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Self-Organizing Networked Learning Environments

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INTRODUCTION

The Internet has long been touted as an answer to the needs of adult learners, providing a wealth of resources and the means to communicate in many ways with many people. This promise rarely has been fulfilled, and often, when it is, by mimicking traditional instructor-led processes of education. As a large network, the Internet has characteristics that differentiate it from other learning environments. As Kelly (1998) puts it, "the sum of the value of a network increases as the square of the number of members." Because these interactions are mediated through computers and may be with many users at once, this is a notable underestimate.

Churchill said, "We shape our dwellings and afterwards our dwellings shape us" (Churchill, 1943, p.23). If this is true of buildings, then it is even more applicable of the fluid and ever-changing virtual environments made possible by the Internet. Our dwellings are no longer fixed, but may be molded by the people that inhabit them. This article discusses a range of approaches that makes use of this facility to provide environments that support groups of adult learners by adapting to their learning needs using nothing more than their interactions to provide structure and shape to their learning.

BACKGROUND

Jonathan Darby (2003) identifies three generations of networked learning environments used in adult education. First generation systems are direct analogues of traditional courses, simply translating existing structures and course materials. Like their traditionally delivered forebears, they are dependent on individual authors. Second generation systems tend to be team-built and designed for the medium from pedagogical first principles, but still within a traditional course-based format. Third generation systems break away from such course-led conventions and provide such things as just-in-time learning, guided paths through knowledge management systems, and personalized curricula. This chapter is concerned primarily with third generation environments.

Saba's interpretation of Moore's theory of transactional distance predicts that in an educational system, as structure increases, dialogue decreases and vice versa (Moore & Kearsley, 1996; Saba & Shearer, 1994). What is significant in differentiating learning experiences is not the *physical* distance between learners and teachers, but the *transactional* distance, measured by the degree of interaction between them. Highly structured educational activities have a high transactional distance, while those involving much discussion have a lower transactional distance. This chapter is concerned with the structured variety of educational activity.

In a traditional learning environment, the structure of the experience is provided by the teacher or instructional designer. One of the few justifications for the lecture form is that it provides a framework for understanding a topic, emphasizing the important points and ordering them in a manner that is intended to be beneficial to learners. However, learners will not benefit equally from any given structure, as different learners learn differently (Kolb, 1984). It would be better if learners could select appropriate approaches for their needs. Without a teacher, help with this might be provided by the opinions of other learners. However, eliciting those opinions, assessing their reliability or relevance, actually finding the resources in the first place, and, once found, fitting them into a structured learning experience is difficult. Several approaches to these problems are available, but first it is necessary to introduce a few concepts of self-organization.

Self-Organizing Processes

Self-organization of the kind we are discussing is an emergent process in which the interactions of the participants and the software lead to organization that does not arise as an intentional, programmed, or planned process, but which arises from the nature of the system itself. Such processes are very common in nature and human social systems. Two in particular are of interest here—*evolution* and *stigmergy*.

Based primarily on work following that of Darwin (1872), evolution is one of the most powerful self-organizing principles whereby a process of replication with variation combined with natural selection (survival of the fittest) leads to a finely balanced self-adjusting system. It is important to note that "fittest" does not mean "best" by any other measure than the ability to survive in a given environment.

Stigmergy, a form of indirect communication through signs left in the environment (Grasse, 1959), leads to self-organized behavior, examples of which include everything from ant trails and termite mounds to forest footpaths, money markets, and bank-runs. For example, ants wander randomly until they find food, after which they return to the nest leaving a trail of pheromones. Other ants are more likely to wander where such pheromone trails mark the route. When they, too, find food, they leave a trail of pheromones. The stronger the trail, the more other ants are drawn to it. This positive feedback loop continues until the food runs out, after which the trail slowly dies away.

A full discussion of the many factors that result in a successful self-organizing system is beyond the scope of this chapter. However, the following brief discussion provides a flavor of what is involved.

Self-organizing processes occur through local interactions. For systems to develop any sort of complexity, it is necessary for these interactions to occur at a number of scales. For instance, the interactions of bacteria in an ant's gut affect the ant; groups of ants can affect tree growth; tree growth can affect climate. Local interactions should form small clusters that in turn interact with each other, leading to ever increasing scales of self-organization. A hierarchical scale where the slow moving features of a system shape the faster changing leaf nodes is a common feature of self-organizing systems, from forests to cities (Brand, 1997). Parcellation is also an important feature of such systems (Calvin, 1997). As Darwin found in the Galapagos Islands, isolated populations tend to develop differently and more rapidly than their mainland counterparts. Any self-organizing system relies on interactions between more or less autonomous units. The precise level of interactivity varies, but it is interesting to note that for a system which teeters at the edge of chaos, neither too stable to change nor too changeable to develop, the average number of connections between interacting agents tends to stabilize around just over two (Kauffman, 1995). Systems must be capable of change, being in a more or less permanently unfinished state. Perfect systems cannot evolve (Shirky, 1996). Equally, systems in perpetual flux can never achieve the stability to achieve self-organization.

Some Examples of Self-Organised Learning in Practice

For many seekers of knowledge today, the starting point is often Google (http://www.google.com). Google's PageRank algorithms use as their basis a principle described by Kleinberg (1998) as Latent Human Annotation (LHA). The principle behind LHA is that most Web pages provide links to other sites if those sites are considered in some way "good." A simplified formulation of this is that the more backlinks (links pointing into a site) that point to a given site, the higher its approval rating. Combined with a content-based search for keywords, documents returned often have a high degree of relevance and reliability. This approach is self-organized, incorporating evolution (unlinked sites "die") and stigmergy (more-visited sites get more links pointing to them). It does not rely on a central controlling authority to provide decisions on a resource's usefulness or give a structure to the content that is returned. However, the large number of results returned, problems with term ambiguity, and the lack of a means of identifying relevant resources for specific learner needs (beyond simple content-based searching) makes Google a relatively poor tool for finding resources from which to learn.

Wiki Wiki allows anyone in the whole world to edit any Wiki page. The potential for chaos is enormous, and yet Wikipedia (http://www.wikipedia.org), an encyclopedia generated by thousands of volunteers with no central authority, is not only possible, but hugely successful. In Wikipedia, self-organization largely occurs through the goodwill of the participants. Although anyone may vandalize a page, the community that creates it quickly removes such defacements, leading to a highly reliable and comprehensive source of knowledge. The success of Wikipedia may be ascribed to many factors, not least of which are its strong structure and simple policies. Interestingly, it makes use of a meta-wikipedia where Wikipedians may discuss issues relating to articles to be posted. This parcellation contributes greatly to the evolution of ideas.

Weblog communities form through links provided from one weblog (a kind of easy-to-edit interactive online diary) to another. Links pointing to a weblog may be discovered through Google (using the related: keyword) or explicitly through referrer logs and backlink tools. As links between weblogs grow, they start to form small, stigmergic clusters (Gregorio, 2003). This is in accordance with the principles of small world networks (Watts & Strogatz, 1998) whereby connections between a small number of nodes within a much larger network form

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