Commentary on: Simon, B., Dolog., P., Miklós, Z., Olmedilla, D. and Sintek, M. (2004). *TConceptualising Smart Spaces for Learning.* Journal of Interactive Media in Education, 2004 (9). Special Issue on the Educational Semantic Web.
[www-jime.open.ac.uk/2004/9/mcgreal-2004-9.pdf]

Published
21 May 2004

ISSN: 1365-893X

Commentary on:

Conceptualising Smart Spaces for Learning

Rory McGreal

A Smart Space for Learning (SSL) is a proposed software application system supporting access to individualized learning materials and experiences using Personal Learning Assistants (PLAs). PLAs are intelligent agent software applications that aid the learner in searching for relevant content across a distributed network. They hold the promise of harnessing the power of the network to break the cost barriers that have restricted learning environments to time- and location-dependent cohort groups. Using SSL, individual learners should be able to navigate their way through the large mass of materials available on the World Wide Web and build themselves a coherent and cohesive learning plan that is independent of time and place.

These personal learning services represent the "Holy Grail" in education. For the first time, thanks to the Semantic Web, large masses of learners using online learning applications and services will be able to access "personalized" learning opportunities that are at the same time appropriate and relevant to their individual or group learning needs. Since the dawn of mass education in the nineteenth century, the only economically rational means of mass education has been the cohort model in which students have been "herded" and grouped by age or academic interest into education factories or schools (Thornburg, 1992).

However from the time of Bathe (1611) and Comenius (1631), enlightened educators have been extolling the virtues of learning materials, activities, and environments made relevant to the experiences of the individual learner. Up to the present it has not been possible to support this learning model in a cost-effective way, and so cohort-based learning continues to predominate.

For centuries traditional classroom-based courses and more recently industrialized distance education models have dominated the educational landscape. Passive instruction through correspondence courses, which emerged in the nineteenth century required self-study skills and self-discipline to overcome the lack of support and mentoring available in the classroom. Twentieth century video/televised courses, aimed at large numbers of learners individually, or assembled in groups, incorporated few opportunities for meaningful interactions. Now, however, with the power of networks, like that of the World Wide Web and the Internet, learners can dynamically interact with their course materials, with computer applications, and with other learners, either individually or in groups.

Metcalfe's Law states that the value of a network increases as the square of the number of users (Gilder, 2000). For example, one fax machine is worthless, with two it becomes practical and its value increases geometrically as you add more fax machines to a network. When the majority of businesses have a fax machine, it becomes indispensable. Likewise for learning networks, they become more powerful as the square of the number of users increases. Through personal learning networks on the Internet, learners can form communities of users such as those built around learning different computer languages (JAVA, PHP, etc) or applications (Dreamweaver, Photoshop etc). The more participants there are, the more valuable the learning network becomes.

For the first time, applications like SSL, using the power of the network, raise the possibility of enabling mass produced, highly interactive individualized instruction or "mass customization". In the past the choice was between independent study correspondence courses that could reach large numbers of learners, but were not personalized nor interactive and classroom-based instruction, which limited the numbers and forced students to learn at the same pace and place but were somewhat interactive (see Figure 1).

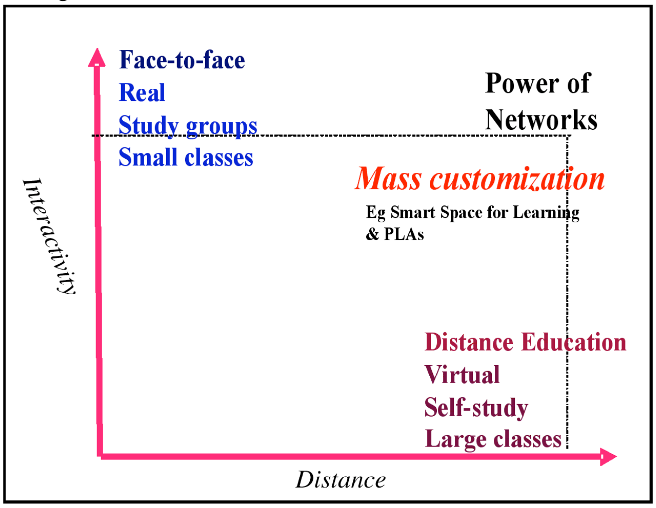

Figure1. Metcalfe's Law applied to a learning network.

SSL and similar software applications are dependent on the building of the semantic web, which is a next generation web initiative that will enable machines to infer meaning from the metadata used to describe the content at different web sites (Berners-Lee, 2002) . The power of this semantic web is enhanced when proper standards-based metadata is used to describe the content. As a learning application the international standard for learning object metadata is the IEEE LOM (IEEE, 2001).

The authors point out the need for defining "basic specifications or standards for exchanging educational artefacts and triggering the delivery of learning services and resources." In Canada, we have been working on the eduSource project, which is specifically concerned with the implementation of such a distributable network of open source applications for the creation of appropriately metatagged learning object repositories based on such standards (eduSource, 2003).

In addition, the CanCore metadata implementation guidelines have been developed to support the implementation of the IEEE LOM metadata that will support the creation of interoperable learning object repositories thus enabling intelligent agents like PLA (Athabasca University, 2004). The CanCore guidelines, by proposing a common agreement on the way that the LOM is implemented also at least partially address the authors' concerns regarding the difficulty of using specific concepts that implementers might otherwise implement in a variety of different ways. The CanCore approach is to recommend a commonly agreed implementation specification for each field of the IEEE LOM (Friesen, Fisher, Tozer, et al., 2004).

The SSL creators also express their need for "a web-service based, simple query interface" that would be used to connect a large number of educational nodes or repositories of learning objects. They are even investigating US initiatives such as the Library of Congress' ZING (Library of Congress, 2003). The Canadian eduSource Communication Layer (ECL) and the open source suite of tools that support it have been created for this purpose. The application suite also includes tools for converting both MARC and Z39.50 records to the IEEE LOM standard, thus enabling their interoperability among a wide variety of learning content repositories (See Athabasca University, 2003).

Applications like SSL will be used to aid learners to sift through the vast mass of content that is available, focusing searches and limiting choices to those that are relevant to the learner, based on their unique learning profile. SSL will also support managers in their quest to make their learning content and applications relevant to their students' needs.

The authors bring up the problem of the cost and effort needed to implement complex metadata structures and argue for solutions to the "quality of metadata problem." I would agree that until we develop intelligent agents or other applications that can extract metadata from the resource itself, complex metadata implementations are going to be problematic, and in many cases not worth doing. Until then, it would be advisable to implement the minimum number of fields required for useful functionality.

The power of personalisation enabled by PLAs also depends on the development of standards for creating learning profiles. This problem, as the author's note has yet to be properly addressed. A commonly agreed representation of learner profiles is needed for robust interoperable implementations and should be considered as one of the principal enabling tasks for the semantic web. This continuing work on learner profiles and models in education is aimed at creating unique models of identifiable individuals and groups of students. So, a commonly agreed representation of learner profiles and models is needed for robust interoperable implementations and should be considered as one of the principal enabling tasks for the semantic web.

This work that allows for customization of response and presentation is a dominant research theme in research associated with artificial intelligence in education and a major subset of a research domain referred to as adaptive hypermedia (Brusilovsky, 1996). Not only are machines learning to adapt differently depending upon the individual known learner behaviour but researchers are also struggling with ways to make this representation of the learner model accessible and manageable by learner, teacher, support systems and content (Zapta-Rivera and Greer,2001).

Further, work on adaptive systems and specifications (for example the IMS Learner Information Package* at http://www.imsglobal.org/accessibility) is designed to allow the web based learning context to adapt to the unique display or cognitive needs of individual students. This machine adaptability leads me to believe that many of the personal interactions currently undertaken to support distance learners can be (and will increasingly be) provided by machines.

Anderson (2003) argues that interaction is a necessary component of formal education and informal learning, but that various forms of interaction (learner-learner; learner-teacher; learner-content) can be substituted for each other depending upon cost, time, amount of use, content and context of learning. PLAs can provide different types of interaction depending on the personal characteristics of the learner. Like Anderson, I see a new generation of learners becoming more comfortable and having higher expectations for the immediacy of service available "anywhere/anytime". This service can realistically best be provided cost-effectively by machines such as PLAs.

To conclude, the SSL environment and PLAs described in this article point towards a powerful future for learners using the Internet. These applications will need to be enabled, as the authors note, by the implementation of a semantic web based on international standards. The eduSource suite of tools, guides, and applications and the international standards on which they are based can be used to address the authors' concerns on both service and artefact interoperability. And, complementary developments in adaptive systems are expected to increase their overall effectiveness to the point where PLAs will be able to meet the expectations of a new generation of learners . To accomplish this, more global collaboration needs to be encouraged, so that we can all profit from each others experiences.

References

Anderson, T. (2003). Getting the mix right again: An updated and theoretical rationale for interaction. *International Review of Research in Open and Distance Learning*. Retrieved January 21, 2004, from http://www.irrodl.org/content/v4.2/anderson.html

Athabasca University. (2003, September 29). *MARC - LOM Converter.* Retrieved January 21, 2004, from http://adlib-j2ee.athabascau.ca/marc/index.html

Athabasca University. (2004, 23 April). *CanCore Metadata Guidelines Home Page*. Retrieved April 25, 2003, from http://www.cancore.ca

Bathe, W. (1611). Janua Linguarum. Salamanca, Spain.

Berners-Lee, T. (2002). *Business model for the semantic Web*. Retrieved 12 March, 2003, from http://www.w3.org/DesignIssues/Business

Brusilovsky, P. (1996). Methods and techniques of adaptive hyper media. *User Modeling and User Adapted Interaction*, 6(2-3), 87-129. Retrieved Jan. 98, 2004 from http://www2.sis.pitt.edu/~peterb/papers/UMUAI96.pdf.

Comenius, J. A. (1631). *Janua Linguarum Reserata*. Prague.

eduSource. (2003). *eduSource Canada*. Retrieved 28 March, 2003, from http://www.edusource.ca

Friesen, N., Fisher, S., Tozer, L., Roberts, A., Hesemeier, S., & Habkirk, S. (2004). *CanCore learning object metadata application profile guidelines. Version 2.0* [Electronic version]. Retrieved January 9, 2004, from http://www.cancore.ca/documents.html

Gilder, G. (2000). Telecosm: *How infinite bandwidth will revolutionize our world*. New York: The Free Press.

IEEE. (2001). *Learning Object Metadata Working group*, from http://ltsc.ieee.org/wg12/s_p.html

Library of Congress. (2003, January 3). *ZING: Z39.50 Next Generation*. Retrieved January 16, 2004, from http://www.loc.gov/z3950/agency/zing/zing-home.html

Thornburg, D. (1992). *Edutrends 2010: Restructuring, technology, and the future of education*. Toronto: Starsong Publications.

Zapta-Rivera, J.,& Greer, J. (2001). Externalizing learner model representations. *Articfical Intelligence in Education Workshop*. San Antonio: Retrieved Jan. 4, 2004 from http://www.psychology.nottingham.ac.uk/research/credit/AIED-ER/zapata.pdf