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Evolution of a higher ed curriculum based ecosystem

Christopher James Cheers

In a Higher Education context learning is an individual experience within a learning community. Such a community no longer needs to be bound by temporal or spatial limitations. Drawing on concepts found in Complexity Science, Ecological Psychology and Distributed Cognition this paper argues that educational design needs to focus on supporting the dynamics and flow of interaction, the exchange of ideas and negotiation of meaning within a curriculum based ecosystem.

Keywords: Complexity Science, Ecological Psychology, Curriculum Based Ecosystem

The dynamics of our lives have changed. Our senses and cognitive processes have been extended and supported beyond our physical selves. We live in a world that has been described as a 'digital ecosystem' where the physical and the virtual are fully intertwined and functioning through well-designed, well-integrated social and technical architecture working together in a wireless mesh that is persistent, pervasive, and mobile (Suter et al 2005). This digital ecosystem is an open, flexible, demand driven, self-organising, collaborative environment. It can, and has, enhanced our abilities to connect with other people, share ideas, work collaboratively and form communities.

Our students are becoming very comfortable with this digital world, at home with its tools and processes. Today's learners increasingly have access to, and use a broad range of social networking tools and technologies that provide a constantly evolving multiplicity of interactive resources for information and communication. As such learners expect to see this diversity reflected in their educational experiences. If our educational practices are to remain relevant our higher education institutions must also embrace this evolving digital age. Unfortunately traditional transmission models of education (reinforced by widespread use of instructivist teaching approaches and top-down management structures) seem to still dominate our educational institutions. (Garrison et al 2003, Laurillard 2006).

> Technological innovation in higher education has been largely restricted to administration and research. The significant technological innovations in teaching and learning have been confined to addressing issues of access and convenience. However, addressing the relevance and quality of the learning experience demands that higher education take a fresh look at how it approaches teaching and learning and utilizes technology. (Garrison & Vaughan, 2008)

Virtual learning environments and social networking solutions have the capacity to cater for a diverse range of learner initiatives and learner interactions. The learner can be provided with opportunities to interact with the tutor, other learners, course content (readings and other resources), and external experts. Learners therefore, have access to a rich socio-cultural context. Unfortunately, the adoption of these technologies seems to have been more about the preservation of the status quo than any paradigm shift. Higher Education practices need to reflect the dynamics of the digital ecosystem our world has become. This requires a major change in current practices if we as educators are to provide our students with educational experiences which will enable them to develop the attitudes, skills and knowledge needed to meet the challenges they will face as professionals in this constantly evolving digital world.

It has been argued that we do not learn a set of rules or abstract theories that we then apply in our interaction with the world. We in fact internalize a common set of practices, roles and ways of thinking that are provided by the current predominant paradigm (Imershein 1977). Knowledge is structured within a paradigm, supporting a particular worldview that defines an understanding of what can be achieved; the paradigm itself guides activities along particular directions. So implementing alternative educational approaches without changing the fundamental underlying paradigm tends to have little or no effect on actual practice. An alternative paradigm needs to be used if real change is to occur, and exemplars based on this paradigm need to be developed to provide concrete models to support change in practices (Kuhn 1970, Imershein 1976).

Our current curricula are not designed to mirror the complex dynamic world we live in and expect our students to be able to function in and succeed in as professionals. Curricula as we find them across our institutes of Higher Education have their roots in Europe in the 1500's. The term 'curriculum' was first used, in an educational sense of a course of study at a university, by Petrus Ramus, Regius Professor of Logic, in the late 16th century. Ramus' ordering and classification of courses and knowledge is fundamentally reductionist (Doll 2012). Reductionism is the belief that the whole can be understood if you understand its parts; that by dividing something under examination into as many parts as possible is the best way to understand that thing. It is the belief that by reducing everything to its simplest parts universal laws can be discovered and/or applied. It has been the foundation of scientific method since the time of Descartes and Newton (Mitchell 2009, Smitherman 2005).

This has led to the prevailing view in education that curriculum design should be based on the categorization and organisation of content to be delivered and learned. However it has been realized that while reductionism has its place as a scientific method it does not provide the means to explain much of our world.

> Many phenomena have stymied the reductionist program: the seemingly irreducible unpredictability of weather and climate; the intricacies of and adaptive nature of living organisms and the diseases that threaten them; the economic, political and cultural behavior of societies; the growth and effects of modern technology and communications networks; and the nature of intelligence and the prospect of creating it in computers. (Mitchell 2009)

Complexity science

A complexity paradigm provides us with the alternative view of the world we need for real change to occur; one that sees it as complex and unpredictable, one where relationships are non-linear and dynamic. It is made up of complex adaptive systems where intelligent agents anticipate the behavior of others and the external environment, and modify their behavior accordingly. Complexity science is not one theory but a combination of theories and concepts informing a wide range of disciplines including physics, biology, chemistry, mathematics, economics, sociology and a growing number of others.

Common properties of complex systems are:

1. Complex collective behavior: They consist of large networks of individual components (eg. ants, neurons, stock-buyers, website creators) each typically following relatively simple rules. It is the collective actions of vast numbers of components that give rise to the complex, hard-to-predict, and changing patterns of behavior.
2. Signaling and information processing: All these systems produce and use information and signals from both their internal and external environments.
3. Adaptation: All these systems adapt – that is, change their behavior to improve their chances of survival or success – through learning or evolutionary processes.

(Mitchell, 2009)

Concepts drawn from Complexity Science relevant to education include:

- The whole is greater than the sum of its parts: a complex system cannot be understood by dividing it into parts.
- Emergence: the process by which new patterns, features, qualities or products result from the non-linear interactions of agents within the system. Emergence is driven by the self-organizing nature of a system far-from–equilibrium.
- Self-organization: the tendency of many systems to generate new structures and patterns over time on the basis of its own internal dynamics – order emerges from patterns of relationships among individual agents.
- Non-linearity: actions can have more than one outcome and can generate non-proportional outcomes.
- Far-from-equilibrium: systems in far-from-equilibrium states evolve and adapt to changing conditions and spontaneously self-organize with structures of increasing complexity.
- Co-evolution: the process of mutual transformation that takes place for both the agent and the environment in which it exists.

When curriculum design is viewed from a complexity science perspective the focus shifts from curriculum content to the underlying processes of the complex adaptive system that is a discipline, a profession. We discover a world where the whole is greater than the sum of its parts. A perspective of curriculum stemming from the complex non-linear dynamics of such a world can spark new notions of epistemology and pedagogy. Through the use of concepts associated with complexity theories, new visions for curriculum can emerge (Smitherman 2005).

Curriculum based ecosystems & ecological psychology

Complexity Science provides us with the language and concepts to describe the nature and dynamics of our world as a digital ecosystem. To build further on this we need to be able to describe how human beings as independent agents within such a system find meaning, know and learn. Developments in ecological psychology provide us with the means to do this.

> … many contemporary thinkers from a variety of domains describe knowing not simply as a psychological construct existing in the head but as an interaction (or what Dewey, 1938, referred to as a *transaction*) of individuals and physical and social situations. (Barab & Plucker, 2002)

This ecological view of psychology takes as fundamental the interaction of agent and environment. Rather than explain things as all inside the head of the learner, explanations emerge from learner-environment interactions that are whole-body embedded in the lived-in world experiences. Interaction is dynamic and continuous, not static or linear (Young, 2004). Ecological psychology is based on the premise that perception and knowing is a property of an ecosystem, not an individual, and is co-determined through the individual–environment interaction. All environments have certain affordances that allow an individual to perform an action or actions and achieve a goal.

> Gibson (1979/1986) introduced the relational terms affordance and effectivity. An affordance being a specific combination of properties of an environment, taken with reference to an individual, that can be acted upon—opportunities for action (Gibson, 1977). Reciprocally, an effectivity is a specific combination of properties assembled by an individual, taken with reference to the environment, that allow for the dynamic actualization of a possibility for action. (Barab & Plucker (2002)

An ecosystem can be seen as an affordance network, that is a collection of facts, concepts, tools, methods, practices, and even people, taken with respect to an individual, that are distributed across time and space and are viewed as necessary for the satisfaction of a particular set of actions or goals (Barab & Roth 2006). An affordance is a possibility for action by an individual and an effectivity is the dynamic actualization of that affordance. An effectivity set constitutes those behaviors that an individual can produce so as to realize the potential of an affordance network.

Many educational practices implicitly assume that conceptual knowledge can be abstracted from the situations in which it is learned and used, this assumption inevitably limits the effectiveness of such practices. Knowledge is situated, being in part a product of the activity, context, and culture in which it is developed and used (Brown et al, 1989). Knowing and meaning, and therefore learning, is part of the dynamic interplay of individual and environment. When designing curricula we need to recognize this and design to support the dynamics and requirements of the ecosystem of the chosen profession or discipline. Learners need to be provided with opportunities to develop the effectivities needed to function effectively and succeed in the affordance network or ecosystem of their chosen field.

How do we identify the 'effectivities' that need to be integrated into the design?

The concept of distributed cognition provides us with a basis for identifying these effectivities. We need to understand the emerging dynamic of interaction within the complex networked world of a digital ecosystem. The theory of distributed cognition has an important role to play in understanding interactions between people, technologies and environments, as it's focus is on whole environments, what we really do in them and how we coordinate our activity in them.

Distributed cognition looks for cognitive processes, wherever they may occur, on the basis of the functional relationships of elements that participate together in a process. While traditional views look for cognitive events in the manipulation of symbols inside individual minds, distributed cognition looks for a broader class of cognitive events. For example, an examination of memory processes in an airline cockpit shows that memory involves a rich interaction between internal process, the manipulation of objects, and the traffic in representations among the pilots.

At least 3 kinds of distribution of cognitive process have been identified:

- cognitive processes may be distributed across the members of a social group
- cognitive processes may involve coordination between internal and external (material or environmental) structure
- processes may be distributed through time in such a way that the products of earlier events can transform the nature of later events

Hollan et al (2000)

Culture, social organization, the structure added by the context of an activity, and the tools used to complete that activity, are all forms of cognitive architecture.

> … in the distributed cognition perspective, culture shapes the cognitive processes of systems that transcend the boundaries of individuals [Hutchins 1995a]. At the heart of this linkage of cognition with culture lies the notion that the environment people are embedded in is, among other things, a reservoir of resources for learning, problem solving, and reasoning. Culture is a process that accumulates partial solutions to frequently encountered problems. Without this residue of previous activity, we would all have to find solutions from scratch. We could not build on the success of others. Accordingly, culture provides us with intellectual tools that enable us to accomplish things that we could not do without them. (Hollan et al 2000)

Knowing and meaning, cognitive activity, is constructed from both internal and external resources, the meanings of actions are grounded in the context of activity. It is not enough to know how the mind processes information, it is essential to also know how that information is arranged in the material and social world. We interact with, and within, the structure in environments, ecosystems. To design effective curricula we must know what that structure is and how it can be organized, the processes individuals and groups engage in and the resources and tools they use to render their actions and experiences meaningful. We need to have an understanding of information flow, cognitive properties embedded in systems, social organizations, and cultural processes.

An ecological view of the world requires a shift of focus in education to learner's interactions rather than the dissemination of information. We need to design experiences that are a true reflection of professional practice in the real world and provide an environment/ecosystem that supports, and in fact enhances, the evolution and emergence of professionally relevant attitudes, skills and knowledge in those engaged in and traveling through a curriculum based ecosystem. We have to support the dynamics and flow of interactions, the exchange of ideas and negotiation of shared meaning, and the engagement with others in a community of inquiry, within and around a professionally relevant educational experience (Cheers et al, 2011).

The author is currently conducting research into the design of a curriculum based ecosystem for Higher Education.

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Author contact details:

Christopher James Cheers, cjcheers@gmail.com

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