New technology supporting informal learning

Downes, Stephen

Publisher's version / Version de l'éditeur:
https://doi.org/10.4304/jetwi.2.1.27-33
Journal of Emerging Technologies in Web Intelligence, 2, 1, pp. 27-33, 2010-02-01

New Technology Supporting Informal Learning

Stephen Downes
National Research Council Canada, Institute for Information Technology
Moncton, New Brunswick, Canada
Email: Stephen@downes.ca

Abstract—**We often talk about games, simulations and other events in learning, but these technologies support only episodic learning. Equally important are those technologies that provide a context for these learning episodes, an environment where students interact and converse among themselves. This paper describes experimentation in the development of distributed online courses and in software - particularly, the personal learning environment - that support the formation of connections between the far-flung pieces of such courses. This work, in turn, is suggesting and supporting the model of learning described in the first section, that of a course network supporting and informing an ever-shifting set of course episodes. This in turn suggests a pedagogy of participation rather than retention, and even suggests distributed and locally-based forms of evaluation and assessment. Future developments will focus on realizing these concepts as software or at least software prototypes. The intent of such systems is to facilitate the conversation and interaction around episodic learning events in a distributed environment, transforming them from elements in a linear flow-based design to free-floating objects in an environment.**

Index Terms—**Web 2.0, Social Web, E-learning, Personal Learning Environment (PLE), Distributed learning environment, RSS, Pedagogy of Participation.**

I. Context

Online learning today is beginning to be dominated by developments in games, simulations and related technologies [1]. And there is no doubt that this is a positive development for the field. Such applications are almost unambiguously beneficial for the student. In addition to providing an engaging and immersive environment for student learning, substantially improving motivation and interaction with the learning material, games and simulations are able to support learning in complex environments, offering a subtlety simple instruction-based or lecture-based learning cannot offer [2].

What most characterizes games and simulations is that they are not merely forms of instruction, they are environments, into which students must immerse themselves in order to participate [3]. As environments, they model complex relationships between variables, resulting in an experience that is unpredictable and unique each time played [4]. It is this feature, and not simply the action and the graphics that motivates learners and draws them in. With the addition of interaction with other participants, as seen in massive online gaming environments, the experience can be almost addictive [5].

That said, these environments, by their very nature, require intense preparation on the part of the designer. In addition to graphics and game play, there is the content of 'storyline' to consider [6]. In the case of learning environments, the planned learning objectives or outcomes need to be programmed into the game design, involving a further layer of preparation. Consequently, games and simulations fall into a category similar to lectures and presentations in that they involve statically designed learning objectives and strategies [7].

As a consequence, interaction with such environments, even the most immersive and addictive game or simulation, must have a start point and an end point. Such systems are by their very nature episodic. Because they must be designed in advance, they are inherently static, at least at the level of overall design and framework. Consequently, they represent a separation between the learner's in-environment experience and his or her wider life of leisure and work. Consequently, in order to place games, simulations and other episodic learning events such as classes and lectures, into the context of the student's wider life, a wider frame of reference is necessary. In this wider frame we would expect to find a wider environment of conversation and interaction with friends and associates. This wider frame situates, and plays a significant role in the selection, of episodic learning events.

Why is this necessary? In short, it is simply impossible for simulation, game and learning designers to design unerringly for the learning needs of the student. First, and significantly, we often do not know what it is we want to teach the student [8]. Today's environment is variable, which means situations - and hence, fact - change fluidly. One day Pluto is a planet, the next day it is not. One day Czechoslovakia is a country, the next day it is not. One day capitalism is the unassailable foundation for our economic system, the next day, following a market collapse, it is not. Moreover, today's environment is complex. The relations between variables cannot be described or even predicted. An understanding of such things as the financial system or global climate change requires a subtle and ever-changing perspective on the discipline.

Second, learners themselves are changing. There has been much discussion in recent years about the rise of the 'digital native' or of the 'net generation'. It has even been suggested that our interactions with modern

doi:10.4304/jetwi.2.1.27-33

communication technologies change the way we think. Even if we reject such descriptions as students as overly broad and inaccurate generalizations - and there is good reason for doing so - it is nonetheless the case that the needs, capabilities and interests of the target audience is rapidly shifting and changing. As much as it is tempting to say that human nature is unchanging, it appears nonetheless the same that human experience is endlessly varied, resulting in any number of approaches to media in general and learning in particular. A child raised on text alone will think and learn differently from a child raised on cartoons or a child raised on Facebook [9].

In part, our best response to the variability and complexity of the subject matter along with the changing nature of the learner is to design systems that are decentralized, to push learning decisions down the hierarchy or out to the edges of the network [10]. This logic, which is characterizing not only new learning but also new approaches to business and management [11], is based on the idea that those who are closest to the situation are in the best position to make decisions about it. In the military, this means that company commanders, and not generals, must make tactical decisions. In business, this means that salespeople and customer service representatives must determine marketing policy. And in learning, this leans students must be empowered to make their own learning decisions. This is the basis for the models and strategies that characterize what has come to be called informal learning [12].

But there is in addition a second and critical aspect to this wider environment of conversation and interaction. It is not merely to create a network into which to situate episodic learning, but rather, to create a network that learns and thus adapts and reshapes itself based on those conversations and interactions [13]. We need to consider learners not only as the subjects of learning, entities to whom we deliver learning content, but also the sources of learning, functioning as the perceptual input for the wider network [14]. The things we say, the things we choose to read or view, the things we link to, the people we send messages to - all of these constitute input to the learning network, causing it to reform, causing it to present, say, one learning episode rather than another, one game rather than another, one simulation rather than another. And, moreover, our reflections and commentary on various games, simulations and learning events constitute feedback for those systems, modifying them internally as well, either directly, or through a series of design iterations, just as we see in (for example) agile programming [15].

Learning networks capture an essential element in learning today, the simple fact that we don't know what we want to teach. Indeed, it is often suggested that the best we can manage is to teach students how to learn, and to encourage them to manage their own learning thereafter. But even this principle is subject to changing affordances of technology and changing capabilities of students; how we learn itself is something that changes, and cannot be precisely taught. The way musicians learn, for example, changes as they grow from novice to expert [16]. For this reason, we need to see the educational system itself as adaptive rather than merely prescriptive.

We are seeing the development of specific instances of this approach to learning today. For example, a learning system called Company Command, designed by officers in the U.S. military starting in 2000, is essentially a learning network composed of company commanders [17]. While most traditional military training is conducted from trainer to learner, Company Command starts with a significantly different proposition: that knowledge exists in the minds of the members or participants, and this knowledge is derived from their direct (and recent) experience in the field.

In addition, the need for content and support emerges from conversations among the participants. These interactions are able to reveal not only what company commanders know, but also what they don't know (and need to know). The interaction, in other words, meets and addresses an objection often put of self-directed learners that they don't know what they need to know [18]. While this may be true, through participation and interaction in this wider environment they are able to identify these needs (as expectations, for example), and hence to select and conduct appropriate learning episodes [19].

The model of Company Command is one that has been repeated many times on the internet. Company Command itself began as one of thousands of Drupal applications. The core purpose of Drupal is to facilitate the creation and management of communities online [20], including communities of practice of the sort that typify such cases as Company Command. Drupal, an open source content management system, enables the creation of individual accounts, the creation of discussion posts and pages and other content, and the sharing of this content online with other community members. Many other systems provide similar functionality [21], and in learning, the learning management system (LMS) provides the wider conversational context for in-person or online learning episodes [22].

More recently, social networking technologies have come to be applied to content and learning management systems [23]. The core of a social networking technology is the capacity to create links between members in a community - to create, in other words, social networks. These links are usually created explicitly, through the declaration of each of the users as 'Friends'. Often, the creation of links is associated with the creation of content, as in content management systems. The last few years have seen the development of social network services online such as Facebook, Friendster, LinkedIn, and MySpace as well as a service for creating social networks [24].

Social networks represent a gradual decentralization of content and contact online. Content management systems (and before them, email lists and useNet groups) organize people and content by hierarchy, by topic and content thread. In social networks, such associations are created by the users themselves. Topics, for example, are not assigned centrally, but are instead created by individuals 'tagging' certain content with terms or categories they

choose themselves [25]. Each person's social network on a social networking site, moreover, is unique; there is no definitive grouping of people, only a clustering of people with more or less similar interests.

Software to create social networks is the logical successor to content management systems such as Drupal, and in the field of learning, the most prominent such system is Elgg. In addition to supporting content creation and the creation of networks of friends among members, Elgg allowed people to import content from remote sites and to syndicate this content through the use of RSS feeds [26]. Systems such as Elgg therefore combine the functions of content management and social networking.

In summary, then: we often talk about games, simulations and other events in learning, but these technologies support only episodic learning. Equally important are those technologies that provide a context for these learning episodes, an environment where students and interact and converse among themselves. Historically, this role has been played by the content management system, while more recently systems supporting social networks have also come into prominence. Such systems represent a partial decentralization of the management of learning, pushing some decisions (such as association with other learners or clustering of material into categories) from central decision-makers to the learners themselves.

II. Current

At the turn of the century, the dominant model of online community proposed by pundits was one that could be characterized as a 'destination resort'. It would be, suggested writers like Hegel and Armstrong, a complete interest-based community revolving around travel, homeowners or personal finance [27]. Members would be attracted through marketing and content, would be encouraged to contribute content, would become loyal to the community through friendships and interaction, and would be monetized through value-added services and sales. What developed instead resembles barrios more than resorts: a complex interweaving of online services, sites, interactions and applications developed ad hoc rather than at the behest of some community planner.

Also at the turn of the century, it was thought that online services would interact with each other in an organized and managed way - they would, in other words, be "choreographed". The classic example involved a travel service where one central provider - the agent - would send requests via web services to hotels, car rental agencies, airlines and even caterers in order to seamlessly manage the experience [28]. What developed instead were random, individualized and often ad hoc assemblages known as 'mash-ups', these based on lightweight communications technologies such as REST, AJAX and APIs [29].

Far from being neat and organized, the internet has become complex. Far from settling into one web community, users jump from service to service, creating (and discarding) new identities as needed. A typical web user may have multiple 'home pages' - their personal blog, their photo page on Flickr or Picassa, their Google Reader account, shared documents through Zoho, their video page on YouTube, their Twitter account, their profiles, on Facebook, MySpace and LinkedIn, their Wikipedia login, their email accounts, and (often least) their university LMS login. While real friendships and communities develop through this mélange, loyalty to online sites and services is limited and fleeting [30].

It is in this environment that the University of Manitoba's Connectivism course was developed in the fall of 2008 [31]. Developed by George Siemens and myself, at least, one intent of the Connectivism course was to facilitate the transition from a neat, constrained and centralized learning management system to a distributed environment in which students and instructors employ multiple online services and applications [32]. Consequently, the Connectivism course must be viewed as one of the first distributed courses to be created - not simply distributed in terms of time or place, but distributed in terms of website or application.

Much has been or will be written about the course elsewhere, but it is sufficient and relevant to say that roughly 2200 people signed up to participate in the course. While the course was offered as a tuition-based for-credit course, in order to foster the network dynamics we also chose to open the course to all participants [33]. In this we were following not so much the model offered by OpenCourseWare and others, which made learning materials freely accessible online, but rather David Wiley and Alec Couros in offering actual course instruction available online. We wanted students not merely to consume learning materials, but rather, in the manner of the wider environment discussed above, to contribute to the learning through conversation and interaction [34].

To this the students contributed in droves. The central course aggregator listed 170 separate weblogs or similar RSS feeds contributed by students, each of whom used their own blog or website to participate in discussion [35]. Additionally, thousands of comments were contributed to the central Moodle forum, three separate areas in Second Life were contributed, Google Groups were created, a Ning was created, and more. In fact, student contributions to the course continue to this day even though the course was completed in December, 2008.

As no viable mechanism for connecting the disparate and distributed course contributions exists, we adapted my newsletter software, gRSShopper, for the course [36]. This software was developed out of a need for a personal online web space to do more than was possible in Drupal (in fact, I document my trial with Drupal in a series of posts). gRSShopper is available as free and open source software for public download.

gRSShopper is a prototype personal learning Environment (PLE). The PLE is a concept developed in 2005 in conversations with and among members of JISC CETIS and their friends and associates [37]. The idea of the personal learning environment is that it performs many of the functions of a content management system

and of a social network system but from the perspective of the individual rather than the community or the institution [38]. Hence, the PLE may be understood as the intersection of the multiple home pages employed by any given individual. In the first instance, the PLE is a concept, rather than an application - it is the idea that a person's web presence can be distributed [39]. And in applications such as gRSShopper it is the instantiation of that idea in a personal application.

In the context of the Connectivism course, the prototype PLE proved to be an admirable teaching application as well. While online course content was provided to students using the more traditional mechanisms of a Moodle learning management system (to host discussions and conversations) and a course Wiki (to host the course outline and links to learning resources) the use of gRSShopper allowed us to send, by email and RSS, a daily newsletter to students' own email or RSS readers [40]. In this way, we were linking course material out, to students. Student registrations to the email newsletter remained at a constant level of 1870 subscriptions through the full duration of the course.

Additionally, however, gRSShopper has a built-in RSS aggregator. Hence, we collected the feeds from the 170 separate blogs and websites created by participants and stored the student contributions in the gRSShopper database. This allowed us to filter content by tags and to include this content into the daily course newsletter mailouts. We selected and distributed material containing the 'CCK08' tag (thus not diluting the newsletter with unrelated material) . We also created (manually) links to online events such as Elluminate and Skype discussions, sessions in Second Life, occasional videos, diagrams and other resources [41].

Because there were so many people contributing to the course, and because the content of the course actually shifted and varied according to participation and input into the course, it was necessary to emphasize to students that their role in the course was not to attempt to assimilate all course content. This was neither possible nor desirable. Rather, students were told that their role was to select and sample course content, pursuing areas of interest, reading related material from both within and outside the course, and then to contribute their unique perspective based on this reading [42]. Students would be evaluated, we said, not based on their retention of course material, but rather, on the basis of their contribution to the discussion, their interaction and sometimes collaboration with other participants, and their evolving capacity to work within a network to produce new knowledge in the field.

Indeed, the world-wide and distributed nature of the course suggested an alternative method of evaluation entirely, one that separated course content from evaluation. Students from other countries and other institutions could register into the course as students and participate in the course, and use their work in the course as material submitted for evaluation in their own home institution. To that end, we made all assignments and evaluation metrics available to all participants, to share with their home institutions. At least one person requested, and was evaluated, in this fashion.

To summarize: we are currently seeing experimentation in the development of distributed online courses and in software - particularly, the personal learning environment - that support the formation of connections between the far-flung pieces of such courses. This work, in turn, is suggesting and supporting the model of learning described in the first section, that of a course network supporting and informing an ever-shifting set of course episodes. This in turn suggests a pedagogy of participation rather than retention, and even suggests distributed and locally-based forms of evaluation and assessment.

III. Future

Future developments around the concept of the conversational and interactive environment begin with preparations for a second offering of the Connectivism course in 2009. In particular, work to date has revolved around the idea of simplifying the production of course newsletters. Even with content aggregation, these were taking the author (me) about an hour every day, as course content (such as planned online events, readings, etc.) needed to be input into the newsletter body. To this end, a system to develop serialized feeds [43] was created, in order to automate the distribution of scheduled course content [44].

The idea of a serialized feed is to create elements and to store them into a data base. Each element of course content corresponds roughly to a blog post - that is, it is dated, has its own page, and may link to external resources or services. Each post is then given an offset value which stipulates, in number of of days, how long after the onset of the course a material should be delivered. When a course is initiated (by the registration of students into the course) the timer is started. The system automatically delivers a newsletter each day. Student contributions, filtered for the CCK08 tag as before, are harvested and inserted into the newsletter. Then any content from the database with an offset matching the current course day is also added. The completed newsletters are distributed by email or RSS.

Serialized feeds are one aspect of a more general development program being undertaken around the idea of the personal learning environment. As noted above, the PLE merges the function of the content management system with the social network service, and does so from the perspective of individual students. Hence the PLE could be depicted as being a node at the centre of a network, connected (using standards such as RSS) to content and other services across the web. Examples of such services in Scott Wilson's paradigm document include Flickr, 43things, LiveJournal (a blogging service), an academic publisher, and more [45].

In the PLE project being undertaken by the National Research Council, the functionality of the PLE is depicted in four major stages: to aggregate, that is, to collect content from the individual's and other online content service providers, where aggregation includes

elements of recommendation, data mining and automated metadata extraction ; to remix, or to organize content from several different sources in different ways, including through automated clustering; to repurpose, or edit, localize, or otherwise modify or create new content; and to feed forward, or send the content to subscribers and other web services, either via RSS syndication, email, Twitter, or other relevant services [46].

When viewed from the perspective of a collection of students taking a class (such as, for example, the Connectivism class), what is created using the PLE is not a recreation of the capabilities of the learning management system, but rather, a learning network. Though through the use of serialized feeds and similar mechanisms educational institutions and instructors can feed content, services and resources into the network, actual structures of the network, along with many of the resources exchanged in the network, are created by the students themselves. These structures are reflective of the students' interactions with each other and with the wider community (surrounding a particular content domain) and hence the structure of the network varies as student experience varies [47]. A network of PLEs is a learning network.

As suggested above, the pedagogy of such a network is strikingly different from what we might find in a content-based (content-management based) course. The order and structure of the content is dissolved; while episodic content (such as books, simulations or lectures) maintain an internal logic and structure, the linear or hierarchal structure that previously defined courses is entirely absent. This does not mean that the relation between course, participants and content is completely unstructured, only that the nature of the structure has changed. It makes more sense to think of learning episodes as objects that inhabit the wider environment, the conversational and interactive environment that constitutes the course [48]. The entities in such an environment - individual students, as instantiated as PLEs, along with course episodes, as instantiated as readings or services or games - interact with each other much in the way physical objects interact in an environment: not according to any central plan, but via the internal motives and affordances of each object.

The computational structure for such a model exists in the field of object-oriented programming, where computer programs consist not (simply) as lists of instructions to be followed, one after another, in a linear or branching manner, but rather in an open-ended consideration of the properties and states of each object [49]. On the internet, the best example of such systems are the Multi-User Dungeons (MUDs) that were developed in the late 80s and early 90s, where objects could have properties and methods (functions) that influence those properties, and could send messages to other objects invoking methods in those objects as well [50].

This model informs the design of learning experiences as well. In traditional learning design, as instantiated by (say) EML or IMS-LD, learning design consists (essentially) of a flow of learning experiences, choreographed (or directed) just as web services manage access to different travel resources, where there is a script, planned learning outcomes, and localized, content-based evaluation or assessment [51]. The traditional model suits a world of content management systems where the delivery of learning episodes as well as the content of those episodes can be anticipated and planned in advance [52]. An alternative to traditional learning design, state-based learning design, will be proposed, such that the presentation (and even the content) of a learning episode will vary depending on the relative states of the objects in a given environment - that is to say, the set of values and methods present in the set of objects in a given interactive space (defined by linkages between individuals and content). In state-based learning design, learning resources are not arranged as sentences in a paragraph or chapters in a book, but rather, are used as a form and means of communication, more in the manner of words in a vocabulary. Their use is suggested by content rather than mandated by learning imperatives.

Such a change is essentially a migration of IMS Learning Design into a Rule-Based design more characteristic of object oriented systems [52]. Rules may resemble simple functions, such as "show an activity" or "hide an activity" or may represent more complex interactions. While traditional IMS learning designs could be mapped into such a system, the reverse would not always be true; as such a system would be capable of more open-ended interactions not describable in a flow-based format. The interaction between user and content would resemble the dynamics and interplay of a simulation or a game. Indeed, these latter learning episodes would take their place as objects within this larger learning environment.

To summarize: future developments have focused on realizing the concepts displayed in the Connectivism course as software or at least software prototypes. The intent of such systems is to realize the objective of the design of the Connectivism course, to facilitate the conversation and interaction around episodic learning events in a distributed environment. This realization is essentially that or re-orienting learning objects, transforming them from elements in a linear flow-based design, such as described in IMS-LD, to free-floating objects in an environment, activated by the triggering of rules in an object oriented environment.

REFERENCES

[1] G. K. Akili, “Games and Simulations: A New Approach in Education?,” in D. Gibson, C. Aldrich, & M. Prensky, *Games and simulations in online learning: research and development frameworks*. Hershey, PA: Idea Group, Inc., 2007, pp. 1-21.

[2] K. Squire, *Game-Based Learning: Present and Future State of the Field*, 2005. Retrieved from Masie Center: http://cecs5580.pbwiki.com

[3] J. Foreman, “Game-Based Learning: How to Delight and Instruct in the 21st Century,”in

EDUCAIUSE Review, vol. 39, no. 5, pp. 51-66, September/October 2004.

[4] C. Aldrich, "Introduction to Systems Thinking," In C. Aldrich, "*Learning by Doing: A Comprehensive Guide to Simulations, Computer Games, and Pedagogy*," in *E-learning and Other Educational Experiences*, San Francisco: John Wiley and Sons, 2005, pp. 18-32.

[5] Ng, B. D. Ng and P. Wiener-Hastings, "Addiction to the Internet and Online Gaming," in *CyberPsychology and Behavior*, vol,8, no.2, 2005, pp. 110-113.

[6] A. Rollings and E. Adams, http://www.gamegrene.com/node/820. In A. Rollings and E. Adams, On Game Design, 2003, pp. 89-119.

[7] A.Amory and R. Seagram, (2003). "Educational Game Models: Conceptualization and Evaluation," in *South African Journal of Higher Education*, vol. 17, no. 2, 2003, pp. 206-217.

[8] Caine, R. N. Caine and G. Caine, "Understanding Why Education Must Change", 1997. Retrieved from *New Horizons for Learning*: http://www.newhorizons.org/trans/caine_change.htm

[9] S. G. Peters, *Do You Know Enough About Me to Teach me?: A Student's Perspective*, King Lindsay Printing Corp., 2006.

[10] D. Wiley and E. K. Edwards, "Online Self-Organizing Social Systems: The Decentralized Future of Online Learning," in *Quarterly Review of Distance Education*, vol. 3, no.1, 2002, p. 45.

[11] T. W.Malone, *The Future of Work: How the New Order of Business Will Shape Your Organization, Your Management Style and Your Life*, Cambridge (Mass), Harvard Business School Press, 2004.

[12] J. Cross, *Informal Learning: Rediscovering the Natural Pathways that Inspire Innovation and Performance*, John Wiley and Sons, 2006.

[13] S. Downes, "Learning Networks in Practice," In E. David Ley, *Emerging Technologies for Learning*. London, BECTA, 2007.

[14] W. Marotzki and M. Specht, "Matching Learners and Technology I - Community-based adaptive systems: Learning from learners, a smart idea?, in *Interdisciplinary Approaches to Technology-Enhanced Learning*," Darmstadt.

[15] McCall, J. Mc Call, "Simulations Games as Historical Interpretations: Critiquing Rome: Total War in the High School History Classroom,". Retrieved from Historical Simulations in the Classroom: http://www.historicalsimulations.net/theory.htm

[16] T. F. Münte, E. Altenmüller, and L. Jäncke, "The musician's brain as a model of neuroplasticity,". In Nature Reviews Neuroscience, 2002. pp. 473-478.

[17] N. M.Dixon, N.Allen, T.Burgess, P.Kilner, and S. Schweitzer, *Company Command: Unleashing the Power of the Army Profession*, West Point, N.Y., The center for the Advancement of Leader Development and Organizational Learning, 2005.

[18] D. E. Clayson, "Performance Overconfidence: Metacognitive Effects or Misplaced Student Expectations?," in *Journal of Marketing Education*, vol. 27, no. 2, (2005). Pp. 122-129.

[19] Chickering, A. W. Chickering and S. C. Ehrmann, "Implementing the Seven Principles: Technology as Lever," in *AAHE Bulletin*, 1996, pp. 3-6.

[20] Drupal, *About Drupa,* 2009. Retrieved from Drupal: http://drupal.org/about

[21] CMSWire. *Content Management Systems (CMS) List,* 2009. Retrieved from CMSWire3: http://www.cmswire.com/cms/products/

[22] Garrote, R. Garrote, *The use of a Learning Management System to promote group interaction and socialization in a trainee project*, 2007, högskolor och samhälle i samverkan. Högskolan.

[23] L. Dignan, *Content management software vendors eye social networking*, 2008, June30. Retrieved from ZD Net: http://blogs.zdnet.com/BTL/?p=9219

[24] D. M. Boyd and Ellison, N. B. Ellison, "Social Network Sites: Definition, History, and Scholarship," in *Journal of Computer-Mediated Communication* , vol.13, no. 1, 2007, p. 11.

[25] E. Barsky and M. Purdon, "Introducing Web 2.0: social networking and social bookmarking for health librarians," in *JCHLA / JABSC*, vol. 27, 2006, pp. 65-67.

[26] Elgg, *About*, 2009. Retrieved from Elgg: http://elgg.org/about.php

[27] J. Hegel III and Armstrong, A. G. Armstrong, *Net Gain: Expanding Markets Through Virtual Communities*, McKinsey & Company, Inc., 1997.

[28] P. Yendluri, Web services choreography. SOA News, 2003.

[29] Rushgrove, G. Rushgrove, "APIs and Mashups For The Rest Of Us," in *Digital Web Magazine*, 2007 (June 4).

[30] K. O'Brien, "Web 2.0 Makes You ReThink the Basics," 2007, May 18. Retrieved from *Marketing Thought:* http://marketingthought.blogspot.com/2007/05/web-20-makes-you-re-think-basics.html

[31] G. Siemens and Downes, S. Downes, Connectivism & Connectiove Knowledge, 2008. *Retrieved from University of Manitoba:* http://ltc.umanitoba.ca/connectivism/

[32] S. Downes (2008, August 1). "Tools," 2008, August 1. Retrieved from *Connectivism & Connective Knowledge Blog*: http://ltc.umanitoba.ca/connectivism/?p=59

[33] G. Siemens, "On Finding Inspiration," 2008, June 18. Retrieved from *Connectivism & Connective Knowledge Blog*: http://ltc.umanitoba.ca/connectivism/?p=25

[34] G. Siemens. (2008, August 6). "Narratives of Coherence", 2008, August 6. Retrieved from *Connectivism & Connective Knowledge Blog*: http://ltc.umanitoba.ca/connectivism/?p=61

[35] S. Downes (2008). "Feeds". Retrieved from *Connectivism & Connetcive Knowledge - The Daily*: http://connect.downes.ca/feeds.htm
[36] S. Downes, "gRSShopper", 2008. Retrieved from http://grsshopper.downes.ca
[37] Wikipedia, "History of personal learning environments," 2009. Retrieved from *Wikipedia*: http://en.wikipedia.org/wiki/History_of_personal_learning_environments
[38] G. Attwell, "Personal Learning Environments," 2006, June 1. Retrieved from *Wales Wide Web:* http://www.knownet.com/writing/weblogs/Graham_Attwell/entries/6521819364
[39] G. Attwell, "Knowledge is best shared and developed through communities of practice," 2007, April 16. Retrieved from *eLearning Europa:* http://www.elearningeuropa.info/directory/index.php?page=doc&doc_id=9098&doclng=6
[40] S. Downes. "The Daily," 2008. Retrieved from *Connectivism & Connective Knowledge*: http://connect.downes.ca/
[41] G.Siemens, & S. Downes, « Wiki," 2008. Retrieved from *Connectivism & Connective Knowledge*: http://ltc.umanitoba.ca/wiki/Connectivism
[42] G. Siemens, "Where does the learning occur?," 2008, September 16. Retrieved from *Connectivism & Connective Knowledg Blog*: http://ltc.umanitoba.ca/connectivism/?p=123
[43] T. Hirst, "Serialised OpenLearn Daily RSS Feeds via WordPress," 2009, January 6. Retrieved from *OUseful Info*: http://ouseful.wordpress.com/2009/01/06/serialised-openlearn-daily-rss-feeds-via-wordpress/
[44] S. Downes, "Serialized Feeds," 2009.. Retrieved from *course.downes.ca*: http://course.downes.ca
[45] S. Wilson, "Future VLE - The Visual Version," 2005, January 25. Retrieved from *Scott's Workblog*: http://zope.cetis.ac.uk/members/scott/blogview?entry=20050125170206
[46] S. Downes (2004, November 10). "Theory of Learning Networks," 2004, November 10. Retrieved from *Slideshare*: http://www.slideshare.net/Downes/theory-of-learning-networks
[47] J. A. Levin, "Organizing educational network interactions: Steps towards a theory of network-based learning environments," in *American Educational Research Association Annual Meeting*, San Francisco, 1995.
[48] S. Downes, "Learning Objects: Resources for distance education worldwide," in *The International Review of Research in Open and Distance.* 2001 (July).
[49] B. Meyer, *Object-Oriented Software Construction*. Prentice-Hall, 1997.
[50] D. Cuciz (2004). "The History of MUDs," 2004. Retrieved from *GamneSpy:* http://archive.gamespy.com/articles/january01/muds1/
[51] IMS Global Learning Consortium, Inc., "IMS Learning Design Information Model,"2003, January 20. Retrieved from *IMS Global Learning Consortium, Inc.*: http://www.imsglobal.org/learningdesign/ldv1p0/imsld_infov1p0.html
[52] E. D. Vries, C. Tattersall, and R. Koper, "Pre-Discussion Paper Future developments of IMS Learning Design tooling," 2005. Retrieved from *Open University of the Netherlands:* http://dspace.ou.nl/bitstream/1820/553/1/discussion%20paper%20IMSLDtooling%20FreddeVries%20preprint.pdf
[53] I. Martínez-Ortiz, J. L. Sierra, and, B. Fernández-Manjón, « Translating e-learning Flow-Oriented Activity Sequencing Descriptions," in *The 6th International Conference on Information Technology: New Generations ITNG*, Las Vegas, 2009.

Stephen Downes works for the National Research Council of Canada where he has served as a Senior Research, based in Moncton, New Brunswick, since 2001. Affiliated with the Learning and Collaborative Technologies Group, Institute for Information Technology, Downes specializes in the fields of online learning, new media, pedagogy and philosophy.

Downes is perhaps best known for his daily nesletter, OLDaily, which is distributed by web, email and RSS to thousands of subscribers around the world. He has published numerous articles both online and in print, including The Future of Online Learning (1998), Learning Objects (2000), Resource Profiles (2003), and E-Learning 2.0 (2005). He is a popular speaker, appearing at hundreds of events around the world over the last fifteen years.