive experience provides different dimensions for the aesthetics of interaction ranging from subversion to camaraderie, from sympathy to danger, from exploration to discovery. Choosing between them is part of the aesthetic decision making process that the artist engages in.
A word closely associated with ‘aesthetics’ is ‘beauty’. This is not a word, like ‘aesthetics’, that we hear spoken that often by artists. Perhaps, in this case, that is because it is often associated with pleasure, whereas art has many dimensions and ambiguities. If we take a bold view of the meaning of ‘beauty’, the term can apply equally to the tortured late works of Mahler and to the joyous late works of Matisse. So, what can we say about the beauty of interaction? Can it be beautiful? Well, when we say that we see or hear beautiful things we generally mean that we have a particular experience, an experience that may be associated with pleasure, or some other emotion, or may be described in more neutral terms, such as ‘spiritual’. There seems no reason not to assume that the act of interacting, of obtaining a particular kind of feedback from an artwork, cannot provide just such experiences. Certainly, in ordinary life, speaking to a baby and seeing a smile in response gives us a positive experience. Interactive art can lead to experiences that can cause us to say that the work is beautiful. Toshio Iwai’s ‘Seven Memories of Media Technology’, for example, consists of seven boxes, each containing a media object such as a flipbook. The lid of each box is a transparent touch screen and the audience can play with the object by stroking the screen. The interaction is gentle and beautiful to experience.

In this book, we find various authors proposing, making and analyzing different forms of interactive experience. Many are concerned with the study of psychological responses to interactive art, even though they may not be concerned with any deep aspect of psychology. They are concerned with audience response to interactive experience. One can see in their work a concern for the creation of beauty in interaction from many different points of view. From an aesthetic perspective, we might say that much of the book is concerned with coming to a deeper understanding of beauty in interaction or, perhaps, the aesthetics of interaction. Whilst artists may not always talk about making aesthetic judgments, the creative practitioners writing in this book are continually making decisions about aesthetic issues. The making of artworks may arise from a theoretical context or may lead to theoretical advances, but as a work is made, the process involves countless moments when the direction taken is aesthetic. Some artists use the word ‘intuition’ to describe the way that they make judgements or decisions at certain points in the creative process. Donald Schön has claimed that the use of the term ‘intuition’ is often a way of saying that nothing more will be said about it\(^1\). It can be a way of closing off discussion. In other cases, no explicit justification at all is made for making a particular artistic decision.

Whether the discussion is closed off or simply avoided, there is no doubt that artists make very firm and committed aesthetic judgments. As Wittgenstein said, in his example of the expert tailor, “The good cutter may not use any words at all, but just make a chalk
There is no question that the jacket should be exactly this length and there is nothing more to be said about it.

Artists have been exploiting the participatory expectation of our times by creating works that invite the spectators to participate in different experiences from playful to political, from spiritual to satirical. In the process, they are developing frameworks and criteria for designing and judging their works in an ongoing process of interacting between practice and research. The role of research in creative practice is critical to the development of practitioner perspectives on the aesthetical dimensions of interactive art. The way the artists in this book are contributing to the aesthetical dimension of interactivity is explored further in chapter 1, 'Interactive Art': pp$$.

A New Research Paradigm for Creative Practice

Respect for the idea of research in art, or even art as research, has a long history amongst artists. In 1923, Kandinsky proposed very explicit art research tasks in his plan for work in RAKhN, the Russian Academy of Artistic Sciences$^{xiii}$. The purpose of this proposed research was explicitly in support of the construction of works of art, as against simply understanding completed artworks. In the 1960s, the collective GRAV even included the word in its name: GRAV stands for Groupe de Recherche d’Art Visuel$^{xiv}$. The group wanted to stress their desire for a more objective approach to art making and saw research as a way of achieving that. In the context of art and technology research, a very important initiative, also in the 1960s, was E.A.T., the Experiments in Art and Technology group that grew out of (but was not part of) Bell Laboratories, the American telephone company's world famous research arm. E.A.T. brought leading avant-garde artists together with prominent engineers to push the boundaries of the possible in art form$^{xv}$. E.A.T. did not frame their work in terms of ‘research’, but, from a contemporary perspective, we are bound to view it as part of this research history. In a book on previous research, “Explorations in Art and Technology”$^{xvi}$, the chapter entitled 'Context' gives a little more of this history and also includes an interview with Billy Kluver, the founder of E.A.T.$^{xvii}$.

Today, bringing research into creative practice is necessary for a number of reasons. In a very real sense, the audience is part of an interactive work, such that an artist cannot understand the work fully without seeing the audience interacting with it. Sometimes artists need to know more about their audiences than casual observation on their part will allow. Where, for example, the artist wishes to understand whether the artwork ‘works’ in a particular way with different people from diverse backgrounds, this might only be achieved by way of systematic studies. Another reason is that very often there is no ‘off the shelf’ technological solution that can be incorporated into the new art system
they wish to create. If this is the case, and it often is, research is needed to identify novel technologies that can make novel art systems possible. This happens frequently as part of practice-based doctoral research and it is simply regarded as a normal part of developing innovative interactive art. Regardless of the situation, however, cross-disciplinary expertise and knowhow is needed and this necessitates collaboration between people from different backgrounds.

The volume of practice-based research being undertaken is growing. A survey of developments in the UK by Judith Mottram\textsuperscript{viii} covers art as well as design, but does not include the practice-based art research that takes place in other disciplines such as computer science or humanities. Nevertheless, this survey demonstrates the growth of the area. A relatively small number of groups have developed full practice-based art research programmes in the digital arts. A well-established example is the Planetary Collegium\textsuperscript{xx}, which has its hub at the University of Plymouth in the UK. In this context, Roy Ascott, leader of the group, and his colleagues have facilitated many artist led research programmes resulting in PhDs in digital art practice. Each group conducting this kind of research has evolved its own set of norms and no two are the same, although the research trajectory model discussion in the chapter ‘Research and Creative Practice’ could be used to compare the various norms in terms of what is prioritised most, what is necessary for each research project and what counts as a valid outcome. A survey of this kind is, however, beyond the scope of this book.

Creative practitioners, inside or outside Higher Education institutions, may or may not conduct formal research and both options are valid. We are concerned in this book, however, with creative practitioners who are engaged in research – practice-based research. Some commentators have argued that there is dissatisfaction with existing models of research amongst practitioners and academic communities and that there can be no single model of research for both practitioners and researchers. The solution is, they say, to create a new research community springing from the two ‘parent’ communities that would have its own values and from which a distinct research model could arise \textsuperscript{xx}. This is, in fact, what is already happening in interactive arts research. Practitioners are adopting approaches to research that transcend the values and norms of existing arts research, sometimes by migrating into other disciplines where the process of making and evaluating artefacts is already embedded in research activities.

The emerging community of practitioner researchers that provides the impetus for this book is one such example of a new research community. It became apparent during its development that many of the values that lie behind the approaches adopted were often implicit rather than explicit. This is a natural outcome for any community of interest
where shared ideas and actions are expressed in terms familiar only to the community itself. Some of the working assumptions about how to do practice-based research were not necessarily shared with those working in university art and design faculties. For example, in the doctoral research represented in this book, investigating the state of the art was almost always a required part of their thesis: this involved an in-depth survey of the context (including art works) as well as research methodologies.

By publishing the outcomes of their research more widely in order to reach audiences beyond their own, the intention is to make their contributions to knowledge more accessible. In doing so, it becomes clear that whilst practitioner researchers in the interactive arts have overlapping interests with other practice-based researchers, they are, nevertheless, differentiated by two factors in particular: first by the technological innovation required of the digital media required for interactivity; and second, by the goal of creative engagement with artworks for active audiences. Making artworks or ‘art systems’ to meet the expectations of this age of interaction demands a new kind of research that, whilst acknowledging the legacy of tried and tested methodologies, is driven by the special needs of this continually evolving field.

**Studio and Living Laboratories**

For creative practitioners in the interactive arts, the limitations of standard laboratory research have led them to adopt different kinds of settings based upon models from art studio practice and public museum experience. The realization of the studio-based environment extended to the ‘living laboratory’ has provided opportunities for practitioners to carry out research that enhances creative practice at the same time as developing methodologies for generating and communicating new kinds of knowledge.

A fundamental requirement of a research environment for creative practice is that it supports and enables the development of new forms of art as well as producing the knowledge that is required to achieve such outcomes. An environment for creative practice with digital technologies must be a highly responsive, supporting iterative process where new insights are fed back quickly into the development process. This co-evolutionary process is fundamental to practice-based research where the existing technology is used in a new way and from which research derives new answers: in turn, the use of new digital technology may lead to transformation of existing forms and traditional practices in art. The continual iteration of the practice-based process in interactive digital arts is not unfamiliar in other technology fields such as interaction design and, similarly, it can lead to innovative outcomes.
A key aspect of the interactive art practice described in this book is an organisational model that brings together studio based and public museum and gallery research. Many of the contributing practitioners began by making prototypes of their works in a university studio setting, which was a place to make works and then test them to a point of sufficient robustness for wider exposure. Once this had been achieved, they were then in a position to install the interactive works in a public museum where they were exposed to public scrutiny. The studio setting was called Creativity and Cognition Studios, or CCS, a space within the University of Technology Sydney, that performed the role of a studio laboratory, equipped with specialist equipment and facilities that enabled observation and recording of interactive situations. The public exhibition space, in Sydney’s Powerhouse Museum, was called Beta_Space, a site for exhibiting experimental work-in-progress, and for working in partnership with audiences. This combination proved vital for success.

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In the creative arts, the studio is a ‘natural’ working environment where the artist dreams, explores, experiments and creates. It is usually a closely guarded personal space in which the works in progress are brought into being, assessed and made ready for exhibition or sometimes discarded. The main purpose of the studio is that it is an experimental or a development space, as distinct from an exhibition space. The existence of studios of whatever kind, are as essential to the artist as the laboratory is to the scientist. In the 1990s, the origins of our organizational framework, dedicated to facilitating and investigating creative practice in the area of art and technology, was the Creativity and Cognition Research Studios (C&CRS) based at Loughborough University, England. The Studios provided an environment where artists and technologists could work in collaboration on art projects and was partially funded by major research grants from the EPSRC, the UK’s preeminent funding body for science and engineering research. A specific objective was to facilitate the co-evolution of art works and technological innovations and, at the same time, to carry out research into the process. A book was published that gave a full account of much of this work and that included contributions from many of the artists and other practitioners involved. This research introduced a "studio as laboratory", which represented a new avenue of research in interactive art. Up to this point all the effort had been focused upon realizing the concepts as material artefacts and evaluating them in the studio within the project group. There was, however, a wider audience and context to consider and this was addressed when C&CRS migrated overseas and was reborn as CCS. What followed was an attempt to address the gap in awareness of interactive art and a need to study such art in 'real' contexts by establishing Beta_Space in the Powerhouse Museum in 2004.
The name Beta_Space derives from the software development practice of releasing new applications and products to the public before they are completed in order to gather feedback and improve their quality. Beta_Space enables practitioners to explore artistic concepts, prototype art systems and evaluate experiences with real audiences. From the outset, the audience is involved in this process, changing the relationship of the artist and curator to the audience, and the relationship of the audience to the artwork. In these ways, the museum plays a vital role as a laboratory for the creation of new work and new knowledge. It acts as an ever-changing exhibition space showing work at various stages of production, with exhibits lasting between one week and three months. The origins of Beta_Space and the course of its rich and varied interactive art exhibitions is, of course, an interesting story in itself and more can be discovered about this in the following chapters.

Beta_Space is a new and powerful organisational model that enables practitioners to explore artistic concepts and prototype art systems and evaluate experiences with active audiences. Beta_Space, and its fellow living laboratories, blur the distinction between production and presentation through an iterative approach to creating and displaying art works. From the outset, the audience is involved in this process, changing the relationship of the artist and curator to the audience, and the relationship of the audience to the artwork. In these ways, the museum is playing a vital role as a laboratory for the creation of new work and new knowledge.

**The Creative Practitioner’s Voice**

A distinctive stance of the book is that it is practitioner led and multi-disciplinary in character. It is informed in part by the realisation that much of the discourse in arts research, and practice-based research in particular, has been dominated by voices who do not participate in creative practice themselves. At present, a large part of what creative practitioners do, and how they think about what they do, is reported by those viewing disinterestedly from outside. Many artists remain silent, often fully aware of how restricted that view is. As Sullivan says, “this makes it easier for artists to pass on the job of defining and defending what they do to critics, aestheticians and historians”xxiv. This is fine for some but others, particularly those working within the university systems across the world, are beginning to recognise that it often means that the terms of reference and support are not always favourable. If our understanding of the nature of practitioner derived knowledge is to be extended in a way that begins to have a beneficial impact on both research and practice, then part of the task of disseminating new thinking and knowledge from practice must fall to the practitioners themselves. A new community of practice-based researchers is developing that can address this issue.
This book is intended to contribute to the practice-based research discourse through the perspective of interactive art and the research approaches associated with this field of creative practice. It represents the outcomes of practice-based research in the interactive arts conducted in a multi-disciplinary environment. The subject matter falls into five main categories grouped as follows:

Interactive Art and Research
Curatorial and Reflective Practice
Collaboration and Communication
Creative Engagement
Art Practice

Each chapter has been allocated to one of the five themes. All address the main themes of interactive art, audience and practitioner research but at different levels of detail and advancing the field in different ways. In addition, Stephen Scrivener takes an expert outsider's view of the texts. His contribution is in two parts. In the first section of the book he outlines his personal position in relation to practice-based research and poses some questions that have concerned him over the years. At the end of the book he reviews the chapters and discusses how far his problems have answers within the book's contributions.

In the chapters that follow, practitioners describe their work of making interactive art or studying audience behaviours with such art or studying the interactions between the various players. None of the authors are pure theorists, although many contribute to theory from a perspective that is informed by practice. The contribution of this book provides a view of practice-based research that expands the opportunities for creativity. There are many links between the book's chapters that cut across the chosen themes. They represent only one way of slicing up the complex set of interesting issues. The research described is intended to support the creative practice of the artist and the exhibiting of interactive art. This is a book about making interactive art that presents an innovative research-based approach to creative practice. Taken as a whole, it presents a new model of creative practice which points towards new ways of advancing knowledge and new ways of making art.
Notes

i Ai Weiwei’s *Sunflower Seeds*:


iii Stephen Wilson’s 2002 book *Information Art* was the first to attempt a full classification of art and digital technology.

iv The eleven classifications are given abbreviated names. Interactive Art is termed ‘I-Art’ (Boden and Edmonds, 2009).

v GRAV: Groupe de Recherche d’Art Visuel. In the 1966 manifesto they promote, for example, the “active participation of the spectator” (GRAV, 1966).

vi Discussed at length by Edmonds, Bilda and Muller (Edmonds et. al., 2009).


viii See Boden (2010: 210)

ix (Boden, 2010: 217)

x Toshio Iwai’s ‘Seven Memories of Media Technology’ is in the collection of ICC, the InterCommunication Centre, Tokyo (Iwai, 1997).

xi In the Preface to his *The Reflective Practitioner,* Donald Schön says, “When people use terms such as ‘art’ and ‘intuition’ they usually intend to terminate discussion rather than to open up enquiry” (Schön, 1991: vii-viii). In fact his book goes on to show, in some detail, how it is possible to unpick and open up enquiry about things that we tend to label intuitive.

xii Ludwig Wittgenstein used the tailoring of a suit as one of his examples in a lecture on aesthetics (Wittgenstein, 1966: 5).

xiii Kandinsky wrote a plan that described both his research and his lecture series plans in which the perceived importance of a research activity for artists was quite clear (Kandinsky, 1923).

xiv See note above on GRAV


xvi The book ‘Explorations in Art and Technology’ included reports on the research results and personal descriptions by the participants and a number of artists who were associated with the work in various ways (Candy and Edmonds, 2002).

xvii This section of the book outlines the history and includes, as well as the Kluver interview, reflections on early computer-based art by pioneer Frieder Nake (Edmonds and Candy, 2002: 5-18).

xviii Judith Mottram presents the results of a UK survey and describes some of the motivations for undertaking it, such as finding a reluctance amongst PhD students to complete a ‘state-of-the-art’ report (Mottram, 2009).

xix See http://www.planetary-collegium.net/

xx See, for example, the discussion by Biggs and Büchler (Biggs and Büchler, 2011: 98).

xxi One paper about the Beta_Space development and the notion of the living laboratory was published in CoDesign (Muller et al., 2006).

xxii This is the book by Candy and Edmonds referred to in note xiv.

xxiii The studio as laboratory research approach is described in a paper by the COSTART research team (Edmonds, et. al., 2005).

xxiv This quotation is taken from Sullivan’s 2010 publication (Sullivan, 2010, p85)