

Conference Presentations

From Prigogine to Freire: attending to non-linearity in complex, online, social organization in ICTD design.

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Abstract

This paper will pose several fundamental questions about currently held approaches to ICTD design and implementation, specifically when tasked with the online education and social/knowledge networking of development practitioners and professionals.

Rooted in the ongoing Cooperator project at the Coady International Institute, this paper is premised on the notion that the reductionist metaphor of a pre-planned, top-down approach to ICTD design is becoming increasingly inappropriate and insufficient when viewing groups of purposeful adults working in an ICT facilitated network, involved in learning and knowledge production activities. Rather, a revised look at the emergent properties, patterns of self-organization and unpredictable growth inherent in a network of purposeful people suggest a design methodology drawing from such divergent fields as computational systems design and aesthetics, instructional media design, community-based development, adult and distance education, architecture, systems and complexity theory, and organizational management. Finding harmony within such a multi-disciplinary solution reflects the desire at all levels of this project to view these online networks as dynamic, self-organizing, and continuously evolving systems. Designing and building ICTD interventions premised on such dynamic systems represents the central focus of the Cooperator project. Beyond the proposed practical implications of such ICTD interventions suggested by the Cooperator approach, this paper also examines the idea that creating an online analog of presently held models of physical organization has intrinsic shortcomings and fails to attend to the power of ICT to inspire a paradigmatic shift in the thinking around online (and indeed otherwise) social organization where goals are directed towards systematic change.

The Cooperator project will examine these broad issues over the next three years; however, this paper will specifically investigate the process of moving from online community-based development education and knowledge production to ICT-facilitated social action. Beginning with a brief introduction to the core concepts driving the Cooperator project, questions are then generated regarding the social structure of online networks and inter-networks, computational interpretation and representation of these structures, the integration of indigenous knowledge systems, the relationship between the user and the online environment, and the attempt to bridge online education and collaboration with online social action. Potential solutions reflective of the Cooperator approach and strategies for deployment are suggested and further questions offered to the reader.

The Cooperator Project – a brief overview

“In the name of ‘progress’, our official culture is striving to force the new media to do the work of the old” (McLuhan and Fiore, 1967)

This project follows several years of research by a number of staff and interns into the potential role for ICT and new media technologies in the work of the Coady International Institute. At its most fundamental level, the Cooperator project embodies the conceptual framework that will form the foundation for new media design and delivery at the Coady. This framework will drive the development of a new media design methodology reflective of the Coady Institute’s commitment

to community-driven education and social action. The term *new media* in this paper is defined as the loose ICT sub-class of digital technologies that have come into being primarily since the birth of the World Wide Web, combining the document form and rich-media in a potentially interactive online setting. The Cooperator project employs a multi-disciplinary approach, looking through the lens of adult education theory and practice, complexity and systems theories, the sociological study of networks, the thinking of computational systems aesthetics and the field of Human Computer Interaction. This is then framed by the current historical, social and cultural context within which the framework operates, particularly the present global socio-economic and political climate.

We eventually aim to create two distinct but interconnected pieces of software, drawn from this design methodology. The first will cater to online, non-formal adult education of development practitioners, leading to Coady accreditation. In current terms, this can be considered a *virtual classroom*, although as hope to illustrate, the general definition implied here may prove incomplete for our purposes. The second will constitute the information and communications infrastructure behind the Coady Knowledge Networks. The central thrust of these knowledge networks will be online community building and user-directed social action through collaborative learning and knowledge construction. The interconnectedness of these two software packages, inherited from the underlying Cooperator design methodology, is a reflection of a desire to find the bridge between learning and the social action implicit in adult education, within an online new media environment. We hope to take the early steps exploring this in the text of this paper.

Briefly, through the Cooperator project, we come to view these online groups as decentralized, complex and evolving social systems, with self-organization in a bottom-up manner the overarching organizational goal. Individual ownership, group dynamics and emergent behavioral patterns are considered foremost in the development of an effective design methodology. As a result, we approach a situation where we are required to relax our assumptions of order, rationality and predictability in social organization, and approach a more holistic concept of design for online adult education. The goal is to create environments that enable the continuous and unhindered emergence of newly constructed knowledge, driven by, and initiated from within a community. It is to provide the tools to enable the user and the group to take full advantage of existing information channels, and control over the construction of new channels in the online setting. This setting is not only seen as any potential Cooperator online environment, but also the global Internet within which it exists. That is, in a virtual world, signified by a disruption of space and time, interchangeable and mobile symbols are privileged over our traditional notions of fixed symbols in the physical world. Not only does the classroom no longer need four walls, one without static walls becomes the more appropriate classroom in the new media age.

Ultimately, this conceptual framework is also used to make more general claims about the current nature of ICT facilitated educational interventions solely implemented in top-down, pre-planned, computer mediated environments, when systemic change is the desired outcome. Important to the process of conceptualization is the idea that the computer in a globally networked world is a significantly different object than the traditionally held image. This allows for a point of departure from the existing metaphor's that currently shape our interaction with computers, both as technologists and users. Through this we hope to explore an emerging universal culture of globally networked communities that may yet prove instrumental in helping to bind Northern and Southern communities in our fragmented and technological modern era. As we are reminded by Marshall McLuhan, without the boldness required to disconnect ourselves from usage metaphors of past technologies, we may be destined to simply bypass the true potential of emerging networked technologies in our very efforts to 'make it work'.

Adult education and Cooperator

"The planning of new educational institutions...should begin with the question, 'What kinds of things and people might learners want to be in contact with in order to learn?'" (Illich, 1970)

For heuristic purposes, adult education theory provides a useful starting point from which to begin our exploration of the cooperator concepts. The Coady Institute has over 40 years of experience in helping to organize communities for education and action. Over that time, the Coady approach to adult learning has been carefully distilled by the experiences of students and staff, both in the classroom and in community-based development initiatives throughout the world. The current Canada-based educational programming at the Coady could be described in general terms as following an underlying Marxist model of emancipatory education, more specifically the *liberation pedagogy* of Paulo Freire. In addition, classroom practices at the Coady follow a blend of Marxist-Radical Pragmatist thinking, with an emphasis on critical reflection through discourse leading to individuation, personal transformation and growth; the so called Transformative Learning (Mezirow, ???). Social action is generally considered by adult theorists as the crucial outcome of such learning, as adults begin to act on newly constructed emancipatory knowledge.

While it initially seemed attractive to apply this educational structure to an iterative software design cycle and attempt to develop an analogue of this structure online, what quickly surfaced was our reliance on a body of knowledge that stressed educator-learner dialogic interaction in the classroom and the community (Freire, 1970). Such interaction must take place between the educator and the learner, freeing the learner from the role of object upon which learning is applied. Crucially for our purposes though, on a conceptual level, dialogue must also take place between the learner and the material to be learned. Offering static electronic informational objects in an online distance milieu cancels out the opportunity for all learners to critically engage with the material. In our modern culture shaped by new media, this situation allows the learner to engage with the *word*, but not the *world*. In this light, being able to email questions to an instructor or post thoughts to a bulletin board can not constitute dialogue in all cases. Also, as we hope to demonstrate, in the modern new media age, this can have the adverse effect of further inhibiting efforts of the learner to liberate themselves from the role of object in a broader cultural sense, since cultural habits formed in virtual spaces are externalized onto the outside world (Manovich, 2001).

Much of the work at the Aesthetics and Computation Group (ACG) at MIT's Media Lab speaks to this very problem inherent in most computer software. John Meada, the head of ACG, has been noted for underscoring the need for actual fluency in the new media age. In his work, he describes how creating computer graphics with software applications such as Photoshop exercise ones ability to interact with the programmer, but not the medium. Only when one begins to disassemble the software itself, and reach into its deeper levels to reconstruct it in an original form, is one truly engaging with the medium and not the programmer (Maeda, 1999). In the world of computer generated graphics, this begins with the construction of *macros* or sets of high level commands that combine to aid in the creation of original form and reaches its apex when one engages with the medium in its own language, hacking it open and reprogramming it from the ground up. An example of this concept made real is the Processing open project spearheaded by Casey Reas at the IVREA Institute and Ben Fry at MIT's Media Lab. Processing, a context for exploring cyberspace through the digital arts, is freely available at no charge, and unlike Photoshop, arrives with no drawing tools to speak of. The creation of graphical objects, brushes, filters, (or perhaps more importantly, no brushes and filters) etc. is entirely in the hands of the user. It operates on several programming levels, from a highly simplified language that resembles spoken English, to the full Java language with all its complexities and nuances. Though currently in closed Alpha testing, as an open project, developers can eventually download the core source code and create an entirely new piece of software that behaves in unique and original ways. As a Java application, one can write reusable code libraries which can be shared with other developers or build entirely new applications that could run that gamut from games to web browsers to enterprise apps. What sets Processing apart from programs such as Photoshop is that by exposing deeper levels of core programming to the end user, the software avoids suggesting context or usage metaphor to that user. The user is responsible, to a greater extent, for engaging with the medium and to a lesser extent, with the programmer. In essence, the user becomes the programmer.

On the surface, electronic new media appeared to remove barriers of time and space in adult education. While this is true in a strict sense and is a property we will exploit to some extent, it is not without its own complexities. As we mentioned above, upon closer inspection, simply deploying existing adult education models in cyberspace can have the effect of relegating the learner to the role of object within this conceptual space. To draw from Freire's own example tailoring literacy materials to relate to the learner's life in Brazilian slums, one modality driving the delivery of information in an online space without proper regard for the language and culture of that space cannot be emancipatory. This is a salient point on two levels; in the case of ICTD, where the learners may represent many cultures and idioms; and in a modern, globally networked computer age where culture is also defined by our existence, however transitory, in virtual space.

Once we established that an online analogue of Coady's Canada based programs would at best approximate a solution, we set about redefining our goals. Our initial task thus became the reframing of online adult education in a thoroughly modern manner, taking into consideration the present social, technological and cultural contexts. In order for us to describe full dialogical interaction computationally, we needed to develop an understanding of what cultural symbols and language best describes informational objects in cyberspace. Rather than try to 'shoe-horn' our existing Coady educational structure into the cyberspace milieu, we traveled back to the fundamentals of contemporary adult education theory and the writings of Paulo Freire and Ivan Illich. During this preparatory phase, we also noticed two important issues that helped sign post our way.

Firstly a recent movement at the Coady Institute exploring community-driven approaches to development, such as Asset-Based Community Development (Mathie & Cunningham, 2001) shows strong evidence for the power of initiatives driven by community members in a bottom-up manner to achieve sustainable positive social change. This set us thinking about how an online space organized and controlled by the learners themselves could potentially facilitate the unhindered interaction with informational objects assuming they are initially built in a sufficiently rudimentary and flexible manner at the design and development stage. To do this we first needed to clarify what is meant by an online group of adults engaged towards some end in a globally networked, technological society. As we quickly realized, since the wider cyberspace favors mutable constructs, this group should not be limited by virtual classroom walls, but rather exist within flexible virtual structures intimately connected with the wider cyberspace (i.e. the Internet) and the physical world (i.e. communities).

Secondly, since the initial overall task of the cooperator project is defining a design methodology for online adult learning and collaboration facilitating to social action, we needed to be sure our heuristic guidelines reflected such sentiments in a contemporary context. Without the existing Coady educational structures to guide us, to set off with the wrong set of heuristics would potentially put us on the wrong course for the duration. As it turns out, in light of the current socio-economic, cultural and historical context adult education finds itself operating in, the practical validity of social action as an implied outcome of adult education in our modern society has indeed come under scrutiny of late.

So we begin again with adult education as our jumping off point, however, this time we must begin by painting a contemporary picture of adult educational practice. We then form a coherent picture of the networked computer as an element of this contemporary social, cultural and historical context. Following this, we attempt to reach a better understanding of the online social group in this modern context. With this complete, we can then begin to construct a conceptual framework of modern online adult education in a new media age by uniting the disparate components.

In their comprehensive work, *Adult Education at the Crossroads*, Matthias Finger and Jose Asun see the present day field of adult education at odds with several factors; the rise of what they call 'turbo-capitalism and the casino economy'; the erosion of the welfare state and its replacement by

transnational corporate entities and non-governmental organizations; the effects of postmodernism on present day culture; and the current ecological crises that accompanies accelerated industrial development (Finger and Asun, 2002). By recognizing the significance of the social, historical and cultural context within which adult education practice is carried out, they construct an astute critique of the erosion of adult education's original agenda of social action. In their treatise of contemporary adult education practice, they present compelling evidence for a field that increasingly negates its role as a tool for the mobilization of communities and the advance of positive social change. For example, the combination of postmodernism in popular culture which has the effect of setting the individual above the community, the increasing privatization of adult education that accompanies the erosion of the nation state and current trends towards self-directed learning championed by various humanistic schools are all regarded as elements contributing to the institutionalization of adult education programs, the instrumentalisation of adult education or 'learning for earning' and the drift away from any communal focus in learning.

A cursory glance from Finger and Asun's perspective might quickly color computer facilitated distance learning as yet another post modern ill designed to isolate the user and further devolve any sense of communal responsibility. The computer may well be the single biggest factor in the recent instrumentalisation of adult education, as we have seen numerous faceless e-schools spring up and existing institutions race to get their course online. Indeed, the headline greeting visitors to the online home of the world's largest educational software suite proudly announces that it "...is a sound technology investment that delivers economical returns". Can the computer really be conducive to a collective transformative learning experience?

In *Technopoly*, Neil Postman begs the question, "Will the widespread use of computers [in education] defeat once and for all the claims of communal speech?" (Postman, 1992) That the introduction of computer technology disrupts traditional educational patterns needs little qualification at this point (Fenwick 2000). However, what may be useful here is a more complete comprehension of how new media work together in a networked world, not simply how a computer can disrupt the learning pattern in a classroom by cleaving orality and print, in favor of the printed word and its consumption in isolation. More importantly than the introduction of the computer from the office into the home or classroom is the subsequent explosive growth of the Internet, in this case representing a change in the historical and cultural context within which adult education works. While often debated, one can hardly ignore the appropriateness of McLuhan here when he states "Any understanding of social and cultural change is impossible without knowledge of the way media work together..." (McLuhan, 1967) As our task is to create online spaces for adult education, Finger and Asun have provided us with a challenge that must be addressed, namely finding a contemporary cultural role for the computer that doesn't erode community. That is, we must integrate the *networked* computer into a model of adult education in a modern social and cultural context. It is our opinion that, in order to attend to such sentiments, one must understand the significant change in the concept of a computer inspired by globally networked computing. The rapid maturation of the World Wide Web over the last 10 years has sparked important mutations in popularly held beliefs about computers in our culture. While Postman's question succinctly echoes the fragmented picture of modern adult education practice painted by Finger and Asun above, the computer in his picture is hardly more than a lonely office instrument for pushing digital information around virtual pages. As McLuhan hints to above, our first task as technologists should be to define the role of new media as a cultural phenomenon, not simply the role of machines in education. As we hope to show, on a cultural level, the computer may not be what we once thought it to be.

It is fair to say that what differentiated McLuhan from many technology acolytes of the past was that he foresaw the *networked* nature of future technologies and predicted the consequences on a social and cultural level. Without imbuing value, he realized that networked electronic media was a distinctly different creature than any other. Nowadays, one can hardly imagine the home computer detached from a network, unable to email, surf the web, download music from a P2P

net, etc. Such an instrument would appear to many of us as nothing more than a word processor and document storage device. Yet, less than 10 years ago, the desktop computer remained the territory of university professors and information specialists. Computer systems engineers and interface designers still found the bulk of their work in massive mainframes, and the Web had just been born and christened the information super-highway, a title that already sounds a little naïve (Pew, 2002). McLuhan's famous statement § , "the medium is the message", takes on a very different form when the computer is seen as a globally linked communication tool as well as an information handling device. Following McLuhan's argument, if print created linear, sequential thought, separating thought from action, and TV, following a one-to-many broadcast pattern started to reunify thought and action once more, then we must endeavor to fully understand the impact of accessible, globally networked computing and its introduction to popular culture of the many-to-many, two-way communication pattern. Prior to the Internet and the new media revolution, the closest the public came to a technology capable of this was the telephone conference call which has, for the most part, proved too unintuitive to garner mainstream adoption (Shirky, 2003). The introduction of the many-to-many two-way pattern into mainstream thought marks a turning point in communications technology, since it is the first widely accessible technology that facilitates social dynamics. An ICT facilitated course that uses e-mail to distribute material is not necessarily social in nature. If the facilitator sends out assignments to all members of the class, but the members can only email the facilitator back, they are engaged in point-to-point, two way communications. This pattern does not create social dynamics. In this role, the computer exhibits the traits of a tool facilitating the practice of individualized adult education, catering to individuals rather than communities of individuals. Many-to-many, two-way communication, combined with the rich media capabilities of new media technologies begins to turn the computer into an integrated social tool for enabling the conceptual movement through communities in a modern, technological society.

Since this communication can be independent of geographical space and happen synchronously or asynchronously, thus independent of time, our environment now also has a collective memory. Now the networked parts of the world begin to resemble the vaunted global village with a global culture and language emerging. Our charge now becomes developing our understanding of the nature of the environment enabled by new media, and its relation to our cultural existence in the physical world. Then we can imagine the computer as something other than the post-modern demon of isolated life; then we can approach the construction of online spaces for adult education in a manner that is in accord with the social action agenda. To counter Finger and Asun, we must decide what the networked computer actually represents within communities; a device for cleaving them into fragments, or a tool to help in uniting them. Since technology is never neutral and its intent is reflective of its form, we must also be careful to qualify what form will be presented to the user (Marx, 1847 the poverty of philosophy). In a paragraph that would seem equally at home in the writing of Ivan Illich, McLuhan states;

"It is a matter of the greatest urgency that our educational institutions realize that we now have civil war among these environments created by media other than the printed word. The classroom is now in a vital struggle for survival with the immensely persuasive 'outside' world created by new informational media. Education must shift from instruction, from imposing of stencils, to discovery – to probing and exploration..." (McLuhan, 1967)

It is true that the computer as a component in a publicly accessible, globally distributed network, where each person/machine dyad represents an element in a larger cultural existence, is a very recent idea (Nardi, 1996; Dourish, 2001). It is such a novel thought that even within the IT field, professionals are racing to evolve design and development strategies quickly enough (Vrendenburg, Isensee and Righi, 2002). This can, however, be illustrated by following the hypothesis of MIT new media guru, Lee Manovich. While ones operations within a new media environment are embedded in the software itself, they not only represent ways of working with computer data, but are externalized as ways of existing in the greater society (Manovich, 2001). He goes on to point out that this closer integration of computers and daily life requires a closer

relationship between the designer/developer and the user, an idea we will explore further in this paper. The important point to note here is that the message fixed in the software we use for adult education is not only witnessed in ones interaction with the software, but will affect ones life outside of the computer. Those of us that use email think nothing strange of getting one message at once to several people separated by geography by CC'ing them. However, prior to the widespread penetration of email in our culture, this was either achieved via group face-to-face interaction, relayed from one person to the next possibly via some communications technology, or not at all. In other words, it wasn't a given that one message could reach a group simultaneously when that group was divided by space and time. Isolated examples existed such as mass phone messaging within corporate level telecommunications networks, but this had little or no relevance to general life outside of the workplace.

Referring once more to this idea that technology is never neutral and our interaction with it is externalized, in this regard, if online adult education is to truly reflect a responsibility to social action, it cannot be instrumentalised by educators or third parties. For example, since ensuring the protection of financial considerations in an online educational intervention may potentially compete with emergent social action initiatives of the learners, educational software cannot aim to be both instrumental in helping the bottom line and truly effective as an educational tool. Software that aims at becoming a tool of adult education and its social action agenda must aim at being that first and foremost and cannot attend to competing roles at the cost of this. Any economical consideration must be a secondary concern. Learning technology that has as its focus the distribution of education programs to thousands of faceless paying clients will always be implanted with this agenda in an overwhelming way, and cause the externalization of this thinking to ones life outside of the computer.

With the *networked* computer hopefully now grounded sufficiently in its role as a social tool, we turn our attention to the learning group itself as it exists in an online environment. Sociologist Manuel Castells recently noted how the networking phenomenon has risen throughout the world, not just on the technological front, but as a new form of social organization (Capra, 2003). Indeed, for some time now social network theorists have considered a group of people connected by new media technology as a true social network (Garton, Haythornthwaite and Wellman, 1997). This interpretation puts the tools of social network analysis at our disposal and allows us to investigate the interplay between the members of this social network and the interconnectedness of the social network with the underlying computer network that facilitates it.

Non-Linear Online Social Organization

"The Sage... accepts the ebb and flow of things, Nurtures them, but does not own them,"
Tao Te Ching; 2 Abstraction

With the aid of network analysis tools, we can begin by constructing a conceptual model of an online social network. Adults within such a social network are individually represented by heterogeneity. That is, adults in a network are non-similar dynamic entities, continuously evolving under the various social forces that surround them (Watts, 2003). Furthermore, while it is true in a general sense to state that adults within a social network try to make informed decisions, irregardless of the source and validity of their information, how they reach those decisions involves such a multitude of complex and interrelated factors, that in any practical or empirical sense, these adults can be seen as randomly acting network constituents. Therefore, our social network consists of diverse and randomly acting adults. This view is further distilled by defining this network of random elements as a *complex and dynamical social-system* (Gorelik, 1975; Capra, 1996; Madron and Jopling, 2003). Any social system (in this case, our social network) with an initial degree of unpredictable complexity will maintain a level of unpredictable complexity throughout its existence. If a system exhibits a set of unpredictable or random conditions in the beginning, it will always exhibit a level of unpredictability related to these initial conditions and

never reach internal equilibrium. In this case, the key to complexity is the internal diversity or heterogeneity and perceived random behavior of adults in a social network.

Important to note here is that the complex and dynamical social system is not without order. Rather, order on a global scale or external equilibrium emerges from the interplay of the constituent parts, each one an ever evolving, dynamic and unpredictable element. This is wonderfully illustrated by this light hearted story. As a final year assignment, a WestPoint officer cadet class was tasked with organizing the playtime activities for a local kindergarten class. Following the rigid, top-down military approach of researching the best set of solutions, drawing up a plan and executing said plan, the cadets were amazed to find total chaos the result, despite their best efforts. What they failed to understand was that experienced kindergarten teachers allow a certain freedom at the start of any playtime and then carefully 'join in' so to speak, to direct the play. They recognize the randomness of each individual element in the complex system, but also the ability for these elements to aggregate and create order on a group level. Clever kindergarten teachers even learn to fill the environment with cues that help them anticipate the order that will emerge from the chaos, thereby allowing them to plan more strategically.

Systems theorists Cynthia Kurtz and David Snowden have coined the term *un-order* to describe this apparent lack of order that gives rise to a particular type of harmony on the global scale of a dynamic group. The prefix *Un* is not used here to denote opposite, but to convey a paradox, as with Bram Stokers use of the term Undead in Dracula, neither dead nor alive but a state pertaining to both at the same time (Kurtz and Snowden, 2003). Before we move on, let me state that we are not of the opinion that all levels of existence, being battered down by the realities of living in a physical world, are subject to complexity theory. To adopt such thinking would be to discard the benefits of efforts made possible by centuries of the scientific application of the reductionist metaphor; obviously an exercise in futility. Instead we submit that both have their place in understanding the dynamic social system (Bolman and Deal, 1997).

In applying this thinking to the design of online learning spaces, we are required to relax a number of expectations early in the iterative design process. Borrowing from Kurtz and Snowden, and their work at the Cynefin Center for Organizational Complexity, we lessen our emphasis on the assumptions of order, (which becomes un-order) rationality and intent in dynamic social systems, in this case an online environment for adult education. Briefly, adults in a dynamic social network can now be seen as less than rational in an abstract sense. Again to reiterate, it is not that we believe adults make uninformed decisions, but in this conceptual model, these decisions are so complex as to be best understood as random and irrational events. This is merely a sense-making exercise that we employ to decouple ourselves from the rigidity of strict hierarchical planning. We also begin to see that intent is inseparable from context. Correctly anticipating intent in one context is by no means a sure fire method for anticipating intent in another, even quite similar context, since order on the group level emerges from complexity, itself unpredictable. Once more, this is not to suggest that adults act without carefully weighed intent. Rather, the premise is that each group, exhibiting properties that continuously emerge on the group level from that group's internal network, shapes the intent of group members and their decisions in a complex and unpredictable way. This further lessens the validity of hard-wired, pre-planned solutions for our design methodology and places the emphasis on reactive, network driven solutions shaped and reshaped by the group itself.

So, to some extent, it can be implied that the group is organizing itself, as chaos on the individual level gives way to emergent patterns of un-order on the group level. In his remarkable book on complexity in organizational management titled *The Living Company*, Arie De Geus performs an exhaustive study on the properties that successful, long-lived company's exhibit. He points out that such companies survive because they continuously demonstrate an ability to evolve and adapt to new circumstances on the group level, by enhancing individuals ability to learn and reach their own goals. Rather than behaving in a Cartesian, mechanistic way, these companies behave like evolving, living systems or networks of sub-systems. In this view, the organization is

not planned by or owned by any higher power. Instead, un-order on the level of the group is brought forward by the continuous interaction of well supported members within the system.

David Wiley and Erin Edwards provide us with some fascinating work on the nature of online self organizing social systems (Wiley & Edwards, 2002). Referring to them as the *decentralized future of online learning*, in one paper Wiley and Edwards examined the Slashdot online programmer community as an example of such a system. Briefly, Slashdot is an online community facilitated through a bulletin board system. Members begin on the peripheries of the community and through a combination of activity over time and peer rating they can elevate their station in the communal hierarchy based on reputation. While the majority of their work is grounds for much excitement, one issue Wiley and Edwards have yet to attend to is the inhibitory nature of the power dynamics that develop in such a community. According to Illich, "...new institutions should be channels to which the learner would have access without credentials or pedigree..." (Illich, 1970) Freire echoes this sentiment when he states "Any situation in which some men prevent others from engaging in the process of inquiry is one of violence" (Freire, 1970).

To understand just how this relates to these self organizing online social systems, one can try a simple exercise. Log in to an open source online community, enter a forum and proclaim the wonders of some new Microsoft technology. Regardless of the validity or quality of ones comment, in most cases, the group will act in its own defense and by outright attack or by simply ignoring you, the community will quickly move you back out to the peripheries. Clay Shirky referred to this pattern in a talk at the O'Reilly Emerging Technology conference 2003, titled *A Group Is Its Own Worst Enemy*. Invoking W. R. Bion's *Experiences in Groups*, Shirky points out that in self organizing online social systems, if the rights of peripheral members are not protected at the early stages of the group's evolution, then pockets of early concentration can hijack that group's development, often unconsciously, to favor their own set of standards. This phenomenon is also known to social network theorists as the *Matthew Effect*, a term coined by theorist Robert Merton. As network ties are formed and strengthened by early successes, nodes of concentration begin to form as members migrate to these ties in search of similar success. These nodes also tend to become favored by new members, since they are the first visible points when entering from the peripheries. In Wiley and Edwards example of Slashdot, if a member answers a question well the first 10 times, the network tends to favor these members at further points in the early parts of the process of self organization, and will eventually grow intolerant of challenges to that member's opinion. Over time, an unspoken agenda forms and the group rejects any contrary opinion, regardless of its quality. In effect, those who get rich early, continue to get richer – those who loose out early, stay poor. What is important to remember here is not that the concentration of effort around successful network nodes is a negative property. Obviously, as several members of a learning group find success together, others will seek them out and make efforts to learn from their success. What is cause for concern however is the rapid blind solidification of these nodes into markers of success, as paths to them become perceived as paths to success rather than paths to one source of learning among many.

So how can we counteract the formation of such power concentrations, if what we are interested in is harnessing the potential for complex and dynamic groups to bring forth un-order from chaos and to self organize? After all, dialogical education as Freire describes it must never place the learner in the role of object. The answer is that we currently don't know, and we likely won't until we can see the cooperator concepts transformed into actual learning software. One early suggestion derived from Cheryl Doran's work with online groups at Capella University is the group charter (Doran, 2000). Doran has found the use of group charters at the critical early stages of group cohesion to be effective in providing a stable and horizontal power dynamic. Conceivably, a unifying parent charter could be drawn up that reflected the principles of emancipatory education and the social action agenda, protecting the rights of all group members, new or old, in the learning process and beyond. Members could then build upon this and construct their own charters by consensus as they move through their own learning groups.

Further research will undoubtedly be forthcoming as this area of study continues to produce some fascinating results.

Beyond the social network is a second set of relationships that signify the existence of another network at play here. It turns out that in regards to group software design we are in fact looking at two separate networks closely interacting. The first and most obvious is the complex and dynamic social network held together by network ties in the form of complex relationships, such as collaborative work efforts, friendship, etc. The other is the computer network itself, consisting of the hardware, but more importantly for our purposes, the software. Using the Human Computer Interaction model, the computer network is viewed as a static substrate of hardware (the wires and machines) and software objects (i.e. IM chat, discussion forums, online course manuals, etc) upon which the communication, collaboration and coordination take place (Ellis, Gibbs and Rein, 1991).

The initial work in computer-mediated group software design stems from the 'groupware' line of thinking in the field of Human Computer Interaction or HCI (Johnson-Lenz and Johnson-Lenz, 1994). Essentially, designers and developers attend to the way in which users interact with their machine. In contemporary popular culture, this reaches its most ubiquitous expression in the GUI or graphical user interface, observable in most point-and-click operating systems such as Windows. Ultimately, groupware design is always approached from this perspective, that being the individual user. Regardless of how the tools are built to enhance group activity, the central concern in current groupware design is the user's interaction with their machine.

An idea that illustrates this well is the notion of interactivity in groupware design. While it may seem intuitive for readers to think what we mean in this context is the interaction of various members of the group, in the current scheme, interactivity is something that happens between the user and the machine. People may be engaged in an online group, but this is primarily viewed in terms of the individual user's ability to effectively interact with their own software. Many people, when asked to describe interactive computing, talk about rich methods for visualizing data, animated screen activity, the machine anticipating choices and so forth. This paper was assembled on Microsoft's Word software. It interacts with me (and my poor English skills) by underlining grammatical and spelling mistakes. Software design following the groupware line of thought can consider how the user reacts to changes in an online social network by anticipating their interaction with the software, but not how the *software* can react to changes in the structure of the social network. The user is predicted to react in one of a number of particular roles. These roles are each facilitated by a piece of software. This software is essentially set with a static number of ways to interpret these roles.

The problem for technologists, in its broadest terms, is that there is no *networkdynamic* considered for the computer network. That is, this substrate of computer network technologies, expressed as software objects, is seen as requiring no dynamic properties of its own over the lifetime of the group. The user's social connections or the *social networkties* can strengthen or weaken as people create and nurture relationships, but the groupware itself remains oblivious to this. These social network ties are facilitated by this substrate of communications technologies, but the substrate itself remains static and unchanging.

Iterating over this view in light of our globally networked context, any groupware can utilize the Internet for information retrieval, or use its HTTP protocols as a platform, but the groupware itself cannot grow beyond its pre-planned boundaries and enable the creation of new, user or group-defined software objects that can be integrated into the wider Internet by the user or group. The virtual classroom has walls in a virtual world that favors wall-less classrooms.

For example, two hypothetical users initiate an online relationship as part of their learning. This relationship develops into mutually respectful discourse over time, and ultimately leads to critical reflection for one or both learners. The structure of the social network or *topology* is changed,

since what was once a non-existent or weak tie has become a strong tie. This strong tie, in turn, can promote further interaction by other users. That is, users who see successful learning can migrate to this area of the network in search of their own learning. As we have mentioned in regards to power dynamics, this happens all the time in current learning software that makes use of bulletin board software, as people join an interesting topic by posting their thoughts. As this process continues, the strength of the learner's relationships can grow or decrease, but the groupware upon which they rely is static. They will only ever have access to the software objects created by the design and development team. The topology of the computer network, as witnessed in these software objects, can not change or evolve in reaction to the change in topology of the social network.

HCI theorists Mark Roseman and Saul Greenberg at the University of Calgary offered their *open-protocols* idea in response to this. This suggests the incorporation of an open set of protocols early in the iterative design cycle to facilitate the addition of group-specific modules long after the initial deployment of the groupware (Roseman and Greenberg, 1993). A practical example of this is the Building Blocks extensibility architecture of the Blackboard learning system. An educator can construct a new Blackboard learning module (or more likely, hire a design and development firm to do this) and plug the resulting module into the core Blackboard learning system. This still, however, places system extensibility beyond the learner and maintains it within the closed system of the original software. If you will, the educator can add a 'lab session' or 'field trip' to enrich the class at a cost in time and finances but it remains beyond the control of the learner.

Clay Shirky again offers some interesting thoughts that help illustrate how well this approach to, as Shirky terms it, social software design, does or does not fit into a globally networked world (Shirky, 2003). He refers to these systems as *hard systems*. That is, they create a robust and stable but closed platform. It is this perceived stability or hardness however that hampers attempts by users to evolve such systems. He contrasts examples of hard systems from the early days of the web, such as FTP Gopher or CompuServe, with the quintessential example of a *weak* system, that being the loose set of protocols and core language set that make up the World Wide Web. In his essay *In Praise of Evolvable Systems* (Shirky, 2003), he suggests "*It's easy for central planning to outperform weak but evolvable systems in the short term, but in the long run, evolution always has the edge*". This is because hard systems cannot expand beyond the initial vision of the design team without being hacked open and reconfigured at every unpredictable turn.

In contrast, the weak and loose nature of the web has allowed it to grow from a simple system of linked documents for physics researchers at the CERN facility, to the ubiquitous WWW that now includes everything from the rich-media of streaming audio and video, massive networked enterprises, e-commerce applications to the intimate daily expressions of bloggers. It is precisely due to this perceived weakness that it could evolve to support the emergence of unpredictable properties as its roles were not explicitly expressed in any definite sense. It is worthwhile mentioning here that the groupware line of thinking in HCI is rooted in a time before the explosion of the global Internet and accessible, relatively high-powered, networked computing devices. HTTP protocols had not yet become the glue holding the global inter-network, or Internet together.

Designing Non-Linear Web Software

"Only the hand that erases can write the true thing" (Meister Eckhardt)

We are now approaching a more complete perspective of the broader cultural significance of networked computers and the integration of the computer as a tool for societies rather than a tool in society. Adding this to our understanding of the complex, emergent social patterns in an online social network we can once again return to adult education theory and begin to construct the conceptual framework for our design methodology.

In what now seems like premonition, Ivan Illich in the 70's coins the term *educational web* in his book *Deschooling Society*, and states that "What are needed are new networks, readily available to the public and designed to spread equal opportunity for learning and teaching" (Illich, 1970). Much like McLuhan, Illich understood the significant difference between the mere existence of communications technologies, and the potential for community-driven education initiatives within a publicly accessible communications network. Illich realized that communications technologies can either strengthen institutional barriers to true dialogical learning, as in the case of his example of state run TV in Bolivia , or enhance the ability of communities to engage with the educator and the material across distance. In this same chapter, he goes on to describe his idea for a decentralized educational web of audio recording devices and a supporting network of libraries for producing, accessing and distributing these recordings, available to any and all.

In Illich's audio-based educational web, the members are capable of accessing ready made tapes, recording their own from scratch, or combining both methods either synchronously or asynchronously, approximating a type of virtual collaboration. The individual could also collaborate with other community members to jointly produce a tape for their own use or the use of other learners. These principles demonstrate the ideas behind what we have termed *Non-Linear Web Software*.

To disable the conceptual objectification of the learner by the online learning environment, we must create software that facilitates dialogue with the medium and not the programmer. We must ensure that the intent embedded in the software, expressed through its form, addresses the social action agenda of adult education. To ensure our computer network, that which supports the network ties of our social network, is potentially responsive to the emergence of unpredictable patterns of un-order in the social network, we aim to make it possible for learners to reconstruct their collective environment internally and construct new objects that not only can exist within the learning environment itself, but also externally in the global Internet, thus also leaving behind the walls of the traditional virtual classroom. For the design and development team to offer solutions in a top-down, pre-planned way is to assume too much in the way of order, rationality and intent. Perhaps the most obvious question then becomes, in the complicated computer world of abstract languages and 0's and 1's, how can we promote such a level of interaction? It is simply impractical to expect learners to become programmers before joining an online group. These points obviously require our attention as we move from conceptualization to the first iterative steps in the construction of the cooperator design methodology.

Before we continue, let us quickly move to point out the main contrast between the Non-Linear design approach and recent movements in the HCI field to involve the user, the two central examples being Participatory Design or PD (Ehn, 1988 *Work-Oriented Design of Computer Artifacts* . Stockholm : Arbetslivscentrum.) and David Cavallo's Emergent Design from the *Future of Learning Group* at MIT. (Cavallo, 2000) While the cooperator concept may employ elements of both these approaches in the design and development cycle, non-linear design stresses the need for the user *and* the group, not just the design and development team, to be able to continue to evolve the software after it is deployed. As suggested by Lee Manovich however, the role of the programmer and the user will continue to blur as new media become more powerful, and it is in this regard that PD or Emergent Design may prove useful for our approach. By its nature, our approach never really sees the design and development team release a 'finished product', but instead an application infrastructure and its associated modules. Our learning network will require some form of well developed feedback and commenting functionality and an ongoing relationship between the learners and the development personnel.

We can approach a better understanding of Non-Linear Web Design by returning to our example of the GUI for a moment. Here, tangible objects such as buttons are modeled in a virtual environment and our culturally adopted usage metaphors are maintained (i.e. push a button to perform a particular function, drag several objects around the screen to group them, etc.). While

we plan to make extensive use of these metaphors and take advantage of generally held GUI usage patterns, it is this thinking that best illuminates our point.

In the physical world, we cannot carry a generic button in our pockets, attach it to a wall and have a light switch, stick it on the TV and have a power switch, etc. If the physical world were modular in this fashion, objects could be combined in ways manufacturers never conceived. This idea is not only possible in the modern world of networked computing, but is a property sought after by most modern programmers early in the design cycle, especially those espousing the Object Oriented Programming (OOP) methodology. Following our example of the button, the basic principles of OOP outline a way for developers to create a generic button at the lowest levels of their programming, and define its functionality by its usage throughout the program. The same button can be instantiated many times to create numerous buttons each with a distinct functionality in each particular instance.

What we suggest is that for groupware to be responsive in a non-linear way to a dynamic online social network and its emergent patterns of un-order, we should follow a similar approach to the design of the underlying computer network, specifically its expression as various software objects. We suggest exposing our software at a much deeper level than current HCI models suggest in an effort to make it more flexible and facilitate dialogical interaction with the material. We plan to introduce a type of visual, drag and drop programmability in our groupware so that it is possible to combine existing elements in the cooperator environment (such as news aggregators, IM chat programs, documents and manuals, etc), third-party elements from the web, and entirely new objects constructed by the user and the group into self contained learning modules. In this system, the user becomes a type of visual programmer in the environment. These modules become a digital version of the tape recordings in Illich's audio educational web. This enables a dynamic and complex self-organizing learning group to create new modules of interest to the members or copy existing ones and customize and re-task them. It enables the members to enter into dialogue with the material being offered, not just the educator or other learners.

The non-linear software design approach also attends to the social action agenda in a number of ways. The user is now in control of their environment, but just as importantly, the group is in control of, and responsible for its own learning. In an open software system using this approach, the learners can combine local case studies, images, audio, video, etc online and construct relevant materials for others in the same region. This makes this strategy potentially attractive to practitioners in the development field, supporting initiatives such as Participatory Action Research and various asset-based approaches. In the larger sense, similar initiatives in very different parts of the globe can be contrasted and compared, with dialogical interaction facilitated for all learners, regardless of location. An online community learning program in Canada using this approach could, theoretically, take a module created anywhere else in the world, reconstruct it to relate to their Canadian context, and contribute it back to the learning environment for others to use. Since this is digital media, the original is kept intact, and the newly created, Canada specific module becomes an iterative step beyond the original. Here we also see the possibility for increased mobilization of indigenous knowledge systems.

The learner, to a greater extent, is engaging with the medium and not the programmer. Since the original form presented to the learner is merely a convenience to facilitate delivery, the user (or the group) can reconstruct the material immediately. If a microfinance module is authored with a case studies layer to illustrate micro-finance practice, the case study content could immediately be replaced by regionally specific content by the user group. Since the user is no-longer objectified in the learning process, the behavior patterns that are externalized reflect the social action agenda of adult education. Since users are no longer required to reshape traditional knowledge systems in order to fit the computer network, the network itself can now respond to the incorporation of such systems. That is, users can shape original software objects to meet the needs of existing knowledge systems. Using this methodology, we can move closer to the goal of

having networked computer technology co-exist and enhance traditional information channels and knowledge systems (UNDP Essentials Series, 2001).

A hypothetical example could look like this. A fair trade organization could initially assemble online from various communities in a region. Each learner has their own space where they can store their own materials, images, documents, etc. Any amount of this can be made available to either others in that group, other groups in the learning environment or the general public via the Internet. They move through a learning program in a recursive, group centric manner, collaboratively designed by the members along with any number of experienced development practitioners, possibly in the role of educator. They can reconstruct their group environment (and any number of sub-groups as well) to meet their own needs, and include other modules taken from, for example, micro-finance, community-based organizational management, asset-based community development, etc. while also having the ability to continually develop and refine their own modules to reflect the applicability of their learning in their own local context. Upon a group consensus, they could then construct a feature rich e-commerce application (which could include many third-party extensions available through the growing XML-based Web Services architecture and made available as a modular plug-in) and deploy this online, integrated into the global Internet. As the group continues its learning and receives feedback, the e-commerce application can be continuously refined. Since this process is controlled by the user group, they could make their learning available to other learners on the network. If the e-commerce application works well, this can also be made available for use to others on the network. Here we have emergent un-order supported in the social network, and reflected in the malleability of the computer network. It is worthwhile to point out that this is merely one possibility of using such software based on current computer usage patterns. The true strength of this approach is that it supports previously unimagined patterns. Of course, the learner or group is not required to engage at all, in which case the software behaves like any currently available, user friendly learning software.

In applying the non-linear design approach, we plan to make use of Illich's four major approaches to constructing educational webs. We have chosen this in order to guide the process of defining the design methodology and aid in monitoring and evaluation elements that we hope to introduce shortly. These four approaches are;

1. Reference services to educational objects. This could include; third party online resources either prepared by the development team or other networks and communities of practice making themselves available to the learning group; tangible services such as libraries, museum and workshops; apprenticeships, internships, etc.
2. Skill exchanges. This might allow people to list the skills they feel comfortable sharing, the conditions under which they are willing to share, etc;
3. Peer matching. This represents the software network that allows learners to communicate the learning they hope to engage in and find like-minded learners on the network; and
4. Reference services to educators-at-large. This may look something like a learner/peer rated directory service, listing professionals, paraprofessionals, and free-lancers who are offering their services to learners, other educators, etc.

Early Days Yet

Design Issues

A great deal remains to be done regarding the range of design abstractions that will make up this Non-Linear design approach to groupware. This project hinges on the role of the Coady institute as a development organization. What place such a design approach has, if indeed any, outside of development remains to be seen. The diverse set of disciplines invoked in our treatise of new media design, such as network analysis and organizational complexity, need clearer qualification and refinement. Also as the intention is to build two software packages, the more formal learning

system and the Knowledge Networks, a more comprehensive picture of directed online social organization is needed.

The power of network analysis and the related toolset are central to this design concept. They allow us to describe a more accurate model of the dynamic social system and its internal activity, which in turn allows us to better approximate a design methodology reflective of adult social patterns in online learning groups. At this stage we have used them in a coarse manner to generate a rather generic picture of our group allowing us to begin the iterative design process. In the same vein, the use of sense making tools in our exploration of complexity in social organization has been quite general and blunt up to this point.

As we move to consider the Knowledge Networks as a discreet piece of software within the cooperator project, we hope to make use of the pioneering work of Jean Lave and Etienne Wenger and the concept of Communities of Practice (Lave and Wenger, 1997). The central motivation of this early phase is to construct the conceptual framework and from that the design methodology. This design methodology must be broad enough to encompass a wide range of online social organizations. As we move to apply this in the building of software however, we will consider Lave and Wenger's concepts of situated learning and learning as a factor of participation in communities of practice. This also opens the door to exploring the concept of social capital and its movement in social networks.

Technical Issues

As this is still the very early days for this project and we have many technical considerations to account for before we reach even a relatively comfortable level. Issues such as available bandwidth, usability and accessibility, language, licensing and design architecture, to name just a few, will require attention.

While the non-linear design approach focuses on the construction of the underlying software, there is still the question of the underlying hardware. To briefly explain, on first glance, an initiative employing the cooperator concept and non-linear design stands to benefit from a peer-to-peer network. However, there are some potential drawbacks to this. Firstly, despite rapid progress in efficient search algorithms across P2P nets, the question of search effectiveness is always present. Unlike most search engines which centrally house indexed results for rapid one-stop-searching, P2P nets require each client to scan the entire net when completing queries. As the net grows, this becomes increasingly inefficient and ineffective. It also makes the issue of terminal sharing complicated, since it relies on each user having an individual machine. Add to this the reliance on active network clients, and P2P nets can be downright frustrating for use in ICTD educational initiatives. On the other side of this spectrum is the centralized network, operating from a central server or server cluster. This raises questions for us regarding power dynamics, learner autonomy and the resilience of the learning network. A centralized server is both more effective and efficient in regards to information storage and processing. It does, however, place the technical responsibility and control for the network in one set of hands so to speak. The network is also less resilient, since a server problem or attack in a centralized network can bring the entire net to a halt. In an effort to attend to these problems at this early stage, current development is taking place in what we call a server micro-environment. A single IBM X-series server houses the database server, the communications server which handles real time persistent connections, the application server and the HTTP server. The basic idea is for a series of these micro-environments to be placed with development organizations or NGOs in a particular region, forming something that looks like a combination of a P2P net and a centralized net. Perhaps using the FTP protocol, automated data sharing could be established between these machines, facilitating shared data storage. This approach offers a compromise between the efficiency of a centralized net, and the devolved power dynamics and resilience of a P2P net. Obviously, we still have much to accomplish in this area.

While it is beyond the scope of this paper, we have also recently begun research on the potential for multiple two-way, *persistent* connections in such online environments. Briefly, this means that many members of the group can interact in real-time with software objects. The simplest example of the persistent connection in current use is the IM messenger application in its various forms (MS IM, ICQ, AOL Messenger, etc). Many people can be logged into the same website at the same time, and interact with each other in real-time. While its uses for IM applications are obvious, the ramifications of this technology become truly exciting when one realizes that these shared software objects don't have to be lines of text in a chat messenger. In our drag and drop visual programming interface for example, this means that one could enable groups of users to use the same site or module at once. Each user would see their own cursor on the screen, identified by a name tag, but also the cursors of other group members, each identified by their own name tag. They could collaboratively construct new modules in real time. In contrast, when using bulletin board type systems, since the server cannot force other client pages to refresh after posting or maintain persistent connections, you may not see messages from these users until you return to the page at a later date.

This also uncovers another technical issue worth briefly mentioning here. The web, by its nature, is a stateless entity. Once you request a page by entering or clicking a link, once that page is delivered to your browser the web forgets about any interaction with you or your browser; it is always a blind call and response method. This has made the development of desktop like applications (such as the kinds of applications suggested by the non-linear design approach) very complex in the past. Perhaps the best attempt to handle this so far was the feature rich but rather bulky Java platform, which was touted as the savior of communal applications online in the mid-nineties. Its difficult language, large file sizes and in-depth development process prevented it from ever gaining mainstream adoption. Recent years, however, have seen the advance of so called 'thin clients'. These are platforms that enable developers to create multi-tiered, desktop like applications in a true web like fashion that is indicative of Shirky's weak systems. Recent years have been very exciting in this regard, particularly with the introduction of two development models; the Rich Internet Application by Macromedia and the Occasionally Connected Computing Model by IBM. These advances coupled with the W3C's interoperability push, the introduction of the XML family of languages and the Web Services architecture makes our non-linear software design approach feasible for perhaps the first time in the history of the web.

Given the focus on system extensibility, it falls on us to integrate a level of developer support into such a design methodology from the beginning. The project is currently being test built using an ISO standards ECMA scripting language for the presentation layer, a fully supported open-source database server for handling raw data, and a J2EE compliant application server. A relatively new proprietary protocol called RTMP has been used for the communication server; however, this choice was made easier by the very limited options presently available and the close integration of this protocol with our other chosen platforms. The drag and drop design of WebPages from within the learning environment is facilitated by the use of CSS files for each document. This provides us with a way to develop a clean separation of form and function when a user decides to publish content beyond the learning environment itself and onto the web. Content can be maintained separately from layout code and provides the user with greater flexibility for customization than current HTML table based layouts would support.

The combination of these technologies has been seamless to this point, and may ultimately be a recommendation of this design approach. As we would eventually like to offer an SDK for third party development, we have also begun to explore the following issues;

- Robust and mature application architecture. The non-linear design approach suggests a rather detailed mapping of the data and presentation tiers, so a well documented architecture is vital, both to aid us at the planning stage and to make the process of core extensibility more transparent for other developers adopting this approach.

- Carefully structured set of API's. In order to offer an effective SDK for developers, the application architecture would be accompanied by a carefully planned set of API's. Again, the level of detail exposed to the end user requires the developer to have strong procedures for handling such detail at the development stage.
- Extensibility beyond our application architecture. At the moment we have been experimenting with the use of WSDL files to describe programming functionality combined with SOAP for a standards-based invocation of this functionality via the Web Services architecture. This may prove particularly useful since it allows us to use our own combination of technologies to write the core functionality, but expose this functionality in certain cases to third party developers using entirely different platforms but. In this way, modules from the cooperator project, or any project utilizing this design approach could, for example, be used in Blackboard Building Blocks extension.
- Content customized for devices. The use of XML and CSS can also allow the user to author content specifically for mobile devices with less screen real-estate, such as handhelds, PDA and cellular phones.

In such a distributed learning environment, the question of intellectual property rights and author protection becomes paramount. While we have yet to closely examine this issue in relation in any great detail, two avenues look promising at this early stage. The ubiquitous GPL license is the standard for an open project and will of course be a focus. Through this we may also be able to take advantage of the CVS system and the broad community of developers such as SourceForge. The more recent licensing system, Creative Commons also looks quite promising. This would allow more user freedom than the GPL license and enable users to exercise greater flexibility over final control of their material.

To this point, we have only alluded to the usability factors of such a program with the rather loose 'drag and drop' phrase. Obviously, however loose this description may be, it competes with standard usability models accepted as fact in web application design. The introduction of feature rich thin-clients we make use of, however, call into question the continued applicability of accepted web design rules such as the three-click rule and the 7+/-2 rule. The three-click-rule states that a user should never have to click more than three times to find a piece of content while the 7+/-2 rule states a user should only ever have between 5-9 navigation choices on a site. A usability discussion is well beyond the scope of this paragraph, but briefly, what limits these approaches is the reliance on the web page being a document or set of documents. Even with current web applications such as e-shopping, one rarely moves beyond the process of filling out forms and moving through a set of documents. Contrasting this with having only 5-9 choices at a time while authoring a standard document in a word-processing application helps to demonstrate the problem. These rules acted as good guidelines when web sites were collections of documents, but the introduction of real UIs in web design will increasingly challenge such notions.

In Conclusion

"Theuth, my paragon of inventors, the discoverer is not the best judge of the good or harm which will accrue to those who practice it" *Plato's Phaedrus*

The number and diversity of topics discussed in this paper make for an exciting starting point from which to begin our study of the elements that aggregate to describe adult education for social action in online environments. From there, we eventually hope to approach a design methodology reflective of adult education in a contemporary context. If there is an overall lesson we have learned in attempting this, perhaps it's the importance of beginning with this holistic view. Without proper consideration, not just for the design of our software, but also its broader cultural roles, we run the risk of committing the sins of Theuth. That is, seeing the technology only through the eyes of technologists.

To paraphrase Tim Berners-Lee, the inventor of the World Wide Web and its HTTP protocols; the web is not becoming a huge network of individual machines, but something quite more, something quite unpredictable. This was never anticipated by e-commerce gurus or global mega-tech corporations. When the only real advances to speak of are advances such as P2P nets, RSS syndication and blogging, it quickly becomes apparent that what drives the advance of computing technology is not silicon or 0's and 1's, it is communities of people acting together for their own betterment.

§ In fact, McLuhan never actually made this statement. It does, however, encapsulate the general thrust of his philosophy regarding new media.