The Semantic Web in Education
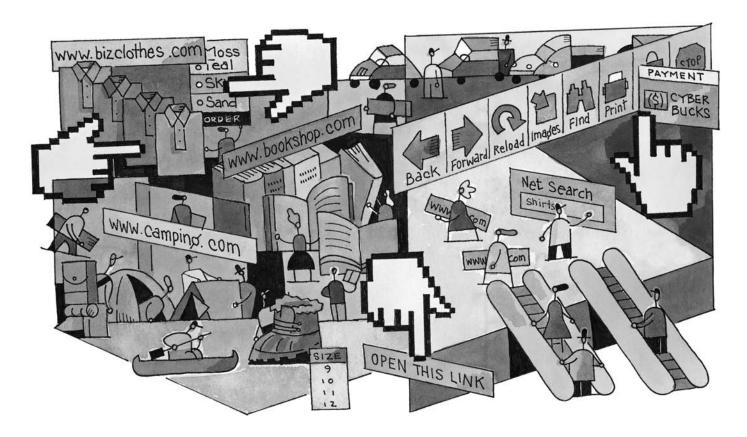
What happens when the read-write web gets smart enough to help us organize and evaluate the information it provides?

By **Jason Ohler**

The mantra of the information age has been "The more information the better!" But what happens when we search the web and get so much information that we can't sort through it, let alone evaluate it? Enter the semantic web, or Web 3.0. Among other things, the semantic web makes information more meaningful to people by making it more understandable to machines.

Consider a simple example. If you want to know my mailing address, currently you need to go to my web page and root around until you find it. That's because the current coding system used to build web pages, largely HTML, displays information without identifying it in any meaningful way. That is, my address is not coded as "an address," it is simply presented as a series of characters on the screen. Contrast this with a database about your friends that contains a specific column called "mailing address." Even if your database included millions of entries, locating my address is easy.

Web 3.0 makes the leap from "display only" to meaningful information by tagging information with descriptors like "mailing address." Further, it allows users to find relationships between tagged information using inference rules and data organizational tools called "ontologies" that provide logic and structure to the information embedded in web pages. As a result, machines can do a lot of the information grunt work currently required of humans. When it comes to a web search, for example, the semantic web makes a reasonable pass at collating, synthesizing, and cross-referencing the

results for you. It does this by employing software agents that can locate and combine information from many sources to build meaningful information collages. Simply tell your agent the focus of your interest—whether a person, subject, activity, question, or whatever—and set it to roam the web, finding and distilling information and exchanging information with other agents.

Ultimately, the goal of Web 3.0 is, in a phrase, data integration.[1] Because the semantic web understands the concept of a mailing address, it can relate my address to other web-defined concepts like walking distance, postal rates, climate, or driving directions to the nearest airport. Thus, if I ask my agent to help me prepare for a trip to the Bahamas, it can make assumptions about the clothes and flights I need, and so on. Because I live in Alaska, it might tell me to order clothing online soon because it takes longer to get here. It may even tell me the names of friends (who have made themselves semantically available) who have visited the Bahamas.
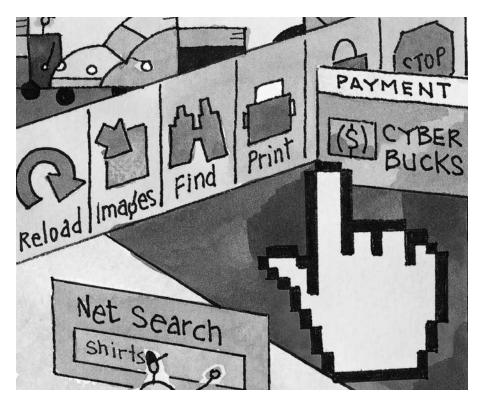
While some websites currently understand my address as an address, this understanding is not shared with other websites. That is, there is no universal definition for "address" that any website could use to talk to my web page about addresses. It is the use of common definitions, inference rules, and ontologies that will turn the web from a series of information containers into an ecosystem in which the parts of the web are interrelated.

Web 3.0 in Education

The implications for education are profound. Let's consider three areas of impact: knowledge construction, personal learning network maintenance, and personal educational administration.

Knowledge Construction

Imagine you are a student researching a topic, like global warming. You might begin by searching Wikipedia, but inevitably you turn to searching the vast information storehouses of the entire web using a tool like Google.[2]

Currently, Googling the term "global warming" returns a gazillion hits, many of which link to complex data resources that link to other resources and so on. Unless the topic is supremely important to you, you won't explore much beyond the first 10 to 20 hits returned in a Google search. The presumption of knowledge in this approach to information gathering and evaluation is faulty, if not potentially dangerous in its limitations.

One vision of a well-developed semantic web includes a search feature that would return a multimedia report rather than a list of hits. The report would draw from many sources, including websites, articles from scientific repositories, chapters in textbooks, blog dialogue, speeches posted on YouTube, information stored on cell phones, gaming scenarios played out in virtual realities—anything appropriate that is accessible by the rules of Web 3.0. The report would consist of short sections that coalesce around knowledge areas that emerged naturally from your research, with keywords identified and listed conveniently off to one side as links.

The information in the report would be compared, contrasted, and collated in a basic way, presenting points of agreement and disagreement, and perhaps associating these with political positions or contrasting research. Because the web knows something about you, it also alerts you to local lectures on related topics, books you might want to read, TV programs available through your cable service, blog discussions you might find relevant, and even local groups you can contact that are also focused on this issue. Unlike a standard report, what you receive changes as the available information changes, and you might have wiki-like access to add to or edit it. And because you told your agent that this topic is a high priority, your cell phone will beep when a significant development occurs. After all, the semantic web will be highly inclusive, providing a common language for many kinds of media and technologies, including cell phones. The net result, ideally, is that you spend less time searching and sifting and more time absorbing, thinking, and participating.

Personal Learning Network Maintenance

Each one of us sits at the hub of a personal learning network (PLN) that connects us to our interests. Unfortunately, much of our time is spent finding

useful information rather than interacting with it and thinking about it. We troll blogs, search the web, wade through long podcasts, and converse with friends in the hopes of finding something we can use. Some services, like iGoogle, make a modest attempt to streamline this process by allowing us to automatically log into web services we have selected, like news services or various podcasting sources. But we still need to pick through that day's offerings to determine whether they contain anything relevant to our interests. This approach to collecting information is at best clumsy and inefficient, and it can lead to inaccuracies simply because we run out of the time or motivation to do a thorough job.

Under Web 3.0, PLNs are built primarily around subjects, not services. Personal learning agents identify relevant information from any source that is semantically accessible and provide an information synthesis tailored to our personal learning objective. The result is similar to the one described in the "global warming" search example, but applied to an educational goal. Again, the objective is to spend less time searching for information and more time trying to understand, critically assess, and creatively expand it. The semantic web makes it possible for the web to become an effective and focused information resource that can be tailored for specific content area objectives.

Personal Educational Administration

Most of us use a multi-source approach to resource gathering. If we want to develop a wardrobe, feed ourselves, or stock a tool shop or music library, we go to several providers to do so, including local stores, online vendors, garage sales, eBay, and even friends. Currently, it is very difficult to use this multi-source approach in obtaining an education and particularly in earning a degree. Educational institutions tend to be stand-alone entities that don't facilitate working with each other.

There is no question that economics and turf drive the lack of inter-institutional cooperation. How-

ever, even if these impediments were to disappear, crafting a multi-institutional education from a student perspective would still be logistically very difficult because schools and other education providers for the most part do not share common languages in describing course or degree requirements. Transfer students can bear witness to how difficult it can be to do something as basic as transfer credit for Philosophy 101 from one institution to another.

The Semantic Web has the potential to challenge this kind of institution-centeredness in the same way that distance learning technologies challenged place-centric education. At some point, institutions will describe courses and degrees semantically, probably just to help their own internal functioning, but with the secondary effect of making many of the components of education at least somewhat comparable across institutions. It is a short leap from that point to students being able to identify comparable coursework and experiences from several educational providers and, in the process, even meet the graduation requirements of yet another. Smart schools will get ahead of this and figure out just what the inevitable institutional inter-connectedness will mean for them.

The Inevitability of the Semantic Web

Is the Semantic Web inevitable? Absolutely. I don't make this assertion based on advanced technological knowledge, which I most assuredly do not possess. Rather I make it because I have come to respect what Michael Dertouzos called "the ancient human in each of us" as a primary force in the evolution of our tools.[3] As ancient human beings, we want to connect, share ideas, maintain relationships, understand the world around us, and sustain ourselves physically and emotionally regardless of—and sometimes despite—technological advancement. Those in the 1980s who told me e-mail would never catch on ignored the ancient human, as did those who told me just a few years ago that the world would come to see blogging as superfluous.

Remember, 15 years ago the web was science fiction to most. Today it is taken for granted. Eventually, we will take the Semantic Web for granted as well. Our thirst to make sense of the information available to us and to broaden and deepen our relationships with the world and each other will most certainly urge us on through whatever complex and challenging development period awaits us. The ancient human will see to it.

Thinking Proactively About Web 3.0 in Education

The Semantic Web is historically unique in that for the first time society can see a foundational shift in technology well in advance of its arrival. For the past 25 years we have been in reactive mode, as one wave of technological revolution after another caught us unawares. With the Semantic Web being both inevitable and slow to develop, we can begin discussing possible learning scenarios that might emerge once it arrives.

In fact, the Semantic Web is far enough into the future that we can actually help shape it. Educators would do themselves, students, and the world a tremendous favor by jumping into the discussion now and helping Web 3.0 developers realize a vision that recognizes education and promotes the public good as top priorities. Bias is implicit in all technology—let's choose our bias for the Semantic Web wisely. *e*

Endnotes

1. Paul Miller, "Sir Tim Berners-Lee: Semantic Web Is Open for Business," *The Semantic Web*, posted February 26, 2008, http://blogs.zdnet.com/semantic-web/?p=105.
2. Note that Web 3.0-type search engines are being developed just for Wikipedia to intelligently access the massive amount of interconnected information it provides.
3. Michael Dertouzos, *The Unfinished Revolution: Human-Centered Computers and What They Can Do for Us* (New York: HarperCollins, 2001).

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