

Rigorous Interdisciplinary Pedagogy

- five years of ACE

Simon Penny

**founding director, graduate program in
Arts Computation Engineering
at the University of California, Irvine.**

penny@uci.edu

Published in

Convergence: The International Journal of Research into New Media Technologies

[SAGE Publications](#), Jan 2009

Abstract

The emergence of media-arts and digital cultural practices has provided a highly charged context for the development of interdisciplinary pedagogy, combining as it does, practices and traditions from historically, culturally and theoretically wildly divergent disciplines. This paper addresses aspects of effective interdisciplinary educational process, attending to questions of pedagogy, theory and institutional pragmatics. In my analysis, the key components of such a project are: deep technical training and understanding; deep training in artmaking and cultural practice; deep theoretical and historical contextualisation, and an open and rigorous interdisciplinary context which maximally facilitates the negotiation of these often divergent ways of thinking and making. In building such interdisciplinary practice in the context of a campus, one abruptly confronts the discontinuity between rapidly changing fluidity of the contemporary moment and the relative stasis of institutionalised disciplines which have an investment in maintaining their identity in the face of such change. Implicit in the project then, is not simply the development of a context for deep interdisciplinary invention, but the formation of practitioners who are neither artists nor engineers, or who are equal parts both. In either case, this formation confounds the disciplines and creates a vacuum of institutional context which has resounding implications for the survival and flourishing of such initiatives and their practitioners.

Keywords

interdisciplinarity, techno-culture, digital cultural practices, media-arts, pedagogy, computer art, critical technical practice.

In order to do interdisciplinary work, it is not enough to take a 'subject' (a theme) and to arrange two or three sciences around it. Interdisciplinary study consists of creating a new object, which belongs to no one. Roland Barthes ⁱ

The main point to realize is that all knowledge presents itself within a conceptual framework adapted to account for previous experience and that any such frame may prove too narrow to comprehend new experiences. Neils Bohr ⁱⁱ

Preamble

The emergence of media-arts and digital cultural practices has provided a highly charged context for the development of interdisciplinary pedagogy, combining as it does, practices and traditions from historically, culturally and theoretically wildly divergent disciplines. This paper addresses aspects of effective interdisciplinary educational process, attending to questions of pedagogy, theory and institutional pragmatics. There is ongoing discussion about the relative merits of interdisciplinarity, multidisciplinary and transdisciplinarity, even antidisciplinarity. ⁱⁱⁱ I am here not so concerned to debate the merits of these approaches as to discuss what happens in practice when, in response to perceived need in pedagogy or research, an attempt is made to combine often divergent disciplines. Therefore (with apologies) I employ the term 'interdisciplinary' loosely. While this paper draws informally on the stories of numerous colleagues in many disciplines, locally and internationally, over many years, its primary reference point is the design and establishment of the Arts Computation Engineering interdisciplinary masters program at University of California, Irvine. I trust that, to the extent that they have faced similar interdisciplinary challenges, my colleagues in ACE and elsewhere will, in broad strokes, concur with my assessment of the problematics of interdisciplinary media arts education in particular and interdisciplinary education in general. ^{iv}

Technoculture, Interdisciplinarity and the Academy

Technologies emerge from specific (technical) cultures. Due, in our current era, largely to the logics of consumer commodity capitalism, novel technologies flow out across society, intersecting with existing cultural practices. The culture around us adopts and adapts these technologies, originating new forms and practices, and in the process, transforming itself. This process will continue, regardless of the involvement of formalised educational

processes – and some would argue that this is the best way for it to occur. Others would assert that the academy might embrace this context as a fertile zone of new knowledge and practices. This involvement arguably might open new areas of research and practice and simultaneously bring the intellectual and technical resources of the academy to bear on such developments. Educational institutions must assess whether they should play a role in this process and if so, what form should that involvement take and to what ends. The answer to these questions as they appeared to me in the early years of this decade (and century) was that one ought build an educational context which provided the relevant resources to train professionals who were well prepared to engage the challenge of building emerging techno-cultural practices. Demonstrably, no one discipline possessed all the requisite resources, so interdisciplinarity was necessarily implicit. In my analysis, the key components of such a mix were: deep technical training and understanding; deep training in artmaking and cultural practice; deep theoretical and historical contextualisation, and an open and rigorous interdisciplinary context which maximally facilitates the negotiation of these often divergent ways of thinking and making. In building such interdisciplinary practice in the context of a campus, one abruptly confronts the discontinuity between rapidly changing fluidity of the contemporary moment and the relative stasis of institutionalised disciplines which have an investment in maintaining their identity in the face of such change: a scenario reminiscent of the unstoppable force meeting the immovable object. Implicit in the project then, is not simply the development of a context for deep interdisciplinary invention, but the formation of practitioners who are neither artists nor engineers, or who are equal parts both. In either case, this formation confounds the disciplines and creates a vacuum of institutional context which has resounding implications for the survival and flourishing of such initiatives and their practitioners. This is a central issue of this paper.

Choosing a (soft) place between rocks.

Each institutional context offers particular structural and intellectual affordances and constraints for such enterprises. Generally speaking, to the extent that one embraces a notion of interdisciplinarity that is both wide and deep, a campus which combines liberal arts with sciences is a desirable location, because of the diversity of expertise. At UCI, ACE students draw on areas of practice as diverse as classical Chinese poetry and biomedical engineering, anthropology and mathematical logic. Each initiative, and each campus, finds its particular palette of disciplines and discourses to mix. For reasons which are largely historical, ACE positioned itself with Arts (plastic and performing), Engineering

and Information-and-Computer-Science as its three major and formal moorings, with less formal connections to humanities, social sciences and biological sciences. The presence of a vigorous and progressive school of Information and Computer Science was seen as, and has proven to be, an asset. But the campus affords minimal consciousness around 'design', as teaching in design and architecture are not present on campus.

From this perspective, establishment of such enterprises within institutions of narrower focus, such as conventional art academies or technical colleges, is challenging. Not only are certain resources absent, but perspectives of practice have theoretical and pragmatic effects. The rigors of technological invention are less likely to be understood or recognized in an art school. An art institution is easily persuaded of the fundamental importance of studio space, but not of the need for a linux cluster or a system administrator. And at root there are fundamental questions of what constitutes valid research. These and similar prejudices are mirrored, of course, in engineering and computer science, where processes of technical realization are native but poetics has no value at all.

The great liberty of such initiatives is the opportunity to shape a new practice outside the constraints of established structures. The price of freedom being (as it is) eternal vigilance, there is danger in such initiatives, and to those involved, in existing outside established structures. The danger is to find oneself 'off the map', stranded in a 'no man's land' unstructured by procedures which elsewhere have heuristically developed as a responses to needs over time. The required antidote to such all-too-common fates is attentive management which, like the attentive parent of a toddler, allows exploration but is there to catch her when she stumbles. Part of the responsibility of such a role is also, like a good parent, to listen. In the following essay, I attempt to address all these issues, from the abstract-philosophical to the administrative/pragmatic.

Introduction

Established in early 2003, the Arts Computation Engineering graduate program at the University of California, Irvine was designed around the notion that only a broad and thorough-going interdisciplinarity would meet the needs of a program purporting to equip practitioners in the merging fields of media arts and digital cultural practices.^v The fundamental premise of the ACE program was, and is, that a pedagogical program adequate to the emergence of a new range of hybrid techno-cultural practices must not

simply provide skills and knowledge, but must provide a context in which to identify and interrogate the structuring characteristics of these new practices. Based on experience of practice and pedagogy in the preceding decade, it was recognised that to apply traditional methods of one discipline to new tools emerging from a very different discipline creates a Pandora's box of theoretical conflicts which would continue to, as it were, rip through superficial veneers of rhetorics of convergence. To avoid this, and to place the practice on firmer theoretical ground - to, in fact, take part in the creation of that ground - a pedagogical program which could mix knowledge and practices of traditionally separate disciplines was required. Furthermore, such a program must be constantly attentive to the schisms and discontinuities which emerge when such practices are combined. Such a program demands, then, a broad understanding of the way that social, cultural, historical, economic and technical aspects mesh together and evolve. Further, a deeper, historiographical and epistemological study is called for, in order to determine which existing disciplines are called upon as relevant; to understand the way that fundamental commitments shape the value-systems of these disciplines and; to draw upon historical precedents in order to construct a sense of historical continuity.^{vi} And lastly, when these various forces are thrown into the crucible of interdisciplinary negotiation, in the classroom and the lab, we must remain alert as to which reagents react violently - who has the protective clothing, and who wears the burns. This perhaps fanciful analogy, in my experience, captures the intensity of some collisions of disciplinary world-views.

The agenda of the program then was to take an intellectual high road, expressly to *not* provide narrow vocational training aimed at one or other of the digital arts industries (graphics, animation, gaming, web-design, etc); nor to harness media artists to the cart of applied technical research; but to train a cadre of thoughtful practitioners who would be well equipped to make significant and innovative interventions in the evolution of these practices and in this interdisciplinary space: to play a role in the development of critical digital cultural practices comparable to Philip Agre's notion of *critical technical practice* in computer science.^{vii} The emphasis on technical and artistic practice and production is central - ACE does not aspire to train theorists of other peoples' practice. The reconciliation of theory and practice is a central dimension of the interdisciplinarity of ACE. Indeed, the very separation of theory and practice is taken to be a problematic legacy of an academic Cartesianism of questionable validity and relevance.

Although this paper takes as its object a particular program at the interstices of particular disciplines; it is written in the hope that, along with finding relevance in the media arts pedagogical community, it will be found to have more general relevance to the wider field of interdisciplinary pedagogy. This paper then:

- discusses the motivations, rationales and intellectual challenges involved in the pursuit of a deep and rigorous interdisciplinarity
- explores in general terms the challenges involved in such pursuit in the context of the academy and the modern campus
- examines the institutional pragmatics of a pedagogical program of such aspirations in such a context, drawing on five years of in-the-trenches experience with ACE.

Deep Interdisciplinarity

As human culture is immersed in a historical process, so knowledge is a moving target - new realms present themselves as a result of theoretical, social or technological change. Universities and institutions of higher learning have generally recognised a responsibility to foster exploration into such areas. Yet these interests are fundamentally at odds with the institutionalised nature of the larger organisations themselves. As disciplines form and elaborate, they necessarily build an administrative and institutional superstructure around themselves. As personal power and vested interests come into play, these structures crystallise, they become resistant to change, increasingly unable to adapt to new contexts. Yet new contexts continue to arise and the academy must accommodate and explore them or become moribund. Interdisciplinarity has of late become a mantra of universities because, presumably, it has been noted that significant innovation originates from outside disciplines at least as often as it originates from within them. It would seem self-evident that this is because disciplines are inherently conservative. There are sound reasons for such institutionalisation, and the Marxist dream of the institutionalisation of permanent revolution seems intractable in long-term practice. If the entire institution cannot *flow*, then at least one hopes that there can be some flow around and between the immovable objects. Hence, one assumes, the general enthusiasm for interdisciplinarity as a middle way. It is where the action is, where the new knowledge is, and it is therefore where campuses with a commitment to research would presumably want to be.

Deep and Shallow

Many things pass for interdisciplinarity. I want here to distinguish between a more or less shallow instrumental mode, and what I call *deep interdisciplinarity*, which, I argue, while more challenging, offers potential general benefits in addition to the immediately identified pragmatic goals. An instrumental approach to interdisciplinarity sees such as necessary in order to bring together practitioners of relevant backgrounds to address complex projects which demonstrably cross disciplines, for example, the designing of a levee system to protect a city from floods while maintaining river ecology and navigability for cargo transport.

There is a simplistic assumption abroad that to practice interdisciplinarity, one can simply drag the methodology or subject matter from an outlying discipline into ones own (with a click of the mouse, as it were). In its most cynical and unenlightened forms, such a process is inherently imperializing and retains an unreconstructed disciplinary hubris. It retains the master discourse status of the 'home discipline', and is thus unable to recognize that in the process of uprooting the products of the outlying discipline and bringing them 'indoors', they might in the process wither and die, transformed and reduced like bleached specimens preserved in formalin. In the worst cases, shallow interdisciplinarity resembles Viking-like academic pillaging and plundering raids, pulling exhibits from distant disciplines which, torn from discursive context, change or lose their meaning in the process. To maintain a conception of interdisciplinarity in which one's own discipline occupies a central position while others are arrayed on a periphery is a form of hubris which robs interdisciplinary inquiry of its potential.

The recognition that the specialist expertise of ones own discipline is necessary but not sufficient to a certain task can result in more or less courageous responses. The less courageous is to retreat into the safe world of ones discipline and assert the sufficiency of its expertise. The more courageous response it is accept that it will be necessary to engage with others whose expertise is different from, often incompatible with or even incommensurable with ones own. When such a realization is carried forward, one confronts an ontological chasm, which, when considers, can throw light upon, not only the differences between disciplines, but on uninterrogated assumptions within ones own discipline. These ontological differences can concern, for instance, fundamental motivations and justifications for working, methodologies and research processes, and ultimately, question assertions regarding knowledge and truth. Such realizations relativise discipline-based realites. As such they reveal that disciplines are cultures and that

disciplinary partisans come, with or without full awareness, to share in a disciplinary world view which validates certain kinds of practices and not others, affirms certain ways in which the world is understood to be and renders others incomprehensible or invisible. For instance, while in some disciplines the notion of emergence even the notion of supervenient causation are well accepted, in other disciplines where reductivist methods are considered fundamental, emergence is regarded as a mysterious and mystical notion which cannot be thought within the disciplinary terms of reference.

Interdisciplinarity can serve (at least) three functions. The first is the pragmatic, applied function I call 'shallow': the task at hand demands a range of expertise which exceeds disciplinary boundaries. The second is more abstract and is aimed at epistemological and ontological concerns I refer to as 'deep': the elucidation and clarification of the structures and commitments of disciplines themselves and the relations between disciplines. Such consideration can in turn lead to a third function: the identification of new areas of research and practice. This third can arise out of the first, but without serious commitment to the second, it may founder on misunderstandings arising out of mismatches of technical jargon or, more deeply, incommensurabilities in the assumptions which ground disciplines.

Knowledge

We labor under the illusion that the traditional disciplinary territories carve up the plane of knowledge in a manner as orderly as a checkerboard. Nothing could be further from the truth.

The topology of knowledge is not a simple plane - it is more a chaotic folded space of fractional fractal dimension. All knowledge schemes imply a plane, (or manifold) through a multi-dimensional state-space of knowledge, the dimensions of which are indefinable in extent and number. Such a described plane or manifold, by virtue of its fundamental assumption and structuring metaphors, privileges certain ways of ordering knowledge, indeed, determines what constitutes knowledge and precludes other knowledge, thus rendered non-knowledge. This privileges ways of thinking which become 'natural' to the discipline, generating the particular order, a disciplinary *umwelt*. Such knowledge, then, is organized according to the world view of the discipline. Such organizations of knowledge serve a discipline well. Indeed, a discipline may be said to be nothing but its particular knowledge order. Deep Interdisciplinarity is the negotiation of the intersection of these planes and thus the contextualisation of these planes in the larger multidimensional space of knowledge. This is a tacit acceptance of relativism of any

disciplinary perspective. Such negotiation can lay bare axiomatic assumptions and render them up for analysis in the daylight, so to speak. In this way, interdisciplinary initiatives render a service for the disciplines by making the implicit foundations of a discourse explicit. (Hence the ACE slogan 'danger of permanent damage to axiomatic assumptions'.) This 'thinking outside the box' can in turn lead to deep and generative questions, such as Irwin Schrödinger's question 'why are atoms so small?' or Gottfried Leibniz' even more fundamental: 'why is there something rather than nothing'? Such questions often open up entire new research fields.

Inside and Outside Disciplines

No practice is inherently interdisciplinary. Practices are interdisciplinary only with respect to a more or less arbitrary and historically particular demarcation of 'disciplines'. There was a time when there was no clear distinction between art and science. Da Vinci was not interdisciplinary. Contrarily, on a personal level, everyone is interdisciplinary, in that they combine a variety of life experiences including, but not limited to, formal educational training, and significantly generative interdisciplinary moments often occur when non-scholastic life experiences are brought to bear on scholastic contexts. Fields of interdisciplinarity are themselves inherently transitory and give way to the formation of disciplines. Indeed, there is a fair argument that, as of around 2005, the descriptor 'new media' has become an anachronism, and the 'field' has moved into a post-interdisciplinary transition phase, it is actively undergoing the transition to disciplinary status via processes of aggregation, solidification and reconstitution.

Silos

One might propose that the kinds of knowledge which are valorized or even possible within a certain disciplinary world view is constrained by the rules and assumptions which structures its practices and undergird its criteria. To extend this Goedelian metaphor, one might propose that there is therefore, in the interstices between disciplines, spaces of knowledge awaiting exploration.

One way to envisage the potential of interdisciplinarity is the familiar *silos* model.

According to this metaphor, disciplines mark territories on the ground, then build skywards, refining and specializing and simultaneously building a cylindrical tower. When you're one hundred meters/years up, you can't easily move from tower to tower. Nor can one access the spaces between the silos. Yet in my opinion, the situation is more desperate and the model requires the following refinement: the original ground is the surface of a sphere, so as the silos grow taller, the spaces between them get larger. This implies that there is an increasing amount of knowledge space between the silos, more knowledge space than is contained within them. If this image seems valid, then this is a strong argument for interdisciplinarity. We can imagine throwing a line between these towers, and building a delicate web or network high in the air. This is, in fact, what it often feels like to be attempting such interdisciplinary initiatives. They are often associated with a high level of insecurity and some trepidation.

The shock of the new

Disciplines are contingent historical constructions, with tattered edges which overlap in untidy ways. Like any other aspect of culture, they are products of a specific historical moment. It therefore follows that they are framed with respect to that context. Hence, a situation which arises after that moment presents a challenge: can it be usefully discussed and dealt with within the framing of the discipline? Or is it necessary to develop novel methods to deal with the novel situation? If the latter is true, then how is this achieved? One way it can be achieved is by collaborations between existing disciplines. This often results in the emergence of new fields. In the contemporary context, we are constantly confronted with such novel conditions, the emergence of bio-medical engineering or specialized branches of anthropology dealing with online communities are examples. One rich source of such novelty is the interaction between emerging technologies and social and cultural practices. The assumption that technologies are gestated outside culture is false. Cultures give rise to technologies with particular qualities; other cultures, adapt, detourn and subvert them.

Clash of world views

It is not unusual for several disciplines to claim the same subject matter, from differing perspectives, and yet be unable to share their knowledge. This is often because hidden but structuring axioms are not shared. The space of knowledge and a practice is heterogeneous and, contrary to humanist precepts, it can be that two disciplines do not

share foundational axioms. A core problem of deep interdisciplinarity is the negotiation of such immiscible and incompatible contexts in a way which affords practice. In fact, the very friction between such world-views is often generative of practice.

Many of us, I suppose, have found ourselves working with colleague from another discipline, and have experienced odd confusions and misunderstandings, only to realize that different disciplines apply highly specific technical meanings to particular words. It is not uncommon in reports of interdisciplinary projects gone awry, that participants will report, for instance: 'it wasn't until an informal conversation three months into the project that I realised that when they said 'x', we had assumed they meant the same thing that 'x' means in our discipline and our discussions until that point had been foundering on this misunderstanding'. Think for example of the word 'representation' and its specialised meanings in various disciplines. Such confusions demand then, a conscientious working through of the continuities and discontinuities between the disciplines. Often these conversations, if they are pursued rigorously, descend to the fundamental axioms and commitments of each field. So here is a great value in interdisciplinarity: to allow interrogators with differing backgrounds to query a specific context. Often, such outsiders can see the infamous pink elephant in the middle of the room, while the training of insiders has encouraged a certain path through the room which results in the gaze always bypassing the said rosaceous pachyderm.

Interdisciplinary relativism

All disciplines seem to have at their root, an array of unquestioned axiomatic assumptions (sometimes difficult to distinguish from articles of faith) which allow the pragmatic business of the discipline to proceed. Disciplinary partisans are immersed in this environment like fish in an aquarium so they are seldom drawn to interrogate it. In technical disciplines, ideology is often reified as technical principle. Control theory, for instance, naturalises a centralised, instrumental organizational mode where action is directed to a specific measurable goal. ^{viii} It is inherently teleological. Clothed as axioms, values are covert. Ascription of purported objective status to certain procedures and methodologies may be understood as sidestepping the need to make explicit an implicit politics. In any field, there are those whose find the 'discipline', its premises and fundamental assumptions, a comforting constraint. Disciplinary fences protect them from the spectre of intellectual agrophobia. It takes a certain courage to willingly abandon such

security. Never mind that such fences are usually arbitrarily imposed upon the landscape without underlying consistency or logic. ^{ix} As Philip Agre has observed, critical inquiry is often regarded as unwelcome by partisan disciplinary practitioners, and is perceived as an aggressive intrusion. ^x

Courage and Compassion

The importance of this kind of practice is, at least in part, in its preparedness to ask inconvenient questions and present counter-examples to accepted rhetoric. Such interventions and their perpetrators are anathema to institutions and disciplines, which are inherently conservative. As Machiavelli observed long ago, *Innovation makes enemies of all those who prospered under the old regime, and only lukewarm support is forthcoming from those who would prosper under the new.* ^{xi} But when one attempts to pursue interdisciplinarity, one interacts with people, as well as with institutions, and people are somewhat unpredictable in their response to the challenges interdisciplinarity presents. So successful practice of deep interdisciplinarity therefore requires certain psychological aptitudes:

Humility:

- professional humility in order to begin from the assumption that the axiomatic assumptions of the 'outlying' discipline may be just as valid or just as arbitrary and contingent as those of one's own.
- humility also in negotiating the insecurities of real or perceived dilettantism. As an interdisciplinarian, one is always open to the criticism of superficial knowledge of a specialized field. Notwithstanding that this criticism is sometimes deployed defensively, one must maintain the professional humility to admit that one does not know, and to view "not knowing" as a condition of possibility and not as a lack. In many academic settings it is rare for anyone to admit that he/she does not know. Often, indifference and even resistance to new areas of investigations stems from fear of being perceived as not knowing.

Intellectual rigor:

- to negotiate the heady epistemological and ontological challenges. (It may be possible to assert a common foundation but it is equally likely that the disciplines will share no common ground).

Courage

- because one is required to relativise one's own commitments, to examine them as rigorously as those of the foreign camp. This always allows for the possibility that one's own assumptions may become unstable.
- also because few people have the moral substance to thank you for destabilising their world view. In fact, a common reaction is a deep anger, sometimes expressed in violent ways, more often as denial expressed in banishment.
- and because such deep interdisciplinarity, however intellectually rigorous, challenges the organization and power structure of the academy.

Interdisciplinarity and Institutional Realities

Many of us find ourselves in institutional contexts in which the virtues of interdisciplinarity are trumpeted, yet such initiatives often founder. When causes are sought, in many cases, it is felt that infrastructure was inappropriate or lacking. This complaint appears to be more common the broader the reach of the initiative in question. That is – the more ambitious the intellectual dimension of the project, the more challenging the administrative task. Nor is it difficult to imagine why this might be. An initiative between say, French and Art History, or between Chemical Engineering and Chemistry, is destined to proceed relatively smoothly not simply because fundamental assumptions about knowledge, research, and teaching are held in common, but because much is shared in the respective administrative cultures – Engineers and scientists (in the USA) are familiar with the administration of NSF grants, all humanities departments are familiar with procedures for academic publication. Often, such enterprises share a common superior administration – a school, college or faculty – and this provides a context in which problems can be resolved. It is when an interdisciplinary initiative crosses such boundaries, and seeks to draw upon personnel and resources in diverse disciplinary areas, that the troubles start. ^{xii} In schools, and colleges, administrative cultures evolve to adapt to specific local needs. Often then, when attempting to interface two such cultures, all kinds of rifts and chasms open up – and must be bridged. As often as not, such rifts are not superficial, but are the exposed edges of deep epistemological or ontological fault-lines.

A note on disciplinary hubris

Media artists feel interdisciplinary, in part because they use tools which are properly the property of another discipline. ^{xiii} Moreover, they are conscious that they are reaching, across and up, as it were, to a discipline which carries a rather positive self-image – of contemporary relevance, economic leverage and scientific rigor. Contrarily, in many professions there seems to be a generally held but naive belief that anyone can be an artist. The combination of these causes a devaluing of whatever knowledge, skills and sensibilities might be the property of the arts fields, or the property of an individual practitioner who might have trained and practiced for many years. These two conditions create a context of disciplinary hubris – the assumption that one's own discipline has a certain master-discipline status and that implicitly, the value of some more or less remote discipline is lesser. Disciplinary hubris, as I argued above, is a serious obstacle to deep interdisciplinarity. By deep interdisciplinarity, I mean not simply the poaching of

techniques or subject matter from another discipline, nor collaboration between two closely related sub-disciplines. Instead, the kind of interdisciplinarity which I hold as truly valuable involves the willingness to reflexively consider the assumptions of ones own field from an external viewpoint, to interrogate the values underlying the methodologies and techniques of ones own discipline. ^{xiv}

A typical component of the disciplinary hubris projected onto the arts is the notion that artists are usefully subcontracted late in a development process to provide visual style and effective communication. While management of persuasive and communicative sensorial effect is an important part of arts practices, the development of conceptually coherent projects from a heterogeneous field of possibility, and the critical skills involved, are an aspect of arts practice which have value at the beginning rather than at the end of a project. The holistic modes of inquiry practiced in (some aspects of) the arts offer techniques to lay bare these meshworks of underlying assumptions and open them to the light of day, as it were, for interrogation. While such inquiry may be locally and temporarily uncomfortable and even destabilizing, it results in more coherent projects and it must ultimately have a positive effect for the discipline, for research and for the academy.

Aspects of Interdisciplinary Pedagogy at ACE

Many institutions continue to grapple with the positioning of (so called) 'new media' and 'new media arts' pedagogy, particularly with respect to gaming and game culture. While ACE was administratively positioned across schools of Engineering, Information and Computer Science, and Arts – involvement of faculty and fields in humanities and social sciences has been critical (no pun intended). Indeed, my preliminary analysis of pedagogical requirements and existing programs indicated that many existing programs were rooted in one discipline with alliances to another: some combined technical science practice with input from literary, critical and media theory, some were based in the arts with input from computer science, etc.^{xv} According to my analysis, each of these inherently heirarchical two-way alliances was suboptimal – nothing short of a thoroughgoing three-way interdisciplinarity was adequate to the task. Hence my image of ACE as an (inherently stable) three legged stool – the three legs being: art practice, technical knowledge and critical and historical purchase. But a *mélange* of these is yet not adequate, a rigorous negotiation is required in bringing these disparate entities together in order to constitute a solid platform on which to plant the fundament of the field. No-one wants a bruised intellectual tailbone.

It is difficult to imagine an interdisciplinary program of more ambitious ontological reach. While much is made of the divide between the 'two cultures' it is important to note that these practices, at least in their academic and pedagogical forms, have much in common. They are rooted in numerico-textual representation, and committed to notions of rationality, abstraction and generality. A theory, after all, is a theory. An artifact, a performance or an interactive application is not a theory, its ontological status is experiential and performative rather than representational. This distinction between the representational mode and the performative mode, enunciated by Andrew Pickering captures the distinction I have for long argued regarding the arts.^{xvi} So while an interdisciplinary negotiation between humanities and sciences is challenging and necessary, drawing in the arts adds a third position which is as different from the other two as they are from each other, as it brings aesthetics and performativity to the fore. In addition, the pursuit of an interdisciplinary practice in 'media arts' demands further negotiation with theoretical and aesthetic discourses in the arts. (see below.) This analysis allows us to approach to interdisciplinary pedagogy in ACE in two ways. Across the plane of disciplines, and on an axis between theory and practice.

Across the Plane of the Disciplines

ACE interdisciplinary pedagogy applies core methods and practices from a variety of disciplines.

Aspects of pedagogy which are learned primarily from the technical sciences include:

- rigorous analytical-technical thinking,
- literacy in modes of technical representation – circuit diagrams, flow charts, coding.
- technical design and research-and-development process, the design-prototype-test cycle.
- hardcore pragmatic rigor – no amount of handwaving can obscure the brutal fact that it works or it doesn't.

Aspects of pedagogy learned from the humanities and social sciences include:

- a commitment to critical thinking and to humanities-academic literacy – the ability to formulate complex arguments and to justify them with appropriate textual resources and research process.
- emphasis on historical and theoretical contextualization: understanding technical,

politico-economic and cultural change as an ongoing interwoven and braided historical process which leads to the current techno-cultural context.

Aspects of pedagogy learned from the arts (specifically the experimental and conceptual plastic arts of the second half of the twentieth century) include:

- A mode of pedagogy tied to embodied practice, performance, development of bodily skills and/or the production of artifacts and affective spaces. Inasmuch as the tokens of exchange in artistic communication are non-textual, so a mode of pedagogy has emerged which develops and exploits verbal exchange around non-verbal, non-textual phenomena. The various modes of studio-based instruction do just this: perform pedagogy around the formation of artifacts and gestures, with or without the secondary involvement of speech and textual-symbolic modes of communication. Spoken exchange is deployed to support demonstration or make explicit distinctions between aspects of artifacts. This is a quite different sort of pedagogy from one in which the subject and the discourse around the subject are contained in the same medium (speech/text). This sort of pedagogy is not limited to the arts, it might be found anywhere where theory is not privileged over practice: in the science lab, or training of surgeons and trades.
- Integrative, holistic concept/project critique – a special quality of idea development in the plastic arts is ongoing group-critical assessment and debate. Such critique is not discipline based – it subjects the developing work to diverse criteria, from superficial aspects of aesthetics and popular culture to political and philosophical positioning to technical analysis. All these divergent critiques must be accommodated by the maker.
- An engagement with embodied, temporal, situated, sensorial experience, and with the crafting of artifacts and processes which attend to such experience with subtlety, lucidity and precision, not assuming them to be the medium through which the creative idea is passed, but in-and-of themselves.
- Non-didactic communication. Art practice relinquishes the notion that information is unproblematically passed from sender to receiver, asserting that culturally contextualized interpretation modulates communication, thus disputing the relevance of Shannon’s Information Theory to human culture. So the task of the artists is not so much to inform or pass information as to create a highly charged scenario of components which are likely to stimulate a rich cloud of associations in a ‘viewer’, which in turn stimulate active critical thought.

- Holistic design and production practice – unlike many technical fields which emphasise more or less extreme specialization, in ACE it is felt that it is important for each student to experience and become conversant with, if not skilled in, every aspect of the realization of a project, the integration of hardware and software, the specification and crafting of materials and components, strategising of presentation and uses experience.
- Asking the right question. Contemporary education places heavy emphasis on ‘problem solving’. While these analytic skills are important, in an open interdisciplinary context, they are only half, and only the second half, of a complete process. *Problem formulation* necessarily precedes *problem solving* and *it* demands a complementary, synthetic and creative thinking style which is unfamiliar to many in established disciplines and is rarely formally taught.
- Student-centered pedagogical philosophy – The goal is to assist each student in the discovery and elaboration of their own special trajectory; based in their past experience, their commitments and aptitudes and their particular vision; marshalling intellectual and technical resources from all over campus as appropriate. This open-endedness is implicit in the interdisciplinary project – there is a fundamental acceptance that, as the field is in dynamic development, it cannot be defined and each student is active in its very development. While certain topics and approaches are emphasized, there is no canon as such to impart. In the spirit of William Butler Yeats’ assertion that *Education is not the filling of a pail, it is the lighting of a fire*, it is assumed that each student, so prepared, will develop optimally as a fully formed creative being, with a particular vision and a self determined position on the interdisciplinary plane.

Some of these aspects of pedagogy adopted from the arts, particularly those which emphasise a broad, integrative, ‘subjective’ or performative approach, are not inherently or uniquely the property of the arts. But it happens that in the contemporary context, the arts are one of the few locations where they are pursued – that is, most disciplines have a tendency to constrain inquiry within disciplinary bounds, whereas the arts, at least since the 1960s, have established a license to draw upon and integrate any subject, event, process, phenomenon or medium which is deemed relevant. This ‘deeming relevant’ is the corollary of *asking the right question*.

Lastly, there are aspects of ACE interdisciplinary pedagogy which emerge from the

process of interdisciplinary synthesis. Some of these include:

- a critical assessment of the intellectual and artisanal legacy of the traditional arts, and the way that such knowledge is 'de-knowledged' as result of the hubristic effect of scientifico-technical paradigms.

- An inquiry into the status of the artifact. The textual and mathematico-symbolic disciplines have a different relationship to the status of the artifact and of matter, emphasizing representation and abstraction and the manipulation of those abstractions rather than matter itself. The creation of artifacts, being sensorially immediate and engaging the mind as qualia, are pre or non-linguistic and pre or non-symbolic. Hence academic pursuit of the production of artifact, system and performance occupies a different ontological realm from practices whose product and currency is textual.

- a critical reassessment of the act of making and the re-integration of abstract and concrete action, in the context of technical sciences and the arts. According to rhetorics of practice in technical sciences, artisanal intelligences are devalued – production of artifacts involves design followed by production. In reality, practitioners embrace the cycle of prototyping. Hence the charming and insightful anonymous adage: *The difference between theory and practice is greater in practice than in theory.*

- attention to the transition from a contemplative/objective and representational mode of aesthetics to the development of an aesthetics applicable to the processual, procedural, enactive and performative modes of engagement in media arts. Questions of agency involved in readership and in viewing have been actively engaged in recent decades (i.e. reception theory). But it is undeniable that the mode of engagement with an artifact which actively reconfigures itself as a result of ongoing user engagement is a novel mode of engagement upon which such conventional explanatory approaches have little purchase. Conventional aesthetics of the traditional plastic arts are thus necessary but not sufficient to the analysis and development of enactive art, precisely because of this fundamental ontological difference between a representational aesthetics and a performative aesthetics; between an aesthetic discourse attuned to static or temporally linear cultural artifacts and an aesthetics of reactive and enveloping forms which inherently refute a physically removed (objective) viewpoint as they engage the subject in an active ongoing process.

- Arising from the need to formulate an aesthetics of embodied process and engagement with real-time computing systems: research into current philosophical, psychological and physiological theories of the integration of perception and action, drawing on neuroscience, ethology, ecology, phenomenology, situated and enactive cognition,

performance theory, complexity theory, artificial life, robotics, cybernetics, and other fields.

In the following sections, some of these aspects are discussed in further detail.

Revaluing and Repositioning the Arts

The role and integration of the arts into an academic campus is not straightforward, because of fundamental differences in motivations and methodologies. The commitment of ACE to production, and the breadth of its interdisciplinarity, serves to focus attention on the strangeness of the ontological rift between the textual/representational disciplines and the disciplines which attend to performativity and the crafting of *qualia*.^{xvii} This rift, combined with a sometimes self-imposed exclusion from the modes of discourse common to other parts of the campus, has led to the isolation and denigration of the arts on many campuses, easily read in the relatively poor quality and often peripheral location of accommodations for those disciplines. With respect to some of the more staunchly positivist disciplines on the campus, the arts are sometime trivialized, reduced to entertainment and decorative functions. In my opinion this is not appropriate, but it is supported to some extent by persistent strains of anti-intellectualism in the arts themselves.^{xviii} While this sometimes self-imposed exclusion from the modes of discourse has much to do with this long standing anti-intellectualism in the arts, it is combined with a valid but seldom-well-enunciated awareness that the pedagogical modes of the arts are necessitated by the fundamental ontological difference in the practice.

Qualium Engineering: embodied engagement, the shaping of sensorial experiences and the generation and management of affect.

Artists are concerned with the production of artifacts and experiences which are persuasive and engaging in the immediacy of the embodied experience. Deeper ideas may be held within, but unless the experience is engaging, the work is a failure. In the kinds of symbolic or text based practices of most of the campus, this requirement for persuasive delivery is absent. The design of persuasive real time sensorial engagement is one of the core intelligences of the arts. In the arts, experiences are woven from complex multimodal sensorial experience, combining materials, images, forms, sounds, spaces and bodily dynamics. These components *mean* in heterogeneous ways, by direct sensation, by association, and by symbolic content. Communication (seldom of a purely literal or didactic kind), and the generation of affect, are achieved by a coherent and persuasive

organization of such qualities, with respect to the specificities of the cultural background of the audience. This is a subtle and complex craft, and when successfully achieved, can be little short of magical. These sensibilities are native to the arts and arguably, to no other group of disciplines on campus. To the extent that other disciplines engage in the shaping of sensory experiences then it is to the arts that these other disciplines should refer for expertise. Such a recognition allows the possibility to re-position the intellectual heritage of the arts in the context of the C21st campus in a way which can be shown to be of value across the campus and which does not demand the abandonment of key and cherished qualities of traditional practices.

Art : Asking the right question

Sometimes, in technical work, it becomes unclear if a problem is due to poor implementation (a bug), or to an underlying problem which is intractable in principle. This happens at every scale, from immediate technical challenges in the lab to the fundamentals of entire pursuits.^{xix} The only way to gain purchase on such problems is to have the ability to 'zoom out' from specific epistemological frameworks - to frame the problem in a larger context. This is an important dimension of rigorous interdisciplinary inquiry.

On today's campus, and in the contemporary world, the arts claim the unusual right to integrate, not just diverse media and contexts, but diverse technical, historical, social and cultural subject matter. The arts therefore provide a balance to the focused specialization of other disciplines. As a student, a teacher advised me: *'Art is not about getting the right answer, It is about asking the right question'*. This advice has accumulated profundity for me in recent years. The kind of intelligence required to 'ask the right question' is radically different from that required to 'get the right answer'. And indeed, the right answer to the wrong question is worthless. Learning how to 'ask the right question' is a skill fundamental to critical thought and from it can arise new formulations of problematic situations which have been found previously intractable, it is intellectually liberating. Teaching people how to 'ask the right question' is not emphasized universally across the campus. In the more established disciplines, the ability to reproduce established solutions to established problems seems the major criterion for success. To look at a situation in the world and to identify qualities which may be identified as 'symptoms' and then to articulate a 'problem' based on those 'symptoms' is a kind of diagnostic intelligence which seems entirely alien to the kind of analytic intelligence required to solve a problem once it is articulated. In a way analogous to the collection and interpretation of sensor

data by a reasoning system: once a problem is articulated in qualitative and quantitative ways, most of the hard work is done. Such broad integrative inquiry often demands the negotiation of world-views and epistemologies which may appear quite immiscible. The arts therefore provide a balance to the focused specialization of other disciplines. Particularly in the process of conception and design of new digital technologies, there would seem to be a way of re-validating these sensibilities which are the traditional intellectual property of the arts.

Aesthetics of Behavior

The application of computational technologies to artistic practice has opened up a new aesthetic territory: the modeling of ongoing responsive behavior of an active 'user' (a term reviled by many media artists), interactor or 'spect-actor' and the complementary design of a 'computer automated cultural artifact' (or CACA). (The very fact that these descriptors seem awkward is an indicator of the novelty of the project). Such a 'computer automated cultural artifact' entails a new realm of design involving the description of decision-making and output behavior of the device in response to changes in its environment as indicated by its suite of sensors and interpretive code. For reasons which have as much to do with the historic technophobia of much of the performing arts (with the notable exception of electronic and computer music) as with the compatibility of plastic arts practices with the emerging technology, much media art practice and pedagogy arises from visual arts. ^{xx} This history leaves an odd legacy, for while various aspects of visual arts methods and theorization (around issues of static and temporal pictorial representation etc) are of immediate value, the plastic arts are undeniably void of any useful theorization relevant to the reactive, emergent, generative and interactive aspects of computational arts practices, while the performing arts may possess resources relevant to the formation of such practices.

The aesthetics of behavior is a new field of aesthetics facilitated by the availability of real time computing as a context for creative work. As is so often the case, practice marches on far ahead of theory and few have grappled, in a useful way, with fundamental issues arising (the work of theorist-practitioners such as Sha Xin Wei ^{xxi} Michael Mateas ^{xxii} and Matthew Fuller ^{xxiii}, amongst others, is valuable). The fundamental transition, as it appears to me, is the previously mentioned ontological shift from representational to performative mode. Theorising of an aesthetics of behavior, as proposed here, must recognize that the traditional aesthetics of the plastic arts at least, are married to the representational

mode, and thus to notions of contemplation as opposed to active ongoing engagement, and at a deeper level, to conceptions of authoritative viewpoint and objectivity, linking such aesthetics to (C19th) scientific philosophy, and in turn, back to Descartes. As approaches from existing disciplines have been brought to bear on real-time-computational arts, much damage has been done already by inappropriate attempts to describe processual and interactive art practices in terms of film theory, media theory and traditional art history. Such approaches are inherently blind to the major structuring reality of the field which is the development of signification through an ongoing structural coupling between (in the paradigmatic case) a person and a machine equipped with the ability to vary its output as a result of measurement and evaluation of its inputs. This brief description of the scenario already lays out starkly that such a cultural practice is inherently biomorphic. Therefore, it is crucial that any attempt at formation of such a study begin by positioning itself with respect to studies in other fields which offer useful insights into such dynamics. These include contemporary sociology, ecology, ethology, enactive and phenomenologically rooted cognitive science.

If the theorization of the conventional visual or plastic arts offer little in the way of theory which might be applied to develop an aesthetics of behavior, then where might we look within the arts? Cinema, theatre, dance, classical music and literature offer us models for practices which inhere temporal transition and development, but these are all locked into a linear stream. It is in improvisatory practice that the most useful theorization might be found, for the behavior of actors, dancers and musicians in improvisatory performance, responding in real time to changes in their environment, structured in some way by pre-agreement, maps well onto the context of interaction design where the people interact with rule base systems (software). Some cultural forms, such as Karnatic music, have developed around this approach to a high degree, and are worthy of special attention in this regard.

Integrated, holistic criticality - an example.

As mentioned, artists, through personal process or institutionalised concept-development and critique, are expected to subject their work to heterogeneous, orthogonal and often incompatible critical positions. This notion is as pedestrian to artist as it is surprising and extraordinary to those coming from a technical educational background. Such surprise in itself is an example of the effects of the isolation of the arts on campus. This process is a basic training in styles of thinking relevant to deep interdisciplinarity: the negotiation of

irreconcilable methods and world-views.

To elaborate: It is not unusual for an artist to be expected to justify their work simultaneously: in terms of formal aesthetics of form, light, color, material (ie: 'did you consider the way your choice of material might bring this set of associations to the work in the mid of the viewer and do you feel this supports the total effect of the work?'); in terms of social, political or environmental concerns (ie : 'how can you employ that technology and pretend that you are taking a progressive position on global exploitation of labor when you could not have afforded it if it had been made in the USA'); and in terms of the dynamics of its presentation (ie : 'in this aspect of the interaction you are creating a false impression that the user has creative freedom, so in effect you are supporting the marketing rhetoric of the computer industry'), etc.

Through this process (ideally) the artist comes to position their work in a large social context, is encouraged to own the work and its implicit politics in a complete way. This owning of the work in the larger socio-political context is, I would say, an epitome of humanistic citizenship, and signals an engagement-with-the-world which few disciplines attain. Certainly, the idea that, for instance, an engineer should expect to be interrogated on the social implications of their work on the behavior of gallium arsenide at low temperatures would, for many, verge on the absurd.

Holistic design and production process

An artist learns to pursue an idea from scant imagining, through sketching and planning, to material specification, prototyping, testing, to final presentation, where it stands or falls.

The artist usually does all the jobs: finds the components, deals with suppliers, works materials with a variety of tools and skills designs and writes PR copy. In the process, she manages the project at all levels from the abstract and philosophical through technical manipulation, skilled artisanry to grunt labor, and interacts with all sorts of people. Key aspect of this way of working are: a constant combination of attention to macro and micro, in order too attend to the way that subtle changes in details of execution may perturb the general effect; and an active negotiation of design through the minutiae of materials and specificities of technique.

The original vision or creative idea subtly morphs through the manipulation of matter and development of finely honed sensibilities of making, in the otherwise tedious processes of setting up tools, drilling holes in the right place, getting edges square. As Micheal Mateas

has noted that, in computer science as in the arts, you push the materials and the materials push back.

The question of theory

In keeping with the emphasis on production, ACE places equal weight on the practical and the theoretical, and emphasizes their negotiated resolution. Indeed, as mentioned, the very separation of theory and practice is problematised. A generative kind of theorization can arise out of practice, out of the impasses experienced in practice. Likewise, abstract theory is tested in practice. Such an approach works against the hierarchical dualism common on campuses which privileges work to the extent that it is disembodied, because this attitude divorces practitioners from the fundamental realities of matter and physics. We teach embodied technical and artistic craft practices – we assert that handwork is not devoid of intelligence. Such a position is consistent with a general commitment to materiality and spatialised, embodied and situated action. In the contemporary context where students are naturalised to a screenal and digital forms, we perceive increasing alienation from materiality, or more precisely, from the incorporation of manipulation of the physical in project development. The scenario in which (all possible) hardware is understood to be pre-given and creative work is understood to be the pasting together such components together with software glue; precludes vast areas of creative and design exploration, and implicitly encourages a consumer commodity relation to hardware. Consistent with the goal of rethinking the mater/information schism, this approach works to counteract an ‘in-the-box’, ‘fix-it-in-software’, ‘simulator centric’ detachment from the physical.

Towards a Theory of Practice

As discussed above, at issue is not so much a question of the value of theory to practice or vice versa, but the very notion of the separability of the two, which smacks more than a little of a warmed-over Cartesianism. ACE seeks an active reunion of theory and practice, both in applying theory to practice, and in theorising practice itself. The revaluing and re-validation of arts practices on the campus involves, then, the development of a conception of intelligence which values artisanal and embodied intelligences and does not automatically privilege the abstract and thus does not tacitly reinforce such Cartesianism.

While the high theory of the 80s has undeniable validity and relevance, the constant complaint of practitioners is that the relevance to practice is tenuous. This complaint itself

reflects the destructiveness of the anti-intellectual strain in the arts. It also demonstrates that artists often feel that their work is grist for a mill which offers them nothing in exchange. As I have quipped in the past, *many theorists see art in the way a cow sees grass*. While there is pragmatic career value in being the subject of critical discussion, feedback relevant to practice is rare. An effort is required to make theory relevant to practice. A practice-centric approach to theory involves an open ended search for ideas which can be leveraged to develop the work, and perhaps secondarily, the discourse around the work. This approach, in which theory is brought to practice, as and where relevance arises, is consistent with the 'student-centric' approach to pedagogy. Beyond this, there is a need to develop a theorization of practice itself, as discussed above, an aesthetics relevant to real-time-computational creative practice.

Hardware Intelligence - the Intelligence of Handwork

Where the drive to abstraction and generality (inherent in digital technologies) meets the specificities of the embodied and situated knowledge of the arts, a complex field of contradictions emerges. Naturalization to software tools and commodified technologies has distanced our students from the joys and rigors of making. The ACE program has a pedagogical commitment to a holistic approach to technologies and the intelligent manipulation of matter and the production of material product. My class "Hardware Intelligence" works against the dualistic academic dogma which proposes that the more engaged with the physical world a practice is, the less intellectual or intelligent it is. Far from being just a remedial skill building class, this class brings students who have been alienated from the physical world by software, back into a rich engagement with it. Hardware Intelligence functions as an intensive familiarisation with the realities of matter and in the process, disabuses student of the false notion that hand work and mind work are mutually opposed. Through this course, students experienced a process in which sometimes grand visions ground-out in humble tasks such as attaching a wheel to a shaft, and they discover that this can be quite as intellectually challenging (and rewarding) as solving an equation or working through a complex text. Two things result from this. First, that the student is enabled to embrace and manage the entire design /production process, and second, they recognize that there is no shortage of intellectual work in hand-work. The general goal is to enable students to envisage, design and make artifacts which combine software, computational, electronic, electromechanical, mechanical and structural components, thus linking the ephemerality of code with the sensorial immediacy of embodied perception and engagement.

Hybrid degrees and degrees by practice

The two-part graduation requirement in ACE: a publicly presented Project and a written Thesis; represent the culmination of this process of melding theory and practice. The Thesis is conceived as contextualising the Project, documenting its development in a reflective way, providing technical background (circuit diagrams, source code), and providing historical, theoretical and contemporary cultural context. The student is required to contextualise their own practice, marshalling historical precedents from diverse fields of technical research and artistic/cultural practice and theoretical resources from sciences and humanities. It is itself a hybrid document in which the various discipline based-registers of scholarly and professional writing are also negotiated.

These requirements are consistent with the current vogue for 'hybrid degrees' and PhDs by practice, and this trend is itself a marker of the changing interdisciplinary context of digital cultural practices and the negotiation of their place in the larger campus context. Such degrees demand a level of literacy not usually expected of a computer science student, a level of technical mastery not usually expected of a humanities student, and a level of sophistication of design and creative process seldom found in either.

This explication then elucidates the need for principled design of such degrees, rather than an untheorised 'a little of this and a little of that' approach which is characteristic of shallow or naïve interdisciplinary pursuits in general. If the motivation is cynically instrumental in any degree (ie, to enforce a layer of text production onto a practice based context to attain institutional validation) then the task is likely to be seen as an onerous and irrelevant add-on by staff and students alike, reinforcing the theory-practice divide. Graduation requirements must arise from an ongoing pedagogical program which problematises and dismantles the theory/practice dualism from the outset.

Conclusions, recommendations and advice

As noted, my fundamental pedagogical premise in designing the ACE program was that, because the practice was inherently so interdisciplinary, no existing disciplinary context was adequate to the task. Nothing but a thoroughgoing and radical interdisciplinarity was demanded. It was strongly felt that being positioned under the discursive umbrella of (any) discipline would be an impediment: a program based in, say, engineering which made a patronising nod to the Arts, or a program based in Arts which made a deferential nod to Engineering - or any other arrangement, would not permit the interdisciplinary

freedom demanded by the situation. Nothing but parallel deep training in both fields, and rigorous engagement of the problematics of combining such different practices would do. Nor would such a combination of technical and artistic practice be adequate without a deep and equally interdisciplinary historical contextualization and the development of rigorous analytic and critical thinking. A level of critical autonomy from the discursive contexts of the supporting disciplines was necessary in order that the pedagogical demands of the area of concern – which might be best identified as ‘emerging digital cultural practices’ – might be addressed. Space does not permit a discussion here of the specifics of ACE’s curriculum and administration as it developed through the negotiation between these pedagogical goals and the specific institutional constraints at UCI. ^{xxiv} Interdisciplinary pedagogy may fairly be regarded as a wellspring of innovative thought and as generally intellectually valuable to the participating entities and to the institution as a whole. It is also, as I hope to have demonstrated, fundamental to the formation of new disciplines and fields of practice. It is a taxing project and it is not for everyone, yet some find it a most rewarding pedagogical project.¹ Trail-blazing is labor-intensive, and faculty must be supported in special ways if they are to undertake such initiatives. Taking on interdisciplinarity is a significant intellectual challenge: negotiating the traditions of multiple disciplines and the heterogeneity of the interdisciplinary classroom is hard work. It is important therefore to relieve faculty, as much as possible, of the additional burden of managing multiple discontinuous or contradictory administrative systems. There is a danger in being pre-emptive and over-structuring, but experience shows that administrations have often been tardy or ad-hoc in their attention to adequate administrative infrastructure. Every institutional context is different, and each has its own affordances and constraints, and opportunities amenable to detournment by the enterprising. Any institution which recognizes and values interdisciplinary activities is thereby bound to support such activities with appropriate management structures. To the extent that this is absent, engagement in such initiative will be a kind of academic martyrdom, and the initials of the title of this paper will ominously represent interdisciplinary initiatives by a more well-known phrase.

Simon Penny, U.C. Irvine, 2007-8

Postscript

The ACE program was closed down by the Donald Bren School of Information and Computer Science (the program’s administrative home at the time) in late June, 2009. Its

last two students are scheduled to graduate June 2011. RIP ACE.

ⁱ Barthes, Roland. *The Rustle of Language*. Trans. Richard Howard. University of California Press: Berkeley. 1972. Page 72. (Thanks to Josef Nguyen for this quote)

ⁱⁱ quoted in John Honner: *The Description of Nature: Neils Bohr and the Philosophy of Quantum Physics*. Oxford University Press 1987. pg 102

ⁱⁱⁱ for instance: Klein, J. T. *Interdisciplinarity*. Detroit, MI: Wayne State University Press. 1990. Mourad, R. P. *Postmodern Interdisciplinarity*. *The Review of Higher Education - Volume 20, Number 2, Winter 1997*, pp. 113-140. Turner, S. *What are disciplines? And how is interdisciplinarity different?* In P. Weingart & N. Stehr (Eds), *Practicing interdisciplinarity* Toronto, Canada: University of Toronto Press. 2000. pp. 46-65.

Lattuca, L. *Creating interdisciplinarity: Interdisciplinary research and teaching among college and university faculty*. Nashville, TN: Vanderbilt University Press. 2001. Moran, J. *Interdisciplinarity*. Routledge, New Critical Idiom Series, 2002. Rossiter, N. *Organized networks, transdisciplinarity, and new institutional forms*. *Intelligent Agent* 6 (2). 2006

http://www.intelligentagent.com/archive/Vol6_No2_transvergence_rossiter.htm. also at

http://www.intelligentagent.com/archive/ia6_2_transvergence_rossiter_transdisciplinarity.pdf Augsburg, T. *Becoming interdisciplinary: An introduction to interdisciplinary studies*. Dubuque, IA: Kendall/Hunt. 2006.

Szostak, R. *How and why to teach interdisciplinary research practice*. *Journal of Research Practice*, 3(2). 2007. <http://jrp.icaap.org/index.php/jrp/article/view/92/89>. Youngblood, D. *Multidisciplinarity, interdisciplinarity, and bridging disciplines: A matter of process*. *Journal of Research Practice*, 3(2). 2007.

<http://jrp.icaap.org/index.php/jrp/article/view/104/101>. Repko, A. *Interdisciplinary research: Theory and methods*. Thousand Oaks, CA: Sage. 2008.

^{iv} As founding director I wrote the program proposal for the ACE program and played the central role in the establishment of the program over its first years. The design of this program was informed by my experience teaching and establishing programs in intermedia, media arts and interdisciplinary art-and-technology initiatives over two decades in various institutions in various countries, and by my active role in the field internationally as a practitioner, theorist and organiser. The opinions expressed here arise from many years of work and thought, and any discerned polemicism should be taken as a barometer of my commitment to the issues. Numerous colleagues across the campus have played a role in the program. That said, this paper does not pretend to represent the positions of my colleagues in the ACE program. Earlier reflections on this subject are found in my *Adequate pedagogy: the missing piece in Digital Culture*, in: *A Guide to Good Practice in Collaborative Working Methods and New Media Tools Creation* (by and for artists and the cultural sector) eds. Lizbeth Goodman and Katherine Milton (fall, 2003) AHDS (Arts and Humanities Data Service).

^v Academic structures and terminology vary from school to school and from country to country. The terminology used here is US-centric. I regret any confusion this may cause to readers outside the US. In this paper, a 'program' means a formalised plan of study which culminates in a degree, 'faculty' refers to individual academic employees, as opposed to 'staff' who are usually clerical or administrative.

^{vi} See for instance, my 'Bridging Two Cultures: towards a history of the artist-inventor and the machine-art-work', in Dieter Daniels / Barbara U. Schmidt (eds) *Artists as Inventors / Inventors as Artists*, Hatje Cantz, spring 2008. ISBN 978-3-7757-2153-0

^{vii} see Agre, P, *Computation and Human Experience* (Cambridge University Press 1997).

^{viii} There is a bevy of such notions – the input-output paradigm, the clear separation of hardware and software, and the authoritative 'objective' view, referred to sometimes in AI as the 'god's eye view' which replicates the problematic notion of the authoritative objective view from outside the system from which all can be known but the system is not effected. It also replicates a strange cognitive skill that we are naturalised to, that of map reading. It is worth noting that it takes significant intellectual contortion to attain the viewpoint which allows for map reading to be meaningful. One must imagine a dual self, with one self on the map, and another self viewing that self for some impossible position high above that first self.

^{ix} See Robert S. Nelson, "The Map of Art History" in *The Art Bulletin*, Vol. 79, no. 1 (March 1997), 28-40. The author makes similar observations regarding the academic organization of the history of art.

^x See his essay [The practical logic of computer work](#), in Matthias Scheutz, ed, *Computationalism: New Directions*, MIT Press, 2002

^{xi} Niccolo Machiavelli, *The Prince* (1513) ch6.

^{xii} Economic issues are of then at the heart of these troubles. For example, it is very difficult to transfer funds for student tuition between schools, not to mention to apportion faculty salaries in cases of teaching collaborations.

^{xiii} In certain fields of CS and Engineering, practitioners valorize themselves with the descriptor tool-maker. This has created an awkward situation in media arts, where artists have historically been supplied with tools which are out of step with contemporary concerns, and are irrelevant to contemporary practice. Contrary to the hubris of this toolmaker clique, the history of media art and its predecessor practices (often called 'art and technology') repeatedly reveals evidence of artists and artist-technician hybrids originating or modeling technological systems far in advance of academic-industrial research. See my *Bridging Two Cultures* (cited above)

^{xiv} See my *Adequate Pedagogy: the missing piece in Digital Culture*, cited above.

^{xv} Within the UC, other graduate programs and centers of varying complexion include UC Davis Center for Techno-Cultural Studies, UC Santa Cruz Digital Art and New Media Program, UC Santa Barbara Media Arts and Technology program. UC San Diego offers an undergraduate program ICAM and has a new 'sixth' college focusing on culture, arts and technology. Outside UC, relevant programs include University of Washington DXArts, Georgia Tech Literature, Culture and Computing, School of the Art Institute of Chicago Art and Technology Department, etc

^{xvi} see my *Experience and Abstraction: the arts and the logic of the machine*, presented DAC07 (Perth) published Fibreculture 1/08. See also Pickering, Andy. *Cybernetics and the Mangle: Ashby, Beer and Pask*. Social Studies of Science, Sage Publications, 2002. 32: 413-417. Andrew Pickering has argued that the cybernetics of Pask and Beer remains impenetrable to most contemporary scientists because it stands on ontological premises which are fundamentally different from positivistic science. He argues that while such 'normal' science works in a representational mode, British cybernetics worked in a performative mode.

^{xvii} In philosophy of mind, *qualia* is a term which is employed to refer to raw sensory experiences prior to linguistic and para linguistic categorization

^{xviii} The history of the evolution of this anti-intellectual, anti-textual stance is an interesting study in itself, but space prohibits further discussion of it here.

^{xix} Hubert Dreyfus asserted that the project of Artificial Intelligence was in this latter way, fundamentally flawed, Philip Agre has made similar arguments. See Dreyfus, H, *What Computers Still Can't Do, a critique of artificial reason* (MIT 1992) and Agre, P, *Computation and Human Experience* (Cambridge University Press 1997). These texts are, in my opinion, crucial reading for anyone grappling with the relation between computer culture and the arts. Interested readers might also consult my *Experience and Abstraction: the arts and the logic of the machine* (see above). *Computer Power and Human Reason: from judgment to calculation* (Joseph Weizenbaum 1976), *Turing's man* (J D Bolter, 1984) and *The Cult of Information* (Theodore Roszak, 1986) are earlier works worthy of inclusion in such a reading list.

^{xx} See my *Bridging Two Cultures*, cited above.

^{xxi} See for instance *Resistance Is Fertile: Gesture and Agency in the Field of Responsive Media*, in *Makeover: Writing the Body into the Posthuman Technoscape*, Two-Part Special Issue of *Configurations*, Baltimore: Johns Hopkins University Press, Part 2: *Configurations*, Vol 10, Number 3, Summer 2002.

^{xxii} See for instance [Media Ecologies](#) *Materialist Energies in Art and Technoculture*, MIT, April 2007

^{xxiii} See for instance [Expressive AI: A hybrid art and science practice](#). *Leonardo: Journal of the International Society for Arts, Sciences, and Technology*, 34 (2), 2001. 147-153.

^{xxiv} Such can be found at <http://ace.uci.edu/penny/texts/ripapp.html>