

Web 2.0–Based E–Learning: Applying Social Informatics for Tertiary Teaching

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Chapter 7

Teaching and Learning Information Technology through the Lens of Web 2.0

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ABSTRACT

Recent advances in Internet technologies, combined with a society that relies upon them, have brought about a new toolset for working and sharing on the World Wide Web. The term “Web 2.0” suggests an updated version of the Web, but really names a new genre of web applications, along with the technologies they rely on and the social content contain. Web 2.0 marks the evolution from a “one-way” Web filled with static content to a dynamic “read/write” Web that has become a platform promoting collaboration and communication, linking people as well as the digital information they share. This chapter applies a connectivist learning approach to creating authentic learning spaces for teaching Web 2.0 concepts in a first-year college information technology course. It suggests best practices for fostering learning by using Web 2.0 tools to create connections with people, ideas, and technology.

INTRODUCTION

Today’s “digital natives” grew up with the Internet; they embrace the social networking features that Facebook, MySpace, text messaging, and instant messaging provide (Prensky, 2001; Palfrey & Gasser, 2008; Tapscott, 1998; see also Chapter 16 in this book). Students today are always online, confident with using computers, and able to find what they need on the World Wide Web.

Advances in technology have changed the way many students learn. Siemens (2005) claims that in recent decades, “technology has reorganized how we live, how we communicate, and how we learn. Learning needs and theories that describe learning principles and processes, should be reflective of underlying social environments” (p. 3).

Many of today’s students have the basic media literacy skills required to participate in a Web 2.0 world. What some of them lack, however, is an understanding of the underlying foundations that make their everyday web activities possible.

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The simple act of creating and sharing a video on YouTube requires basic skills in editing audio and video, understanding the need for data compression and appropriate file formats, file transfer protocol (FTP), and the notion of a web server to store multimedia on the Internet.

Web 2.0 technologies have changed the way students and their teachers *use* the Web, and they have also impacted how to teach *about* the Web. Drawing on experiences from an introductory information technology (IT) course, *IT 101*, at Bentley University in Waltham, Massachusetts, USA, where a connectivist approach was applied to create a learning space for teaching Web 2.0 concepts, this chapter describes several trends, technologies, and applications and how they may be used to foster student learning both using and about Web 2.0.

CONNECTIVIST LEARNING AND WEB 2.0

Siemens (2005) defines connectivist learning as learning “driven by the understanding that decisions are based on rapidly altering foundations. New information is continually being acquired” (p. 7). It is important to be able to distinguish between what is important and what is not, and understand how changes in information and technology may impact earlier learning and decisions. These are precisely the skills required of tomorrow’s knowledge workers. The culture of participation fostered in a rapidly changing Web 2.0-oriented environment supports such a style of learning required in this digital age.

Siemens (2006b) states that a decentralization of knowledge contributes to the enrichment of learning, giving more control to the end-user, so that learning becomes a process of gathering, adapting, and creating knowledge. This results in a challenge to authority, a need to be connected, and ultimately a desire to be able to make change. To fill this gap, Siemens proposes the theory of

connectivism, which views learning as occurring in the process of creating connections between new ideas and experiences, an idea that is consistent with and appropriate in a Web 2.0 world.

Siemens (2006b, p. 31) identifies nine principles for connectivist learning:

1. Learning and knowledge require diversity of opinions to present the whole ... and to permit selection of best approach.
2. Learning is a network formation process of connecting specialized nodes or information sources.
3. Knowledge rests in networks.
4. Knowledge may reside in non-human appliances, and learning is enabled / facilitated by technology.
5. Capacity to know more is more critical than what is currently known.
6. Learning and knowing are constant, ongoing processes (not end states or products)
7. Ability to see connections and recognize patterns and make sense between fields, ideas, and concepts is the core skill for individuals today.
8. Currency (accurate, up-to-date knowledge) is the intent of all activities.
9. Decision-making is learning. Choosing what to learn and the meaning of incoming information is seen through the lens of a shifting reality. While there is a right answer now, it may be wrong tomorrow due to alterations in the information climate affecting the decision.

O’Reilly (2005) coined the term “Web 2.0” in recognition of new patterns in the ways people use the World Wide Web. According to him, the Web has become a platform for supporting applications that promote collaboration and sharing, providing rich user experiences on multiple devices. These have become possible because of increased availability of bandwidth and Internet access, advances in networking technologies,

and development of new tools and platforms for creating software applications.

Connectivism suggests that knowledge rests in networks and is facilitated by technology. The development and rise in popularity of Web 2.0 applications such as social networks and collaborative tools that work by “harnessing collective intelligence” (O’Reilly, 2005, “Blogging and the wisdom of crowds,” para. 10) of users promote and facilitate learning, linking both people and the knowledge they share.

Vossen and Hagemann (2007) attribute the emergence of Web 2.0 to the merging of three independent streams of development: applications, technology, and socialization. New web applications and services have appeared that require little technical background to use. Progress in hardware, networking capabilities, and software tools form the foundation for those applications, and the increased ability for users to participate and interact on the Web through social networking has changed the culture of how people use the Internet. The convergence of these “techniques, technologies, and usage patterns ... has received the preliminary and ... fancy term ‘Web 2.0’” (Vossen & Hagemann, p. 65).

As Web 2.0 software applications are in “perpetual beta” (O’Reilly, 2005, “End of the software release cycle,” para. 5), so are Web 2.0 learners—learning is constant, and ongoing. Web 2.0’s lightweight programming models allow for information sharing, facilitating the use of technology to enable new learning spaces, activities, and approaches. Harnessing collective intelligence through online collaborative tools such as blogs and wikis encourages the gathering, organization, and discovery of knowledge from many different information sources.

The synergy between both sets of principles is strong, suggesting that a connectivist approach to teaching Web 2.0 concepts using the tools that embody its principles is also in order. The recent shift in how people use web technologies also inspires a shift in how to teach them. The

impact of new media on the world is profound. Just as the desktop publishing tools of the mid-1990s spawned the phenomenon of home-grown newsletters, the emergence and acceptance of web publishing tools in the mid-2000s has spawned a “blogosphere” with global reach:

Too many educators fail to understand how technology is changing society. While hype words of web 2.0, blogs, wikis, and podcasts are easy to ignore, the change agents driving these tools are not. We communicate differently than we did even ten years ago. We use different tools for learning; we experience knowledge in different formats and at a different pace. We are exposed to an overwhelming amount of information—requiring continually greater levels of specialization in our organizations. It is here—where knowledge growth exceeds our ability to cope—that new theories of knowledge and learning are needed. (Siemens, 2006a, p. 7)

Given this evolution in how people have come to use the Web, it becomes necessary to teach these tools and technologies in a way that is congruent with current learning styles “influenced ... by socialization and technology” (Siemens, 2006a, p. 4). Two main questions emerge, which are addressed in the remainder of this chapter:

- What are core Web 2.0 topics for the IT classroom?
- How might one use Web 2.0 tools to teach these topics in the IT classroom in such a way that models connectivist learning principles and supports collaborative, experiential learning?

INTEGRATING WEB 2.0 INTO THE TERTIARY CURRICULUM

In recent years, an increasing number of students has arrived on campuses of tertiary education

institutions with previous computer experience (Palfrey & Gasser, 2008). This is most likely due to greater computer availability and usage at home and in high schools. The popularity of social networking sites such as Facebook and video-sharing sites such as YouTube among college students is perhaps at least partly responsible for their interest in the Web. The traditional computer literacy course required of most first-year college students becomes an important place for teaching not only about these applications and how to use them responsibly, but also how to be literate in a Web 2.0 world.

Integrating Web 2.0 into the tertiary curriculum is becoming more common, as many colleges and universities are offering new courses focused around specific aspects or technologies of Web 2.0. For example, *Create engaging web applications using metrics and learning on Facebook* was offered for the first time at Stanford University in Fall 2007, as an “experiment in how to teach the process of successful software development” using Facebook’s open platform (Eldon, 2007, para. 10). In Spring 2008, Matthew J. Hall at Vanderbilt University offered *Beyond the one-way Web: From publishing to participation* as a course concerned with the social impact of new media and technology (see Hall’s class blog at <http://beyondthetoneawayweb.wordpress.com/>).

Computer Science departments at institutions such as the University of California, Berkeley have offered programming courses using new web technologies such as Ruby on Rails and AJAX. Departments in other schools have introduced Web 2.0 courses that deal with new ways to use the Web for business, marketing, and social media. Executive and business programs teach Web 2.0 from a strategy perspective, discussing trends for transitioning companies to using Web 2.0 techniques and technologies, and the new business opportunities they present (Shuen, 2008).

Another approach is to integrate specific Web 2.0 tools and technologies into existing courses. Alexander (2006) suggests that social writing

platforms “appear to be logistically useful tools” (p. 38) in higher education for a variety of purposes such as teaching composition, and suggests that “The rich search possibilities opened up by ... tools [such as Google News and Digg] can further enhance the pedagogy of current events” (p. 40). Students must see the value of the tools they are exposed to in order to continue using them. The adoption of such tools in the classroom will “help student employability by preparing them for teamwork, global audience and peer reviews and in general for the new business model” in which knowledge workers are expected to collaborate (Cubric, 2007, p. 11). Many tertiary teachers have made use of blogs or wikis as a tool for promoting active learning and knowledge creation, or for continuing discussions beyond scheduled class times (Cubric, 2007; Davi, Frydenberg, & Gulati, 2007). Kamel Boulos, Maramba, and Wheeler (2006) cite concerns about monitoring and moderation of open wikis and blog content, especially in the fields of healthcare and medicine, where patient privacy is critical, and note the ease of use of such applications for sharing information.

TEACHING IT THROUGH THE LENS OF WEB 2.0

IT 101 is an introductory technology course at a Bentley University, a leader in business education in the New England region. Students are required to take an introductory technology class in either the first or second semester of the first year in their undergraduate program. The course ensures that all students gain competency in basic IT skills, including using and maintaining their computers, while developing individual skills in creating web pages and spreadsheets, understanding basic Internet protocols and applications, and navigating the Windows operating system.

While the specialized or advanced courses alluded to earlier require specific domain knowledge, this chapter argues that computer literacy

and Web 2.0 literacy are both relevant, and surveys common Web 2.0 tools that can be integrated into the curriculum to teach IT concepts. By transforming a traditional, first-year computer literacy course into a relevant, Web 2.0 literacy course, students become active contributors in Web 2.0's "culture of participation," as they use its applications for collaboration and communication, and have an understanding of the technological and social developments that made them possible. The goal of this approach is to teach students traditional IT concepts and current Web 2.0 applications, and show their connections to O'Reilly's (2005) Web 2.0 principles.

Specifically, students in IT 101 interact with Web 2.0 applications in ways that facilitate their development of IT skills and introduce them to the social and business perspectives of Web 2.0. The course aims to achieve the following learning outcomes:

- describe the historical and technological milestones that led up to Web 2.0;
- demonstrate proficiency in using RSS, blogs, live and microblogs, wikis, podcasts, mashups, and other collaborative tools;
- identify characteristics of Web 2.0 applications and apply them in a business context;
- create and participate in social networks and online communities to experience the social impact of Web 2.0 tools.

Authentic Learning: Web 2.0 in the Classroom

Integrating Web 2.0 tools and topics into the IT classroom augments the traditional topics usually found in such a course. Blogs, wikis, podcasts, mashups, tagging, and social networking must all find their way into the syllabus through the creation of real-world scenarios that characterize their use. Collaborating to plan trips, creating podcast videos, writing reflective journals, and

developing an online portfolio are among several examples Herrington and Kervin (2007) cite as characteristic of authentic learning enhanced by technology. They provide meaningful activities and contexts for using Web 2.0 tools to create knowledge, and promote reflection to enable abstraction. They place the student at the center, and allow the teacher to play a supporting role as students take the lead role in the learning activities.

One of the main challenges in teaching Web 2.0 concepts in the classroom is designing authentic activities that will engage students as they learn about these technologies. "While blogs, wikis, podcasts, and social bookmarking are receiving much attention, the real point of interest lies not in the tools themselves, but in what the growth of the tools represents and what the tools enable. Primary affordances include: (a) two-way flow, and (b) activities reflective of networked activities of individuals" (Siemens, 2006a, p. 33). Web 2.0 presents a landscape filled with a range of new applications; IT provides a context for examining them as tools for creating opportunities for learning.

Like Siemens, Herrington and Kervin (2007) conclude that teaching technology for its own sake is not sufficient; there must be a clear purpose for including it as part of the learning experience. This puts onus on the teacher to take steps to ensure that students appreciate how introducing technology to solve a problem will improve the process of doing so:

Experiences that put technology into the hands of the students challenge the traditional roles of teachers and students and their associated relationships. It is the teacher's responsibility to ensure that technology experiences are closely associated with the rationale and purpose of an authentic learning experience. Each of these examples highlights the importance of the teacher and students having a clear rationale for completing the task, understanding of the real-life application of the task and appropriate support

to complete the task. Technology affords students the opportunity to engage with tasks that could not be completed using traditional paper-based methods. (Herrington & Kervin, 2007, p. 233)

Student Motivation

Anderson (2007) suggests that the participatory nature of the Web 2.0 culture motivates students to learn, and that “the process of learning [will be] more compelling when they are producers as much as consumers” (p. 32) of knowledge. Others argue that Web 2.0 technologies in the classroom are nothing more than a fad that will lose their initial attraction after becoming fully integrated in the classroom.

Pettenati and Cigognini (2007) support the design of effective learning experiences in a networked environment. They find that lifelong learning requires continuously being creative and creating personal learning environments (PLEs), representing the “temporal horizon through which [to] look at the lifelong learning of a subject” (p. 49), which involves both the formal and informal, expected and unexpected learning activities. Teaching Web 2.0 in the IT classroom can contribute to the attainment of such learning goals:

In the emerging social software, “Web 2.0” environment, the production of ideas takes place in a collaborative, participatory mode which breaks down the boundaries between producers and consumers and instead enables all participants to be users and producers of information and knowledge, or what can be described as producers. These producers engage not in a traditional form of content production, but are instead involved in produsage—the collaborative and continuous building and extending of existing content in pursuit of further improvement. (Bruno & Humphreys, 2007, p. 2)

Wikis and collaboration tools enable students become co-creators of both knowledge and classroom materials. “All of this blurring of the IT lines portends a further rise in efficiency and productivity as smart managers allow these prosumer/producers to adapt their native tools to fit the demands of their jobs” (Tapscott & Williams, 2006, p. 124). In the classroom, students become teachers and teachers must become students once again, as both engage in a learning partnership.

Technology Advancements Change the Motivation for Teaching Core Concepts

Current Web 2.0 and Internet developments have changed the motivation for teaching many core IT concepts. For example, the main rationale behind teaching the hypertext markup language (HTML) today is different than it was a decade ago, when creating a personal web page by entering HTML tags manually in a plain text editor like Notepad was one of the few common ways to maintain a web presence. Now, one can use blogs, wikis, and web-based web page creation wizards, all of which hide the underlying HTML from the user, to accomplish this task. Hence, the reasons for teaching HTML have to change.

While some students may create personal web pages from scratch, more than half of online teens have profiles on sites like Facebook or MySpace. Along with blogs and other social networks, Facebook has become a place where today’s digital natives create true social connections. Text messages and instant messaging are more popular than email as a form of communication (Lenhart, Madden, Rankin Macgill, & Smith, 2007). They need not use HTML to maintain a web presence.

From a learning point of view, today’s students learn HTML or XHTML (extensible hypertext markup language) to have the experience of developing an application according to certain rules of syntax to understand the precision that

any software or web development task requires. From a practical point of view, today's students also learn to develop web pages in order to gain the basic skills to be able to customize their presence in other places (MySpace, Facebook, etc.) on the Web.

Reasons for understanding the fundamental concepts of computer memory, file sizes, and formats become evident when one looks at the process of downloading multimedia: the smaller the file size, the faster the download. Users also must understand different compressed data formats, recognize those that provide true compressions, those that may lose quality, and when such a loss is permissible. All of these issues come to light when examining the technology through the lens of Web 2.0.

O'Reilly's (2005) principle of "data as the next Intel inside," that the power of one's application today is based on the data it contains, just as the power of the microprocessor defines the power one's personal computer, may best be illustrated by teaching students to create mashups—Web 2.0 constructs that combine and apply data from different sources on the Web. Doing so also reinforces the fundamental concepts of input, output, and processing, the most basic functions of any computing system.

A SURVEY OF WEB 2.0 TOOLS AND TECHNOLOGIES

Blogs and Wikis

Blogs (short for "web logs") and wikis are two specialized web applications for posting or publishing information on the Web, and have varied use in higher education (Davi et al., 2007). Introducing blogs and wikis to the classroom process and requiring students to contribute to them tangibly demonstrates their similarities and their differences: while a blog allows its users to comment on one another's posts, participants

cannot change anything that they themselves did not post. Blogs are online journals organized chronologically with new posts at the top, while wikis have a much more open structure, which allows participants to add new pages, or change the content of existing pages. Anyone can post to a blog, but cannot change what is already there. With a wiki, it is possible to change (or delete) existing content. Students also experience being "locked out" of a wiki page when someone else is editing it, and can view the history of the page to see how the wiki tracks all edits and provides the ability to "roll back" to an earlier version. Having mastered the mechanics, students can begin to envisage how they might use these tools as part of their own learning, and in other aspects of their personal and professional lives.

Class blogs have been used across the curriculum in different contexts for students to post topics of discussion for their classmates to answer prior to a class session; doing this lets the students identify the class readings of interest to them (Davi et al., 2007). Some blogging providers such as Blogger (<http://www.blogger.com/>) support the easy uploading of audio or video files, facilitating the process of having the instructor or students in the class create podcasts or vodcasts based on course sessions. By limiting posting access to only current students, the instructor can easily determine which students participate in the blog. Unrestricted access, on the other hand, allows students to see the benefits of inviting comments from a global audience on the Internet, leveraging the power of the "wisdom of crowds" (Surowiecki, 2004) that epitomizes Web 2.0.

Brownstein and Klein (2006) present several applications for the use of blogging in education: learning, constructing, argument, commentary, chronology, extension, resources, and composition. Individual student blogs support student writing, and give students another presence on the Web without having to master HTML. From a social point of view, bloggers have influence on current events, and have spawned an entire

movement of grassroots journalism. This example illustrates the socialization of the Web coupled with advances in technology to support the level of collaboration that many now take for granted. According to Halavais (quoted in “Blogs move student learning beyond the classroom: An interview with Alex Halavais,” 2004), blogs support self-regulated learning. Students are more self-directed, as they hold themselves accountable for their own progress and learning.

A wiki is a website whose pages can be added or edited by anyone. Pages are hyperlinked to one another, and little, if any, HTML knowledge is required to create or edit one. Ward Cunningham, who is credited with inventing the wiki, named it after the “quick” shuttle he took between terminals at a Hawaiian airport, to denote the speed and ease with which wiki pages can be created and modified (Cunningham & Leuf, 2001). The term now describes “a freely expandable collection of interlinked webpages ... where each page is easily edited by any user with a forms-capable Web browser client” (Cunningham & Leuf, 2001, p. 14).

Wiki software tracks changes as users make them, making it possible to revert back to an earlier version of a page. Because multiple users may modify the same page concurrently, most wikis will prevent (“lock out”) others from making changes until the current user has completed his or her updates. While it is possible to host a wiki on a local server, it is more common to register with a free wiki provider. The website WikiMatrix (<http://www.wikimatrix.org/>) compares the features of several wikis and provides a wizard for determining the platform that best suits one’s particular needs.

Wikis have entered the tertiary classroom in many ways, perhaps most notably as a tool to enhance a traditional course management system (CMS). Traditional CMSs are generally used for accessing course materials and student grades. Instructors need to be more creative in their uses of wikis in the classroom, otherwise they are nothing more than “an advanced photocopier, allowing

faculty members to deliver course materials to their students with greater ease than was previously possible” (Maloney, 2007, p. B26). A wiki can enhance a traditional content management system, as both students and the teacher may share in the responsibility of creating and posting course materials. A syllabus stored on a wiki page is easy to edit, maintain, and update as the course goes along. Wiki pages also can be used to facilitate students signing up for group projects, or to serve as collaborative workspaces for students working on such projects (Frydenberg, 2008a).

Mindel and Verma (2006) have articulated additional classroom uses for wikis, including collaborative business analysis projects, developing a literature review for research, needs assessment, sharing notes and project summaries, and making materials available for students. Others have adapted or developed specialized Web 2.0 collaborative applications for use in educational settings. Zhang and Su (2007) discuss the development of a new generation of collaborative learning environments to encourage intercultural communications and collaborations in educational scenarios. Their collaborative learning and teaching system “bridges the increasing gap between traditional computing educational systems and the new demands of industrial computing communities” (p. 153). Their extensible system allows students to create additional modules, tag items, and submit and syndicate content.

RSS

RSS (Really Simple Syndication) is the underlying technology that enables sharing of blog posts, podcasts, news headlines, and other content on the Web. The markup scheme was invented by Dave Winer in 1994 as a tool for scripting web content, which later became popular as feeds for blogs and podcasts.

Competing formats, such as Atom and GData, emerged as alternative standards in later years. All syndication mechanisms use a “publish–

subscribe” model, in which the author publishes content, and subscribers use an aggregator program to check the feed periodically and notify them that new content has been posted. RSS syndication and aggregation is possible because the data (originating from blog posts, podcasts, stock tickers, and news headlines, for example) is represented in a standard XML (extensible markup language) format. Such aggregator functionality is now standard in versions of web browsers such as Internet Explorer and Firefox through the use of live bookmarks. A standard RSS feed includes a standard set of XML tags for describing the title, author, publication date, description, and hyperlink for each item in the feed. The RSS feed for a podcast or vodcast contains an additional “enclosure tag” describing the uniform resource locator (URL) for the multimedia, its length in bytes, and content type (audio or video file format).

Mashups

Mashups, the combining of data from multiple sources into a single display, are popular Web 2.0 constructs, often difficult to create without previous programming skills. Mashups are at the heart of the Web 2.0 business revolution, as companies such as Facebook, Google, and Yahoo! make their data available through open APIs (application programming interfaces) for other applications to consume. Web applications that plot landmarks or housing data on maps (e.g., Zillow at <http://www.zillow.com/>), combine RSS feeds (popurls at <http://www.popurls.com/>), and graphically display photos from photo-sharing sites (Cooliris at <http://www.cooliris.com/>) are examples of mashups.

Mashups also introduce the notion of interacting with data, which is a fundamental business problem. Software development has evolved into *application* development, as current approaches to building a complete system entail linking together previously designed core components. The notion of “software as a service” (O’Reilly,

2005, “DoubleClick vs. Overture and AdSense,” para. 1) and service-oriented architectures have changed the way in which web-based software is developed and deployed. While some specialized software applications may be necessary, usually off-the-shelf components can be configured to solve common business problems. Web 2.0 shifts the focus from building application software to integrating web applications and services. This promotes the sharing of data between the applications and services. The ability to reuse or remix information becomes significant when resources are open and discoverable, licenses are open and transparent, and formats are open and remixable (Lamb, 2007). Creating mashups introduces students to the API as a core strategy for Web 2.0 companies to share information between software applications, and the importance of XML as the underlying language for representing that information in a manner that permits interoperability.

When teaching about Web 2.0 tools, the task is to empower students to create their own mashups, as the very process of designing a mashup requires an ability to recognize connections between otherwise unrelated objects in the world. In the words of Cronon (1998), “More than anything else, being an educated person means being able to see connections that allow one to make sense of the world and act within it in creative ways” (p. 78), and this also resonates with the aforementioned theory of connectivism. In addition, the process of creating mashups has great educational potential for teaching basic programming constructs and software development and architecture concepts. Because these tools provide access to APIs for many Web 2.0 applications (Flickr, Facebook, and RSS feeds), students learn to interact with data in a new way, and create end products or results that can be shared. Because websites and applications will inevitably change over time, it is important to view each as a potential tool for teaching about mashups. By learning about applications of mashups and what components are needed to create one, as illustrated by using

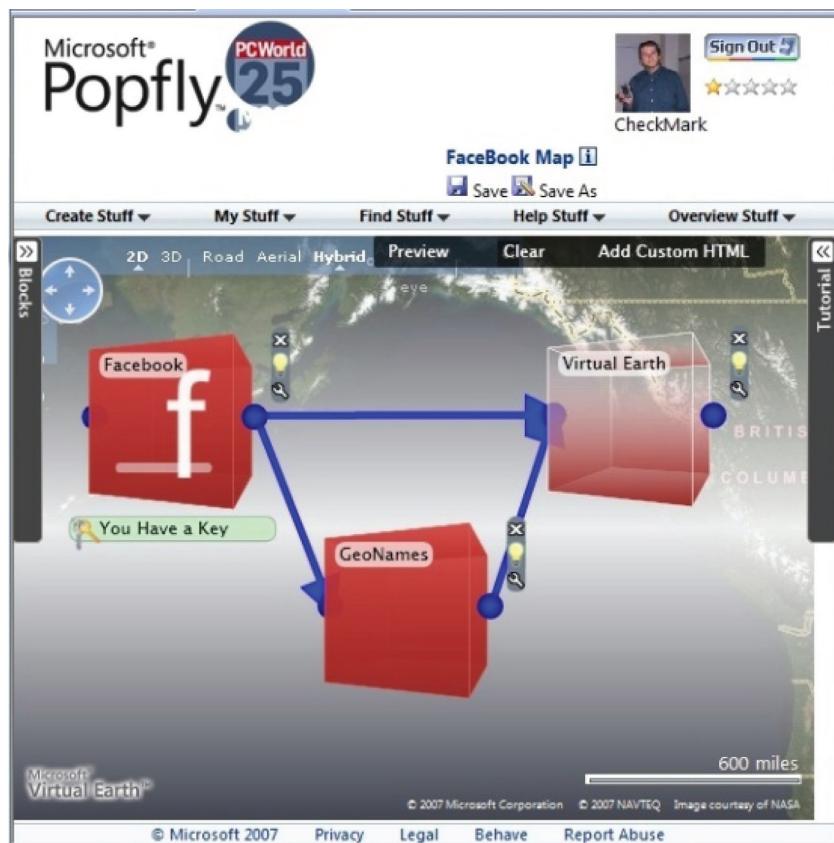
a particular tool, students will be better prepared to adapt in an age of constantly changing software applications.

This approach integrates learning traditional programming concepts using a non-traditional environment that also promotes critical and analytical thinking. These mashup tools reduce the barrier to entry to creating simple Web 2.0 applications, as little or no prior programming experience is required to achieve impressive results. At the same time, the very act of creating a mashup requires students to interact with familiar data in new ways.

Figure 1 shows a mashup created using Popfly, a web-based mashup creation tool from Microsoft. Microsoft supported Popfly from 2007 to 2009. In this example, the Facebook block obtains a list of a user's Facebook friends, and sends the city and

state of each to the GeoNames block. The GeoNames block uses a web service to determine the corresponding latitude and longitude. The Virtual Earth block receives that information, along with the friend's first and last name, city and state, and photo, in order to plot each friend's photo on the map in the location of his or her listed city or state. By connecting blocks, students make connections in an information flow that results in solving a problem. They must learn to decompose a larger problem into smaller components, identify the input and output data from each task, and determine how each task fits together to contribute to the larger solution. The key to creating mashups using any application is the ability to access and process data from the Web. Other tools such as Yahoo! Pipes (<http://pipes.yahoo.com/>) also provide this capability. Their familiar graphical or

Figure 1. Creating a Popfly mashup



function-based interfaces hide the implementation details that would be of interest to programmers writing code, and enable beginning students to interact with real data to create simple yet useful and interesting applications.

AJAX

O'Reilly (2005) describes a “rich user experience” within the web browser as characteristic of Web 2.0 applications. As such, many Web 2.0 applications sport a rich user interface that has much more of a desktop application “look and feel” than a traditional browser-based application. This is often because such applications are implemented using a combination of web technologies collectively known as AJAX (Asynchronous JavaScript and XML). AJAX has gained popularity as a tool for creating browser-independent, dynamic web pages in which only a portion of the page updates at a time.

While it is outside the scope of an introductory IT course—and beyond the ability level of students with no prior programming experience—to implement even the simplest web-based interfaces in AJAX, it is entirely reasonable to explain the concepts of client-side and server-side processing, and the role of JavaScript, so they might be able to identify an AJAX-enabled page when they see one. Students should recognize this behavior in their web-based Microsoft Outlook client, Google Maps (<http://maps.google.com/>), and many online travel booking sites. In each case, only the relevant portion of the page changes without reloading the entire page. Relating these concepts to students' own experiences of them while using familiar web applications creates an opportunity for learning.

In AJAX applications, JavaScript function calls run separately (asynchronously) from the loading of a web page. The function calls may invoke web services or other JavaScript methods to acquire new information with which to update the page, and only a portion of the page may be updated without refreshing the whole page. Pages rely on

JSON (JavaScript Object Notation), a lightweight data interchange format, for passing structured data across a network in a way that is transparent to the user. As a result, the user's experience is perceived as more interactive. Some ASP.NET AJAX controls obtain input from calls to external web services. Only controls on the page that receive the updated data from a web service call are refreshed, enhancing the experience of using the web application (Frydenberg, 2008b).

Google has introduced several tools for building rich web applications. Google App Engine (<http://appengine.google.com/>) allows for the production of web applications that run within Google's infrastructure, and Google Gears (<http://gears.google.com/>) provides open source extensions to add new features to web browsers.

Tagging

Tagging tools are another way to provide for learning by making connections between people and knowledge. Tagging is a fundamental concept in the Web 2.0 world. Students must understand the nature of both physical and digital information to be adequately prepared to manage digital information. Tags are used in applications that extend beyond social bookmarking sites (e.g., delicious at <http://www.delicious.com/>), Flickr ([http://www.flickr.com/-for photo sharing](http://www.flickr.com/-for-photo-sharing/)), and Technorati ([http://www.technorati.com/-for indexing blogs](http://www.technorati.com/-for-indexing-blogs/)), which that were the first to use them, and they are now found on websites of all types. According to Bumgardner (2006), “these amorphous clumps of words now appear on a slew of web sites as visual evidence of their membership in the elite corps of ‘Web 2.0’” (p. 1). Many sites such as delicious incorporate tag “clouds” in which larger fonts and darker colors indicate more popular topics among those that a user has tagged. Each tag links to a page at delicious containing hyperlinks to the actual articles.

Abbitt (2007) investigated the impact of social content sites such as Digg (<http://www.digg.com/>)

and delicious in an educational setting. In a pilot study using social content in an undergraduate educational technology course, he examined usage patterns from students who used their customized social content software over the course of a semester. It was found that social content sites were new to most students and many felt that using them helped them to find resources that they believed would be useful later in their careers (Abbitt, 2007).

Microblogging / Social Networking

Twitter (<http://www.twitter.com/>) is a microblogging application, where users perpetually respond to the simple question, “What are you doing?” Twitter broadcasts and receives short messages to the mobile phones (cellphones) or computers of all those who “subscribe” to another user’s broadcast, allowing users to build significant social networks. By signing up to “follow” one another, friends can send and receive messages. Because Twitter messages may be received on mobile phone, the application is highly mobile, which leads to a number of interesting possibilities for classroom use.

Lew (2007) and Parry (2008) summarize several educational applications of Twitter. With its 140-character message limit, Twitter requires students to be concise in their writing. To carry on conversations beyond the classroom, students could sign up to follow each other, posting when they see something that relates to a topic discussed in class. They might view Twitter’s Public Timeline (http://twitter.com/public_timeline/) to get a sense of what Twitter subscribers around the world are doing. Twitter can be a research tool as users can track posts containing particular words or phrases and receive updates when any Twitter posts containing those terms are posted. Collaborators can leave short notes for one another as they work on a joint project.

Twitter searches on a current topic give students an instant connection to a network of people

with similar interests. There are also several tools for integrating Twitter feeds into a standard RSS format, thus promoting their availability in other applications.

A CONNECTIVIST APPROACH TO TEACHING WEB 2.0 WITH WEB 2.0 TOOLS

This section maps connectivist learning principles to an approach for teaching Web 2.0 concepts in the classroom. Collectively, they all illustrate that gaining up-to-date knowledge of a current technology is the underlying intent of each activity, but more importantly, the process of completing these activities gives students the skills to stay up-to-date by exploring and learning new technologies on their own.

Learning Requires Diversity of Opinions to Present the Whole

An effective way to initiate a conversation with students on Web 2.0 topics and technologies is to show a now-well-known video clip entitled *Web 2.0 ... The machine is us/ing us* (Wesch, 2007b). This short video, available on YouTube, presents a panorama of Web 2.0 technologies, and decisions that must be made about organizing all of the new data brought about by such tools. A major turning point in identifying Web 2.0 as a new phenomenon is Wesch’s observation in his video that “The Web is no longer linking information, it is linking people.” Through collaborative tools, wikis, blogs, and social networks, people are connected in ways that were not previously possible. The video concludes by raising the issues of ethics, identity, privacy, and copyright that are prevalent as a result of using today’s Web 2.0 applications.

The question of how today’s students learn and the challenges of surviving in a digital world is the subject of Wesch’s (2007a) *A vision of students today* video, also posted on YouTube. This video

highlights “some of the most important characteristics of students today—how they learn, what they need to learn, their goals, hopes, dreams, what their lives will be like, and what kinds of changes they will experience in their lifetime.” The stark contrast between traditional, frontal teaching and collaborative learning becomes obvious as today’s learners multi-task, have a constant need a desire to be connected, spend more time online than in class, and realize that the jobs they may obtain after graduation may not yet exist today.

These two videos present the diversity of opinions and issues related to Web 2.0 and how today’s students learn. Asking students to share their opinions of them opens the door to a larger conversation relating to the impact of Web 2.0 tools on the lives of today’s students. They need to learn general skills that they can apply in a variety of contexts. “We need to be teaching kids these skills earlier, and in ways that work for them in the digital environment as well as in traditional environments” (Palfrey & Gasser, 2008, p. 183).

Learning Connects Specialized Information Sources

Using social applications is an important step in understanding the impact that one person can have on the web experience of others. Students vote on popular news articles by “digging” (voting for) them at Digg.com, where the stories that receive the largest number of “digs” (votes) appear on the site’s front page. They post to blogs and wikis, upload photos, or tag articles of interest. Performing this activity exposes students’ personal and previously private interests and entries to a larger community—be it their classmates, or ultimately the world—all of whom may benefit from their participation.

On a practical level, students experience several advantages to using social bookmarking sites such as delicious over storing bookmarks privately in a browser on their local computer. A user’s bookmarks are stored “in the cloud” of the Internet, so they are available from any browser

when logged in to the site; bookmarks can be shared; and the same resource can be tagged with multiple keywords. Along with each tag, delicious displays the number of people who tagged the same article along with links to other resources with the same tags. As mentioned earlier, tag clouds visually display more popular tags using variations in font size and color.

Social bookmarking sites are a useful research tool for teaching and learning purposes. Mejias (2006) cites the use of delicious in the classroom by student who contributed articles to pertinent reading list for the class, thereby “creating an effective distributed research community” (p. 2). Students can draw upon the wisdom of crowds to assume that several people tagging a particular article on a topic is an indication that it is probably worth reading for information on that topic. Because tags are assigned by humans rather than programs, they are often a good measure of the quality or usefulness of a resource, and may be more a effective means of locating relevant content than a simple web search engine query based on keywords. This approach blends a “folksonomy” with a more traditional taxonomy for organizing resources on the Web. The application of “social software in this manner supports constructivist pedagogy where students feel empowered to take charge of their own learning” (Mejias, p. 5). For students previously unfamiliar with tagging, the teacher’s role is to involve students in a realistic scenario that requires them to organize a large volume of information in a personally meaningful way, and then “evangelize” the use of a social bookmarking tool so students will see its value in making the task at hand manageable. Creating such an authentic learning environment provides a context to reflect the way the knowledge (or tool for classifying it) will be used in real life (Herrington & Kervin, 2007).

Tagging is one of several Web 2.0 tools giving individuals the ability to express and discover their own individuality. Siemens (2006b) notes the tension between privacy and individuality thus:

we know and can be known. We scatter our lives and thoughts across the web. Each question in a forum, each thought in a blog, each podcast, each comment to an article—these distributed pieces are splashed across the internet. They form who we are, how we think (at a certain time), and the things we believe. We are known by what we have done and said, and by what others have said about us. We are laid bare ... Our identities are exposed, revealed for anyone to explore. (p. 72)

After tagging articles related to their interests and favorite activities regularly on delicious, for even a short time, students may notice that their tag clouds begin to form a profile that reveals information about themselves in ways that might otherwise not be so easy to discern.

The strengths and shortcomings of such a “folksonomy” quickly become apparent to students. While users can define their own tags for organizing web content, students quickly find that the same tag may have different interpretations. Students learn that the new “order of order” of Web 2.0 is “changing how we think the world itself is organized, and—perhaps more important—who we think has the authority to tell us so” (Weinberger, 2007, p. 23). Students are empowered when they effectively organize information in ways that make sense to them, thereby creating their own PLEs (Wilson, Liber, Johnson, Beauvoir, Sharples, & Milligan, 2007).

Knowledge Rests in Networks; Learning is Facilitated by Technology

Lippincott (2006) claims that “a social process involving interaction with, and observation of, others is an important component of learning” (p. 169). Fostering communities of learning and practice has long been a model for student engagement across academic disciplines and topic areas. Collaborative Web 2.0 tools extend this notion,

as now students can connect with classmates, instructors, and others virtually to share ideas and extend their views.

Requiring every student to contribute to the same wiki page quickly illustrates O’Reilly’s (2005) aforementioned notion of harnessing collective intelligence, as students work together to create study materials for themselves and their peers, and improve the quality of the application for other users. Collaboration through Web 2.0 tools shows that students can network with and learn from one another. In one classroom setting, students may collaboratively create a “study sheet” in preparation for an examination. Each student supplies one question and provides the corresponding answer on a wiki page. By doing this, students see how each of their individual questions contribute directly to the production of a joint artifact that is of mutual benefit and value to all students in the class.

Apart from wikis, the use of Twitter and other social networking tools to support collaboration gives students access to a network of individuals with whom they can share their knowledge. Networked collaborative learning is a hallmark of Web 2.0-based tertiary education, and such activities can give rise to increased student engagement, improved student satisfaction, and the development of higher-order thinking skills (Resta & Laferriere, 2007).

Capacity to Know More is More Critical Than What is Currently Known

The ability to model, interact with, and share data is a key idea in a business context but is also relevant in tertiary education. At an introductory level, students interact with data by understanding RSS feeds and what they represent. Showing students the underlying XML data and how it is structured underscores the main difference between XML and HTML: the former is primarily a tool for

describing information, while the latter is a tool for displaying (formatting/rendering) information within a web browser.

To reinforce the concept that content is separated from how it is displayed, students interact with RSS feeds in different ways. They subscribe to their feeds within a browser, or use a web-based aggregator such as Google Reader (<http://reader.google.com/>). In addition, there are several desktop gadgets for displaying information from RSS feeds within a Windows Vista or Google sidebar. Similarly, a web gadget enables the display of the same information on one's blog or website by embedding some HTML code provided to the user when configuring the gadget. Demonstrating these features and/or encouraging students to experiment with them also introduces students to the Web 2.0 concept of a mashup.

Learning and Knowing are Constant, Ongoing Processes; Currency is the Intent of All Activities

Web 2.0 software is in perpetual beta (O'Reilly, 2005), just as its users are in a constant, ongoing process of learning using its tools. Students see new ways to use the Web all semester long and blog several times during the semester about their experiences. Adding content regularly shows that their blogs or websites—like their learning—must remain fresh and current on a continual basis, and chronicle progress throughout the semester. Engaging in such an active approach to learning based on cooperative questioning, conceptual understanding, iterative assessment, and refinement promotes retention and lifelong learning (Wirth, 2007; Nicol, 2007).

Learning Requires an Ability to See Connections and Make Sense of Ideas and Concepts

Interoperability is a major tenet of the Web 2.0 landscape. The ability to use data from different

sources in a single application, as well as the ability to use the same application on different platforms, contributes to the openness of this landscape. By relating each of these back to core IT concepts, students are prompted to make connections between Web 2.0 technologies they learn in the classroom and real-world situations they may encounter later in employment or life at large.

For example, in one group assignment on wireless networking, students collaborate by using Google Docs (<http://docs.google.com/>), a web-based word processing tool with multi-user capabilities, to write their laboratory (lab) reports. This assignment creates an authentic problem scenario for which synchronous collaborative writing is a perfect solution (Herrington & Kervin, 2007). Each student contributes his or her “part” of the assignment to the group's document, editing from a different computer, either at the same or different times as their fellow group members. They must make sense of their own ideas within the context of the same document that their partners are editing at the same time, to determine where in its flow their ideas best belong.

This exercise also introduces students to the benefits and drawbacks of a collaborative desktop application that lives “in the cloud.” By requiring their use, students evaluate and master these Web 2.0 tools as part of their regular assignments.

Decision-Making is Learning

Connectivism suggests that an important way in which students learn is by making decisions about their own learning, and choosing what they will learn (Siemens, 2005). One way to learn about Web 2.0 is to select and investigate a collaborative or social media application, and apply O'Reilly's (2005) characteristics to it to determine what “makes” it Web 2.0. Students learn by synthesizing and applying these concepts to a tangible software application, then deciding the best way to present their findings to their classmates through a short video. Students evaluate the application, com-

menting on its ease of use and how it compares with other similar programs they know about, in addition to suggesting at least one possible enhancement to the functionality of the application.

Students are allowed to present their ideas in groups, where each group's presentation takes 10 to 15 minutes, and includes both a live demonstration and a PowerPoint slide show. Presentations are video recorded so students can later edit the videos and post them to the class pod/vodcast channel for peer critique and comments.

This assignment has several pedagogical benefits. It is one of the first collaborative assignments students complete; they must evaluate an application well enough to demonstrate, comment on, and recommend improvements for it; and they have to apply their understanding of an accepted general model—O'Reilly's (2005) Web 2.0 characteristics—to a specific case, determining which elements of the model are applicable. Finally, they create a collaborative work product to share with their classmates. Students demonstrate their mastery of several technical skills in order to post their videos to the class channel.

Another project introduces the use of the free Voice over Internet Protocol (VoIP) service Skype (<http://www.skype.com/>) as a new communication tool for collaborative learning and knowledge exchange. Students in IT 101 use Skype to converse with students studying a similar course at a university in another country (Chan, Frydenberg, & Lee, 2007) to produce a collaborative work product in the form of an audio recording. In order to complete the exercise, participants in each team (consisting of members from both countries) use a wiki page as a collaborative workspace to share resources and communicate in between scheduled synchronous conversations. They must decide what the content and format of their recording will be, who will participate, how to delegate responsibilities, and how to generate productive dialogue with peers about a topic with which they are just beginning to gain familiarity. They record and edit their audio conversations, making choices

about which clips to share and which to discard, and post the finished products online as podcasts to which others may listen.

Both of these examples show how “the Internet not only makes readily available a vast amount of information and resources but brings people together in a shared environment to exchange ideas, learn and engage in collaborative decision making” (Hamburg, Engert, & Anke, 2008, p. 153). Through collaborative decision making, students not only influence their own learning trajectories, but also those of others who are the audience of their completed presentations.

CHALLENGES OF TEACHING WEB 2.0

Teaching Concepts or Tools?

Teaching IT concepts “through the lens of Web 2.0” requires more than simply integrating blogs, wikis, podcasts, mashups, and social networking applications into the university or college classroom. These tools have found their way in to the digital fabric of students' online experiences. However, the specific tools will change over time; for an IT student the educational value of learning about any Web 2.0 tool is in understanding what it does and why it does it. Developing relevant problem-solving and decision-making skills enables students to make connections between identifying problems and specifying possible solutions, in a way that process of doing so will make an impact on their lifelong learning.

A downside to this approach is that students may become so caught up in the tools or websites they use that they lose sight of the key academic learning objectives—the course could easily fall back into a survey of Web 2.0 sites without looking deeper at their structure, or the impact that they have in on business and/or society. It is particularly important to “keep a balance between literacies and technologies” (Hicks, 2006, p. 51) to develop skills

that are transferable. This is crucial in both the K-12 (schools) sector as well as tertiary education. Creating a learning space that enables students to make the connection between the conceptual and the concrete is vital. Siemens (2005) says that participatory tools increase access to a network of people, ideas, and content. In connectivist learning, participatory tools also offer opportunities for conceptual learning through experiential activity that involves a global community.

While the collaborative nature of Web 2.0 encourages assignments that allow students to work together, a network of one does not support connectivist learning. With such a focus on group process, the simple act of assessing an individual's own acquired knowledge as the result of an exercise, rather than his or her contribution to the whole, becomes difficult and problematic. Students no longer live in a "fill-in-the-blank" world. Assessment tasks and evaluation methods need to evolve to ensure that networked, authentic learning is supported and that Web 2.0 tools and strategies are integrated.

Extending the Model

This chapter has discussed techniques for introducing Web 2.0 concepts in an IT classroom through the use of Web 2.0 tools. Certainly, several of the social and collaborative tools mentioned here can be—and have been—applied across the curriculum with success. The trend has been for tools to become so sophisticated that they hide underlying technologies and complexities, to the degree that anyone can create a mashup, web page, or video despite having little technical knowledge or experience. For the non-technical user, such applications open new possibilities in terms of creativity and communication.

What distinguishes the IT classroom from other areas is its focus in cultivating an understanding of the technology *and* experience in using it; in this vein the approach taken in *IT 101* results in a diverse Web 2.0 repertoire or "toolbox" that students can readily apply to all areas of their lives,

and that they will hopefully continue to expand and refine well after the conclusion of the course.

CONCLUSION AND FUTURE TRENDS

Web 2.0 is the result of the impact of advances in technology on a changing society constantly connected via the Internet. Portable computers and mobile telephones require software to be developed beyond a single device, necessitating a separation between data access and data presentation. The popularity of software as a service facilitates the move between different devices and platforms.

When considering Web 2.0 tools for classroom administration, tools for content creation must improve to the extent that the process of using them becomes transparent. Much in the same way that student expectations for instructors to post course handouts online prompted the development of automated LMSs such as Blackboard and WebCT in the late 1990s, today's demands for podcasting and participation will see traditional CMS applications integrate additional Web 2.0 functionality for classroom management.

To promote the teaching of Web 2.0 concepts in the classroom, tertiary teachers need to promote the active use of Web 2.0 tools by students. By integrating collaborative and social media applications in authentic learning environments, and creating opportunities for students to become both consumers and producers of classroom materials, students can experience the culture of participation that is central to Web 2.0. In the Web 2.0 classroom, the process is equally as important as the result: by encouraging students to explore, tinker, and experiment with tools they can build competence as well as confidence that will be crucial for continued lifelong and life-wide learning.

Some claim that "Web 3.0," the next stage in the evolution of the Web following Web 2.0, will be the "Semantic Web," where adding meaning to web content will enable machines and humans to

both read and understand it. (Berners-Lee, Hendler, & Lassila, 2001; see also Chapter 20 in this book). This is definitely an area open to research, first in development, and second in determining how to make these concepts accessible to students whose major is not in IT.

Tomorrow's university students will continue to embrace Web 2.0 applications, with little knowledge of the developments that led up to them. Incorporating Web 2.0 concepts in the classroom has many possibilities, and empowering students to use Web 2.0 tools to create learning artifacts—podcasts, blog posts, mashups, multimedia objects, tagged resource collections, and so on—and share them is a worthwhile endeavor with many potential educational benefits. A fundamental understanding of the origins and architecture of the Internet, coupled with an awareness of the social and ethical issues related to using the World Wide Web, will be even more crucial for tomorrow's students as they become informed participants and future leaders in a networked, Web 2.0-based society and knowledge economy.

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KEY TERMS AND DEFINITIONS

Application Programming Interface (API):

An interface exposed by software to enable programmers of other applications to write code to interact with it and use its services, without the need to understand its inner workings.

Blogs: Web sites on which users can easily post information and comment on one another's posts.

Connectivist Learning: A learning model that suggests learning is an ongoing process that occurs in networks, is facilitated by technology, and connects both people and knowledge.

Mashup: A Web 2.0 application constructed by combining data obtained from two or more other sources on the Web (e.g., an application that displays listings of houses for sale drawn from a real estate website on a map whose data is supplied by Google Maps.)

Social Networking: Web applications that facilitate locating and communicating with people who have similar affinities.

Tagging: The act of assigning keywords to digital artifacts such as images, websites, and videos so they might be easily found and retrieved (by the tagger him/herself and/or others) at a later stage.

Web 2.0: The shift in the use of the World Wide Web from static, “read-only” content to applications that promote collaboration, communication, and user-generated content.

Wikis: Collaborative web applications that enable users to post and edit one another's information.