Enhancing learning ecology on the Internet

C.K. Looi
Institute of Systems Science, National University of Singapore

Abstract Recent notions view learning as participation in a learning environment or community where learners work together and support each other as they use information resources and tools to pursue their learning goals and solve problems. A broader meaning is to extend the idea of the learning environment to the overall setting in which learning communities come into existence, evolve, fade away, regenerate or transform. The advent of the Internet has brought about a powerful medium for creating and supporting such a notion of the learning ecology. Through the image of biological ecologies with their diversity, complex dynamics, and opportunistic niches for growth, learning problems and solutions on the Internet are explored and ways to enhance the ecology are suggested.

Keywords: Collaboration; Distributed; Groups; Internet; Learning community; Learning environment; World-wide web

Introduction

Learning happens in many informal ways, and learning happens through instruction, or despite instruction. Learning happens from ‘stealing’ from the practices in the school or workplace, at home or elsewhere (Brown, 1996). To recognise the different structures and organisational forms that give rise to learning, knowledge and learning are seen as part of a larger social and ecological process (Lave & Wenger, 1991). The ecology metaphor of learning views allows the environments to be seen from a systemic perspective, and to understand learning at a rich diversity of levels, in which the participants interact within and between each level.

The Internet has provided a variety of mechanisms that enable people to interact, share information, and develop diverse relationships with each other. As a two-way medium, it has enabled participants to be members of virtual communities and thereby learn and benefit from that membership. An earlier paper discussed the learning ecology on the Internet from the perspectives of diverse participation, information production and consumption, representations, and experiences (Looi, 2000). This paper explores the properties of the Internet that support a learning ecology and examines ways in which the ecology can be enhanced so as to enhance the quantity and quality of learning interactions. Viewing learning as happening through the various interactions and dynamics among the participants, both
technological and non-technological structures, that can foster the creating and sharing of knowledge will be explored.

The learning environment as a biological ecology

In a learning environment, learners work together and support each other as they use a variety of tools and information resources in their pursuit of learning goals and problem-solving activities (Wilson, 1995). Visser (1999) extends the meaning of the learning environment as the overall setting in which learning communities come into being, evolve, die, regenerate and transform. Using an ecological metaphor, the learning environment is likened to the biosphere, and ‘the learning environment is to learning what the biosphere is to life’ (Visser, 1999). In the biosphere, organisms coexist and the life of one organism is conditioned by the life of the other organisms in the environment. At a higher level of organisational complexity, species interact with each other to form biological communities.

Associations can be made between the ways that life forms coexist and coevolve in a biological ecology and the ways learning happens in the learning environment. In the biological ecology, life forms exist at different levels of organisational complexity. It is possible to study relationships between organisms and habitats of different sizes, from microscopic bacteria to the complex interactions between the myriad of species of plants, animals and other life forms found in a desert.

Similarly, learning happens at a rich diversity of levels in the learning environment and can be seen from different perspectives. At the individual level, learning happens at the cognitive level. At the group level when the individual learns with peers, interactions take place at the species level as group, peer or social learning interactions. When different species or populations coexist, there is a thriving community. Different communities form a learning ecosystem in which there is interaction within and between each level giving ecosystems complex behaviour.

Examples of learning communities include the school, the work place, the home, a place of worship, the extended environment of family and friends, or a special interest group. The advent of the Internet as a medium for two–way interaction has brought about a variety of learning communities in which people become members and derive great learning benefit from their interaction.

An ecological perspective emphasises the relationships and dynamics between the various participants in the classroom or other learning situation. Davenport & Prusak (2000) posits that human relationships are critically important to the health of an information ecology as they make the various interactions and interdependencies possible. Relationships, more than information, determine how problems are solved or opportunities exploited. These social networks of human ties of trust and reciprocity generate much of the capital on which the participants can leverage.

Growing and maintaining communities on the Internet

Diversity of participation provides efficient, adaptive and robust ways of doing things. When people are connected online through the web, they have access to diverse sources of information and expertise. The learning tasks become one of knowing how to look for relevant information and knowledge, how to evaluate, assimilate, synthesise and apply it, and how to work with others to achieve their goals. Learning from a systemic perspective includes all the diverse participants –
students, teachers, parents, principals, education officers as well as institutions such as colleges, universities, libraries, etc.

People can benefit from participating in online communities where expertise is rare in their own local environment. In such a way, ‘the monopoly of expertise is being shaken loose from universities, big businesses, large cities, and developed countries, and is being distributed throughout the world via the Internet’ (Wilson & Ryder, 1996). Technologies, tools and websites on the Internet which help bring together people with complementary interests or expertise, or with different points of view, help to create and support these diverse relationships.

The evolution of the Internet has brought out the growth of these online communities as people of like-minded interests congregate at their virtual ‘watering holes’. Myriads of communities thrive on the web. There are collections of communities with overlapping interest which cross-pollinate each other (Brown, 1999a). Communities evolve and self-organise on the web and designers of educational technologies need to think of mechanisms to help cross-pollination and to help sustain and grow good communities for learning.

In biological evolution, there is a major process called speciation in which the original species splits into more than one descendant species, each adapted to a different niche. Niche is a term in ecology which means the place occupied by a species in its ecosystem, or the potential place or role within a given ecosystem into which a species may or may not have evolved. The notion of niches maps onto the communities of interest on the Internet. If the community is too narrowly defined, it may risk extinction as its niche disappears. The larger, the more varied (resulting in diversity of contributions), and more flexible a population, the greater its ability to spread to new niches. Here is the notion of communities of interest splitting and specialising into different niches.

The survival of a population is defined as the continuation of its genetic code. The analogy for a learning community is for its knowledge base, tools, approaches, practices and values to continue in some form. Online communities are a means to help preserve and continue the interests, knowledge and culture of a group bound by common interests.

Shaping the use of tools and artifacts in the ecology

The ecological perspective is consistent with that of distributed cognition. By viewing cognition as fundamentally distributed rather than residing ‘in the head’, the tools, the rules, values and actors in a classroom form a highly complex, interacting system (Hewitt & Scardamalia, 1997). Knowledge is distributed among different people and mediated by tools and artifacts in the environment. Besides emphasising the relationships and dynamics between the various participants in a learning situation, it is useful also to examine the interactions the participants have with the tools, artifacts and content which are provided by designers or other participants.

Different parts of the ecology coevolve, changing together according to the relationships in the system (Nardi & O’Day, 1999). As people participate in the ongoing development of their ecologies on the Internet, they drive some of the technological and social aspects in the evolution of the Internet. The participants of a learning ecology are responsible for deciding how to use the tools and technologies available, and in doing so, establish the identity and place of the technologies. Designers of tools for the Internet are responsible for providing useful and clear
functionality, but they do not complete the job (Nardi & O'Day, 1999). It is left to the users of these tools to integrate them into their own context of use that make sense to them. Learning ecologies provide the context for the use of tools as well as the content available on the Internet.

Applying the ecology metaphor to learning on the Internet is more than an information ecology as the chain does not stop when the user accesses and receives relevant information. How does learning occur? What is being learned? How is information and knowledge processed, used, applied and internalised by the user? Tools and artifacts available on the Internet play an important role in the application and transformation of information and knowledge into active learning.

Enhancing the information ecology

Aggregate behaviour within an information space such as the web has been seen as an ‘information ecology’ (Card et al., 1996). The participants in such an information ecology are the producers, gatherers, and consumers of information. To learn how to enhance the ecology, for example, by gathering more information at lower cost (Guzdial, 1997), it is necessary to study the rules of behaviour and the relationships between variables in the information ecology. For example, ecological models of the web are being developed that describe when pages are created or deleted, and when they are accessed (Pitkow & Pirolli, 1997). When information is accessed or consumed by participants for the purpose of learning or knowledge advancement or performing or acting upon, the information ecology becomes a learning ecology.

Ecological theory focuses on populations, not individuals, and on the dynamics of the relationships between populations and environment. An ecological system has variables, relationships and dynamics. Looking at the Internet as an ecology, then in terms of variables, anyone can become an author, and contribute content to the web. This may take the form of sending emails, creating and uploading web pages, contributing to discussion groups or chat forums. Relationships comprise the links, relevance evaluation, aggregation and search, which relate to the contents created by authors. Authors of content can create the linkages from their content to other content, for example, messages may contain URLs. Such web content may be rated with relevance ratings, and catalogues of web content can be created. Once the content is on the web, search engines can index such content and include them in future searches. The dynamics comprise content design and delivery mechanisms. Good content or designs are copied instantaneously. Contrast this with the print medium where information transfer is several orders of magnitude slower. Once content is posted to the web, the gatherers and consumers can access it immediately.

The exponential growth of the web is expedited by the increasing availability of authoring and delivery mechanisms, which make it easy for anyone to be a producer of content.

Enhancing the sharing of content

A particular niche activity is to structure content for delivery through learning systems. Enhancing the ecology can be brought about by the development of software application frameworks and approaches to enable true interoperability of learning systems. The perspective is to avoid learning systems functioning as independent among an ever increasing base of online learning content and service
providers, partners, suppliers and competitors (Singh, 2000). There is a need to move from creating and delivering large training courses toward creating learning content objects that can be reused, searched and modified independent of their delivery mechanism. A consensus is growing around an object-based approach to constructing content for online delivery. The concept is based on chunking content into reusable components and developing ways of creating instructional sequences.

Such structuring of content provides several benefits: from the development perspective, reusability decreases the time and cost of content development; from the delivery perspective, a higher level of individualisation is possible by ‘late binding’ or personalisation of curriculum to individual needs and interest (Singh, 2000). Technologies like XML (Extended Markup Language), a standard format for Internet data information exchange, make possible the meta-data tagging of content objects. If a planned or de facto standard indeed arises for reusable educational objects, products and services will grow to harness such opportunities. This will stimulate substantial growth in the use of the Internet for delivering learning.

Technologies that help protect the copyrights of content providers and that help guard against the unauthorised use of content will encourage people to provide more content on the web.

**Foraging for information**

From another perspective, learning is a form of intellectual foraging. Learners forage for ‘food’ on the Internet. This metaphorical food suggests good information, data and knowledge, which can promote learning. Some consume good knowledge and produce better knowledge. Others consume bad knowledge and suffer. Can the analogy be extended? How do foragers learn what is good and bad food? How do foragers pass this knowledge on to other members of their community? Herein lie opportunities for designing and using technologies and tools to provide such mechanisms to support this process and improve the ecological balance. For example, while paper publishing is a one-way medium, the web is different. A consumer of web content can invariably interact with the author.

One way of perceiving the web as an information food chain (Etzioni, 1997) is to view the web pages and their linkages as being at the very bottom of the food chain. The myriad of search engines can be viewed as the information herbivores (‘they graze on web pages and regurgitate them as searchable indices’), and the information carnivores as those that hunt and feast on the herbivores of the web. Information carnivores move up the value chain as they seek to provide more value from the results of web searches, for example, by finding relevant information and transforming it into useful knowledge that suits the personal preferences of the consumer of the information.

Ecological systems exhibit the herd principle such as when searching for sustenance, follow the track of others. Recent work has looked into the capture of the interaction history and the notion that the work done by past users can be important to helping current users solve problems such as navigation in a complex information space. For example, map and trail mechanisms are created by designers on top of hypertext systems like the web for guidance or pedagogical purposes. They include: Scripted Documents, which are top-down created artifacts to assist in navigation (Zellers, 1989); WebWatcher, a tour-guide agent for the Web (Joachims et al., 1997), Walden’s Paths, a K-12 educational application of scripted paths (Furuta
et al., 1997), and Footprints, which are higher-level structures that link information related by topic or interest (Wexelblat & Maes, 1999).

Tools are also available for users to create and edit content with ease. For example, websites built using Wiki Wiki Web are full of useful information on various topics (http://c2.com/cgi/wiki?WikiWikiWeb) and all pages on the sites can be edited by anyone. These websites promote an online culture in which anyone in the community can build upon someone’s contributions and increase the content.

Supporting rich representations

The Internet is a medium that carries multiple forms of information: textual, visual, abstract, musical, social and kinesthetic (Brown, 1999a). There is now a plethora of media available on the Internet: streamed video, images, and text that provide multiple ways of representation. There are effective ways in which these different media augment each other for the new learning ecology. The coupling of different representations in innovative ways allows the creation, capture and sharing of knowledge that supports effective learning, and respects multiple ways of knowing and multiple intelligences. Multiple perspectives of a phenomenon are possible through rich representations which can be further annotated by other people.

The medium plays an important role in terms of the affordances for visual and verbal representation. An audio stream provides a linear exposition, while a text stream allows for more introspective reading as it is possible to go back to previous portions of the text. Video by itself is a visual medium, but it does not provide for active engagement and interactivity. The development of technologies has shifted heavy use of verbal representations on the Internet (initially with text, and later graphics and voice) to more visual representations (videos, etc.). Visual and verbal representations augment each other. Verbal text tools can be used to annotate not just web pages, but visual streamed media. In this way, visual tools provide the richness of context, while textual tools allow the formulation of discourse, which focuses on particular aspects of the context. Conversely, visual tools are often used to animate or depict what the participant wants to communicate (as researchers, grab the nearest napkin to illustrate ideas quickly). Augmenting representations through annotations add more context to the main representation or message.

There is a role for technologies that can adapt content to be presented on different platforms. The advent and pervasiveness of portable devices make information access possible at any time. With the right bandwidth and at the right cost, rich representations such as video and other complex media are available. With lower bandwidths and at lower cost, a digest or summary or surrogate version of richer representations can be obtained. Herein lie opportunities for adapting presentations to suit the bandwidth, the display device, the cost and the type of consumer. Sites are offering their own products, such as quick updates beamed to small handheld computers and cell phone screens, with subscriptions to longer versions of articles and other features.

Supporting engaging experiences

A more recent model of the Internet is Pine and Gilmore’s notion of a move beyond a service economy to an ‘experience’ economy (Pine & Gilmore, 1999). In the business sector, all businesses must orchestrate memorable events for their
customers. Pine and Gilmore explain the difference between service and experience: 'When a person buys a service, he purchases a set of intangible activities carried out on his behalf. But when he buys an experience, he pays to spend time enjoying a series of memorable events that a company stages – as in theatrical play – to engage him in a personal way'. Pine and Gilmore argue that for any compelling experience, there should be elements of entertainment, education, esthetics and escapism, the design of which would invite participants to enter and to return again and again. As McLellan (1999) observes, Pine and Gilmore’s model of the experience economy provides an excellent starting place for educational institutions to plan how to capitalise upon their valuable experience assets in cyberspace.

The Internet is the first mass media that is increasingly becoming a product of its audience. In contrast to print, film and theatre, the Internet is defined by what the users themselves put on it, do with it, and express to each other through it. A key element of the new media will be the formation of small communities engaged in an experience derived from storytelling. There is a general trend towards the increasing use of stories that require direct participation. Online educational material is organised as a web of interrelated learning materials, but there is no story to bind it together. Amusement park rides create a compelling story, but the experience is brief and the end-user has no chance to express creativity and build lasting relationships or to become an active participant in shaping the story experience. Tools supporting participatory storytelling combined with creative content, story, character, sequencing, and a deep understanding of online social behaviour, can help create an effective and engaging learning environment.

Learning ecology can be seen in terms of the providers of education experiences, the space and the props, and the consumers of the experiences. Educational experiences on the Internet, require the design of the entertainment, educational, esthetic and escapist elements (McLellan, 1999). Ways are sought to capitalise on the lasting experience value of education in cyberspace, for example, by helping alumni network with each other and shared continued experiences such as travel and enrichment opportunities.

Conclusion

The ecology metaphor helps a broader perspective of learning by respecting the ways it can occur through the myriad of interactions and interrelationships between the participants at different levels of organisational complexity. The Internet as an interactive medium has provided impetus in the promotion of the growth and richness of learning ecologies. The Internet enables new forms of interactions and relationships between people. The Internet substrate supports information, links between information, aggregation of information, tools and artifacts.

Brown proposes the formula for learning as the rate of change of knowledge over time, i.e. $L = \frac{dk}{dt}$ (Brown, 1999b). Looking at learning on the Internet through the ecology metaphor, there is a need to enhance the ecology by creating inflection points where $\frac{dL}{dt} > 0$, where the rate of change of the slope for knowledge changes sign, for instance, going from negative to positive. This paper has articulated an ecology perspective of learning on the Internet, which enables analysis at a high level of abstraction by studying aggregate relationships and behaviours. By suggesting successful learning designs, technologies and tools for online learning, it is hoped to stimulate further discussion on what these inflection points might be.
References


