WEB 3.0: HOW THE “INTERNET OF EVERYTHING” WILL IMPACT HIGHER EDUCATION

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ABSTRACT

Universities are finding that adopting Web 2.0 is necessary to remain competitive, while, at the same time, the evolution to Web 3.0 is on the horizon. This paper discusses Web 3.0, how it builds on Web 2.0, examples of current applications of Web 3.0, the potential benefits for higher education and lifelong learning which experts predict from Web 3.0 and concerns that have also been voiced.

INTRODUCTION

Over the past two decades, many institutions of higher learning and their students have reaped benefits from using Web 2.0 tools such as Wikis, Facebook, blogs, tagging, LinkedIn, virtual reality, social bookmarking, mashing, rss, podcasts, folksonomies, ePortfolios, chatrooms, and similar technologies, which facilitate communication, give participants a feeling of group membership, and are user-friendly. Specific benefits include: learning-related benefits: (Anderson, 2007; Alexander, 2006; Wesch, 2009; Reuben, 2008; McDonald, 2009; Brainard, 2007; Thompson, 2008; Minocha, 2009), such as facilitation of collaborative learning, development of independent learning skills, problem solving, team work, reflective learning, quick/early feedback from instructors, overcoming isolation of geographical distances, peer-to-peer support/feedback, visibility of students’ work, integration of multimedia assets, and the creation of informal relations between educators and students.

Universities are finding that adopting Web 2.0 is necessary to remain competitive, while, at the same time, the evolution to Web 3.0 is on the horizon. This paper discusses Web 3.0, how it builds on Web 2.0, the potential benefits for higher education and lifelong learning which experts predict from Web 3.0, and concerns that have also been voiced.

ANATOMY OF WEB 3.0

Web 2.0 democratized the Internet by shifting web content development power from the sole domain of coders and web site developers to enable authoring and development by anyone who accesses the Internet (Ingle, 2012). Internet content has grown and evolved with input from individual people, businesses, and organizations all around the world. The amount of information on the Internet is now tremendous, but it is also chaotic and unstructured, like a database into which data is entered in a haphazard manner that limits the ability to retrieve relevant, accurate information. Web 3.0 promises to integrate the vast data on the Internet to make it more useful and valuable for users.

While Web 2.0 focuses on the front-end aspects of the Internet and its ability to bring people together and to share knowledge, (Naik and Shvalingaiah, 2008), Web 3.0 will concentrate on
upgrading the back-end, by maximizing communication and interoperability between and among Web sites and electronic devices, so that computers themselves will have the capability of searching for, organizing, and finding connections among pieces of information (Strickland). Web 3.0 will not replace Web 2.0; indeed the social aspects of Web 2.0 will still play an important role, and information on blogs, social networks, and wikis will be made more accessible by smart Web 3.0 browsers. The increasing connectivity of information provided by devices and other objects that are part of daily life is evolving into what has been called the “Internet of Everything” (Evans, 2012).

The following are the key elements in Web 3.0 Technology:

**Information tagging**

Today’s web browsers have only limited capacity for discovering connections among pieces of information that might be useful or valuable for users (Ohler, 2008; Spalding). A standard Google search yields hundreds of results, many of which are either irrelevant or marginally relevant to user needs. HTML, the language used to create the vast majority of current webpages, was designed for simplicity with a fixed set of tags that provide a word to word translation of a search key word. Broken links, a fixed set of tags, formatting constraints, and inefficient search results are limitations of HTML (Moreyne; Ohler, 2008).

With Web 3.0, website developers will use international standards World Wide Web Consortium Standards to create structured online content, using tags or fields with descriptors like “last name” or “fax number” that enable a web browser to identify, understand the meaning of and integrate information on Websites more readily (MacManus, 2009; 4imprint.com, 2010). This will require the translation of billions of bits of online information into micro contents that enable more accurate searches in which smart search engines can recognize and avoid the confusion presented by linguistics issues like homonyms and synonyms (Naik and Shivalingaiah, 2008).

Web 3.0 will use languages specifically designed for data, such as Resource Description Framework (RDF) and Extensible Markup Language (XML) (Moreyne; 4imprint; Spalding). While HTML can describe documents and the links between them, RDF and XML Web 3.0 languages provide coding to data within documents and link them to data from other databases or web sites, so that they can be read and understood by computer applications. Content managers will use machine-readable “metadata” descriptions that add meaning to Web site content and describe the structure of existing knowledge about it, making it possible for a computer to process knowledge using human-like deductive reasoning and inference.

As a result, Internet content will be efficiently searchable, interconnected, and retrievable (4imprint.com). Keats says that Web 3.0 represents the return of experts and authorities to the web (Keats and Schmidt, 2007), because of the monumental task of determining and applying semantic standards to all Internet content. For this reason, Web 3.0 is not expected to be functional until 2020 (Bikakis et al., 2012).
Ontologies

An ontology describes the concepts and relationships in a particular knowledge domain, including the associated vocabulary and computerized specifications for the meaning of terms used in the vocabulary (Ohler, 2008). The tagging of information described earlier will enable the use of ontology inference rules and data organizational tools to provide logic and structure that can discover meaning and synthesize information on web pages and create domains of pre-organized knowledge on different topics that can be updated on an ongoing basis (Ohler, 2008; Devedzic, 2006; Yu, 2007; Ghaleb et al., 2006; Verizon, 2010). Because of the emphasis on computers being able to understand the meaning behind text in web content, Web 3.0 is often referred to as the semantic web.

Web 3.0 will have natural language search capabilities that enable users to ask a complete question, rather than input noun phrases in isolation. Currently, users often must work hard to crystallize their search entries into what has been called “keyworsese” (4imprint.com, p. 4) in order to obtain relevant results. Web 3.0 search engines will be able to interpret and process complete sentences. Barney Pell, President of Powerset, Marketing and Web 3.0 remarked that “Search engines…train us to become good keyword searchers. We dumb down our intelligence so that it will be natural for the computer. The big shift…is that instead of moving human expressions and interactions into what’s easy for the computer, we’ll move computers’ abilities to handle expressions that are natural for the human.” (4imprint.com, p. 4). “Common definitions, inference rules, and ontologies will turn the web from a series of information containers into an ecosystem in which the parts of the web are interrelated” (Ohler, 2008, 8).

Personal Assistant for Learning (PAL)

Each Web 3.0 user will be able to enter his/her preferences and interests, and the computer will customize and provide information for him/her that fits these criteria. Each user will, in effect, have a personal profile, called an Open ID (Pablo’s site, May 17, 2010), which will guide the browser as it searches for relevant information. User profiles will function like a virtual avatar that represents them and their interests online.

Multimedia Information

Web 3.0 will also provide users links to relevant multimedia information, such as Virtual worlds, augmented reality, and 3-D environments (Ingle, 2012; Green, 2011). Second Life, for instance, facilitates real-time collaboration and interaction in a virtual environment (Ellis and Anderson, 2011; Ferguson, 2011; Dalgarno and Lee, 2012). Augmented reality overlays computer-generated materials onto real-life objects to enhance real world experience of them (Yuen, Yaoyuneyong and Johnson, 2011; Zhou, Duh and Billinghurst, 2008; Spalding).

Artificial Intelligence

Web 3.0 will make more use of artificial intelligence to enable programs and applications to become capable of understanding higher logic and reasoning, and making decisions in a more effective manner. These programs will be self-learning, which means that they can learn and
evolve on their own, by for instance, tracking habits of users and then, providing search results that suit their preferences.

**Interconnectivity**
The number of everyday devices that will be connected to the Internet will increase to include sensor-equipped and networked devices such as energy-using household appliances, office equipment, web-enabled printers, vehicles, and even natural objects like trees and crops for scientific analysis. Connectivity will be provided by IPv6, the Internet protocol that provides an addressing schema and IP-based platform that will connect devices and components and enable user searches access to data and information on a wide number of devices (Evans, 2012). The ability able to glean information from a number of devices and media types led to the Web 3.0 being referred to as “The Internet of Everything” (Evans, 2012).

**Open source software and code**
The availability of open source software and code will enable any user to develop web pages in which linked content is accessible to Web 3.0 smart searches. Open Graph protocol will enable people to “mark up web pages with RDF, to make information on a web page more searchable (The Open Graph Protocol, May 14, 2010).

**EXAMPLES OF CURRENT APPLICATIONS OF WEB 3.0**

Many scientific knowledge portals, information management and integration systems, electronic commerce, and semantic web services already use ontologies to share, reuse and process domain knowledge. Protégé is a free, open-source platform that has a suite of tools that can be used to construct domain models and knowledge-based applications. The Protégé-OWL editor enables users to build ontologies in the W3C's Web Ontology Language (OWL). An OWL ontology includes descriptions of classes, properties and their instances, and can make connections among facts that may not be present in the ontology, but are related semantically (OWL Web Ontology Language Guide).

GoPubMed, a knowledge-based search engine, enables scientists to access biomedical texts that are organized under Gene Ontology and Medical Subject Headerings (MeSH). (GoPubMed website). NextBio integrates life sciences experimental data that is tagged and connected through biomedical ontologies, so that researchers can quickly access relevant information (http://www.nextbio.com/b/nextbioCorp.nb). Facebook presents individuals whose interests may match that of the user and are suggested as potential friends. Facebook’s Open Graph is formatted so that users can markup webpages with RDF. Then, when a person “likes” something on the user’s page, the user has access to that person’s Facebook and all of the information and links on it (Shaw, 2011).

Best Buy implemented a semantic ontology for e-commerce (Chief Marketing Technologist, May 17, 2010). The company revolutionized its search engine, using RDFa (RDF and XHTML) markup and GoodRelations, a standardized vocabulary (ontology) for product, price, store, and company data that can be embedded into existing static and dynamic Web pages and processed by other computers. Users experience more targeted search results that enable granular product
comparisons, and Best Buy’s products and services are more visible in the latest generation of search engines and recommender systems (Shaw, 2011).

Amdocs provides customer relationship management for service industries like telecom, health care, utilities, and insurance. The company uses semantic technologies to integrate information from many sources in real-time in order to predict the reason for a customer’s call and to promptly give the appropriate response (Shaw, 2011).

The BBC’s 2010 FIFA World Cup site contained more than 700 pages whose content was dynamically linked using semantic language technology (Shaw, 2011). When a user requests specific information, the web site automatically gathers information to create a web page that includes the information sought (Shaw, 2011). The Amsterdam Fire Department uses Web 3.0 Linked Data technologies to link together relevant information—from other first responders and from OpenStreetMap—that decreases response time (Shaw, 2011).

City24/7, Cisco IBSG, and the City of New York collaborated to develop City24/7 Smart Screens that integrate data from the government, local businesses, and individuals to provide information that is available anytime, anywhere, on any device. Smart Screens located at bus stops, malls, and sports facilities provide touch, voice, and audioteach technology that can provide formation related to the exact location in which users access the system (Evans, 2012). Wolfram Alpha answers factual queries directly by computing the answer from semantically structured data, rather than providing a list of documents or web pages that might contain the answer (Evans, 2012).

WEB 3.0 AND HIGHER EDUCATION

Thompson (2008) characterizes the role of Web 2.0 technologies on college campuses as that of a disruptive technology, since it requires a university, its faculty, and students to rethink and restructure the learning process in order to effect the change the technology requires in order to be used effectively. The same is true for Web 3.0. Wikis, Facebook, blogs, tagging, LinkedIn, virtual reality, social bookmarking, mashing, rss, podcasts, folksonomies, ePortfolios, chatrooms, and similar technologies that are considered Web 2.0 will remain important and will play a key role in Web 3.0. However, the gradual increase in the use of Web 3.0 technologies will impact high education in many ways, some predictable, others yet undefined (Anderson and Whitelock, 2004; Gerstein, 2013; Bradford, 2008).

Reduced expense

University budgets for hardware and software will be reduced, since all machines will be Internet-connected and provide access to knowledge (Delaney, 2012).

Changes in teaching

Parry said that “ethically, we are called on as teachers to teach them [students] how to use these technologies effectively, (Parry, 2001). With Web 3.0, teachers will be able to develop engaging, interesting, more complex assignments that are supported by a variety of resources. Students will
develop more independence, which will free teachers to tutor individuals, work with small groups, and design collaborative projects (Delaney, 2012).

With an increase in online education, teachers will need to catch up with the new media. A paradigm shift will change the traditional student consumption of teacher-provided content to student creation of content. More project-based learning will be possible and supported by the increased resources available through web 3.0 (Delaney, 2012).

**Learning**

Students will spend less time gathering and integrating knowledge and more time on higher level thinking—synthesizing information, constructing new knowledge, and applying what they learn (Reynard, 2010; Ohler, 2008). Students will be able to learn anywhere and anytime if they have access to the Internet through mobile devices.

**Knowledge Construction**

Web 3.0 search engines will produce a report that is multimedia and draws from many sources—websites, scientific repository articles, textbooks, blogs, YouTube videos, cell phone stored information, virtual reality content (Ohler, 2008). The report would also compare and contrast the information presented, and allude to different arguments, as well as alerting the use to related topics, books, and lectures/events local that relate to the topic. A cell phone could be set to give beep whenever new info on the topic is available. Reports will update themselves as new information is available. Students will have more time to absorb, think, and participate (Bradford, 2008).

**Smart Searches**

Head and Eisenberg (2010) write that students become frustrated with Internet searches, because they often yield unrelated information, and students feel that they can never do a search that is exhaustive enough. The customized search capabilities that will be possible with Web 3.0 will yield only information that fits criteria specified in advance by the user. Students will also be able to access bodies of knowledge on various topics for which ontologies have been created that include relevant information from diverse web sites and media types (Green, 2001; Devedzi, 2006; Reynard, 2010). Smart search engines will use linked data to provide a search report that can include lecture notes, resources, videos, journal article, blogs, television programs, and social networking content (Ohler, 2008; Loureiro, Messias, and Barbas, 2012).

**Personal Learning Network Maintenance**

Personal learning agents will search for information related to a learning goal and will only report relevant information (Ohler, 2008). Web will be a focused information resource that can be tailored for specific content area objectives. Location-based services can sense a user’s location and send appropriate information that is useful to the user in this location.
Virtual worlds and Augmented Reality will provide new dimensions to learning content that may improve student learning, and will enable students to study at their own pace (Yuen, et al, 2011; Carmigniani, 2010; Chen, Teng, Lee and Kinshuk, 2011; Mayer, 2001).

**Personal Educational Administration**

Universities will use the semantic web to describe courses and degrees so that it will be easy to transfer credits, and students can easily determine a number of colleges that could give them the knowledge they seek (Ohler, 2008).

Keats and Schmidt (2007) give the following description of education in the web 3.0 world: “Education 3.0 is characterized by rich, cross-institutional, cross-cultural educational opportunities within which the learners themselves play a key role as creators of knowledge artifacts that are shared, and where social networking and social benefit outside the immediate scope of activity play a strong role. The distinction between artifacts, people, and process becomes blurred, as do distinctions of space and time.”

Keats and Schmidt (2007) argue that, several key elements are already in place for Web 3.0, and that higher educational reform is at a tipping point for reform that can ready it to make the changes necessary to achieve Education 3.0:

- E-learning and just-in-time learning are now commonplace
- Teacher-centered approaches to teaching are being replaced by student and/or resource-based learning.
- The Internet plays an important role in daily life
- People are used to collaborating and interacting with dispersed individuals via the Internet.
- Online educational content can be used and reused without requirement of permission from the authors/copyright holders.

Keats and Schmidt (2007) also outline changes which institutions of higher learning need to adopt in order to prepare for Education 3.0:

- Embracing and contributing to free software that fosters collaboration within/across institutions, and across disciplines and nations.
- Free and open standards for sharing and co-creating, to ensure that resources remain compatible and accessible.
- Free and Open Resource for education (FORE) to which the institution contributes and makes use of.
- Embracing the concept of students as creators of knowledge resources rather than just consumers, and rubrics to assessment rip-mix burn activities (rip means to copy; mix means to re-edit or re-form however the user wants; burn means to publish in a way that others can see. (opencontent.wgbh.org/report/glossary.html)
- Evidenced-based research on the implications of Web 3.0 in higher education and new assessment tools of less-structured learning activities and for a wider range of learning activities, beyond formal, onsite, or classic distance courses.
Several critical strategies have been suggested for preparing teachers and students for Web 3.0—become fluent in expressing oneself appropriately in various settings and multitasking, build on the knowledge of the past, create and collaborate, and conceive of work and play as seamless (Armstrong, 2009). Educators need to develop students’ digital literacy skills, including critical discrimination and management of online information (Ingle, 2012).

**AREAS OF CONCERN ABOUT WEB 3.0**

Despite the excitement around Web 3.0, areas of concern remain for which solutions are needed before the potential of Web 3.0 to enhance education can be realized.

**Impact on Student Learning**

Students’ spending less time gathering and integrating knowledge and more time on higher level thinking have been described as benefits of Web 3.0 (Reynard, 2010; Ohler, 2008). However, one could argue that gathering and integrating knowledge are important steps in the learning process, and that simply presenting students with information that has already been synthesized eliminates the critical thinking, evaluation, and argument building that are crucial in the educational process. Similarly, the introduction of calculators, for instance, was expected to free students from manual computations so they could concentrate on the solution of higher-level mathematical questions. This is true for students working at advanced levels of subject knowledge, but if introduced too soon, calculators can impede the development of basic mathematical skills.

**Tagging information**

Decisions must be made about who will decide which information is tagged (Berners-Lee in MacManus, 2009, and who will perform the tremendous amount of coding necessary to achieve Web 3.0 (Moreyne).

**Developer Bias**

Insights into human nature point to the likelihood that developer bias and perspective will go into tagging information. Even subtle tweaks could eliminate some relevant information and/or include other information that is important according to the developer (Ohler, 2008).

**Information Security and Privacy**

User preferences and online behavior can be inaccurately interpreted and used to filter their future information needs in directions that users did not intend (Anderson and Whitelock, 2004).

**Censorship and privacy issues**

A large amount of personal data will be on the Internet through social web sites that are linked and whose information is available and disseminated widely. Data Scraping, in which data, from web pages can be extracted and used for articles that reach completely different conclusions than
those intended by the author and without giving credit to the author (Moreyne). Additionally, individual users who upload content may not use standard content protocols. If their content is not coded, it may not be “ignored” by Web 3.0 browsers and thus may not become part of the content knowledge of a specific subject area.

**Six Challenges for the Semantic Web** (Contreras, Corcho, and Gomez-Perez, 2002)

1. Few pages are coded with semantic languages and ready for the semantic web.
2. Ontology availability, development, and evolution
3. Overcoming foreign language translation biases
4. Visualization of search results- users will want to visualize the content of their search and obtain first relevant results.
5. Standardization

**CONCLUSION**

This paper has highlighted the ongoing evolution of computer technology from Web 2.0 to Web 3.0, which has been called “the Internet of Everything.” Web 3.0 promises to integrate Internet data in a way which will make Internet searches more focused and customized to gather and present information from various types of media in a format that is relevant and fits user needs.

This change will depend on careful coding of web site content using Web 3.0 markup languages that insert coding into web site content that links bits of data on them and makes this information accessible. Web 3.0 markup will also enable the development of ontologies or structured collections of information about a particular topic that can be automatically updated as new data is posted. Individual users will have the opportunity to establish and use one online identity that enables them to access information without having to log in each time. Everyday objects will have sensors that monitor the data they contain and make it available to the interested user.

The growing evolution toward Web 3.0 is exciting, but concerns have also been voiced, particularly regarding privacy, the potential bias of developers who create ontology content, and the issue of what should be done with the vast amount of content in websites on the Internet that is not written in Web 3.0 languages.

One of the most interesting aspects of Web 3.0 is its potential impact on the field of higher education. Education experts point out that students will be more able to learn on their own, no matter where they are, and that they will be able to spend more time analyzing and building on knowledge produced by web 3.0 and less time searching and compiling information. A concern directly related to education is the danger that, by being presented information they seek in a pre-organized format, students will miss the opportunity to develop their own powers of analysis and evaluation.

Admittedly, the arguments presented in this paper about Web 3.0’s potential role in higher education are still speculative, but as Web 3.0 tools become more available, educators need to determine the impact on teaching and student learning, so that the appropriate pedagogical methods and student support systems can be put into place to maximize the benefits provided by Web 3.0.
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