
The Web 2.0 way of learning with technologies

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Abstract: While there is a lot of hype around various concepts associated with the term Web 2.0 in industry, little academic research has so far been conducted on the implications of this new approach for the domain of education. Much of what goes by the name of Web 2.0 can, in fact, be regarded as a new kind of learning technologies, and can be utilised as such. This paper explains the background of Web 2.0, investigates the implications for knowledge transfer in general, and then discusses its particular use in eLearning contexts with the help of short scenarios. The main challenge in the future will be to maintain essential Web 2.0 attributes, such as trust, openness, voluntariness and self-organisation, when applying Web 2.0 tools in institutional contexts.

Keywords: knowledge management; knowledge sharing; knowledge transfer; eLearning; education; communities; technologies; social software; Web 2.0; scenarios.

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1 Introduction

There is a new star shining through the clouds in buzzword heaven: Web 2.0. Although this concept has already received an enormous amount of attention in the internet industry and beyond, its implications in the context of learning technologies have, so far, not been properly explored. This paper plugs this hole by first providing the relevant background about Web 2.0 (Section 2), then moving on to investigate its implications for knowledge transfer (Section 3), and finally delving deeper into the particular contexts around eLearning, providing more concrete examples of how traditional approaches may become complemented or even replaced by a new way of doing things (Section 4). The conclusions (Section 5) make a particular point by paying attention to the underlying characteristics of Web 2.0, which are not at all limited to technological issues.

2 What is Web 2.0?

Web 2.0 is a term that was coined to summarise a set of key features, which has been gaining traction over the last few years. Since the Web 2.0 Conference (2006) organised by the publisher O'Reilly, first took place in 2004, the term Web 2.0 has been taken up by a lot of people, who now regard themselves as the Web 2.0 community. One interesting point is that the Web 2.0 movement itself uses mainly Web 2.0 technologies for communication and knowledge transfer. Up to now, however, there have been very few academic publications on the topic – but a lot of blog posts, wiki pages and discussions. Because of its collaborative nature and communication methods, Web 2.0 is an ambiguous, even polymorph concept, which is understood in different ways by different people. In this section, we aim to clarify different views on Web 2.0 and extract the essence of a definition of the concept. As Web 2.0 is partially defined through buzzwords representing the main concepts of the movement, we point out these buzzwords in italics throughout the paper.

2.1 Web 2.0 design patterns

There are many different ways to define the Web 2.0 hype and movement. A *Web 2.0 way* would be to not formally define it at all, but instead simply characterise it with the help of a lot of keywords that regularly come up in conversations about the topic. In the opinion of Tim O'Reilly, founder of the publisher O'Reilly and one of the most prominent Web 2.0 supporters, Web 2.0 is defined by eight simple principles called design patterns. In software engineering, design patterns are standard solutions to common problems in software design. In the context of Tim O'Reilly's explanation, they are understood as rough guidelines for bringing the characteristics of Web 2.0 into web applications. Any application adhering to the eight design patterns can be called a Web 2.0 application. Web 2.0 then is the set and network of those applications. A weak point in this approach is that many of the current Web 2.0 features are not integrated into this explanation. Using these design patterns, however, we can explain Web 2.0 and related concepts by integrating the most common principles in the generic design patterns approach. In the following eight subsections, we explain these design patterns, extending Tim O'Reilly's view with further concepts and buzzwords from the Web 2.0 movement to provide a more complete picture.

2.1.1 *The long tail*

The Web 2.0 community widely agrees that the term *the long tail* in the Web 2.0 context was coined by Anderson (2004). Originally, this concept was used in statistics to describe distributions that decline very slowly after an initial sharp drop. As a design pattern, the long tail means that it is not the top sellers and the most popular topics that make up majority of the web, but rather a huge number of specialised topics and small communities. A Web 2.0 application should therefore integrate and take advantage of the long tail.

2.1.2 *Data is the next 'Intel inside'*

Building on application features and performance is a common practice in software development in general. In Web 2.0 applications, data is of greater value than a feature-rich interface, as defined by the pattern *data is the next Intel Inside*. Taking for instance, the photo sharing system Flickr beta (2006), it can easily be seen that for many purposes, the onsite search for photos easily outperforms currently available online image search engines like Google image search or Yahoo image search in terms of yielding relevant results. So hosting and storing all available images and their metadata seems to be a key success criterion for providing a good image search. Other Web 2.0 concepts, which are strongly related to this concept, are *less is more*, where the interface and feature catalogue are reduced to the necessary minimum, and *simplicity and efficiency*, which states that the simplification and efficiency of an application are crucial to its success.

2.1.3 *Users add value*

Another key issue in Web 2.0 is the concept *users add value*, which means that users are integrated into the content creation process, thereby adding value to that process and its results. For example, Wikipedia (2006) users create and evaluate content for other users. The company maintaining the platform does not provide the data, only the facility for publishing and sharing. Having mentioned Wikipedia as the biggest example, it is worth mentioning that this concept also works great for small communities, for instance, for generating and maintaining software documentation within a collaborative process. Concepts related to this design pattern are *peer production*, saying specifically that the actual content is created not by a central authority by distributed peers, like how it is done on the front page of del.icio.us, where the bookmarks of users are presented in an aggregated way, and *co-creation*, more generally suggesting that multiple people work on the same creative activity, for instance, by writing books together cooperatively, like how it is done in Wikibooks. Note that content creation does not necessarily imply authoring in the traditional sense. By adding annotations and *social tagging* (adding keywords not restricted to a controlled vocabulary) of a resource, users add valuable metadata. Tagging leads to continually evolving superimposed structures, which are called *folksonomies* (in order to distinguish them from centrally designed and maintained taxonomies). Statistical analysis and interpretation of folksonomies lead to *tag clouds* and *tag networks and clusters*, which show dominant tags and interconnections of tags and tag groups. Using the data provided by users, providers of Web 2.0 applications can harness *collective*

intelligence (also called the *wisdom of the crowds* or *aggregate knowledge*), which means that through contributions of many people, an overall greater knowledge pool can emerge, as it happened in the case of Wikipedia.

2.1.4 Network effects by default

As it cannot be expected that everyone using a Web 2.0 application will explicitly add content for others, a big share of the actual users will be visitors or *lurkers* (Preece, 2000), which means that they are just consuming, not contributing to the content, like for instance, just reading blogs without having their own blogs. By analysing their use of the application, however, data can be generated, too. This in effect is a form of the *network effects by default* design pattern at work: The more users a service has, the more valuable it is to its users. In the example of an instant messaging service, the network effects would be that after reaching a critical mass of users, using the service becomes almost inevitable for staying connected. This is in accordance with Metcalfe's law, which defines a proportional relation between the value of a telecommunications network and the number of users of the system.

2.1.5 Some rights reserved

As the data created by users by default belongs to the creators themselves, an adaptable and flexible set of rights has been created, which is easy to understand and easy to apply. The set of rights, known as the Creative Commons (2006), is integrated using the slogan *some rights reserved*, which means that content within Web 2.0 is not protected by conditions as severe as, for instance, those common in the music industry, and therefore allows re-use of content and content snippets, like blog entries or images. This offers legal *remixability*, which stands for mixing and re-publishing content from different sources, such as displaying photos from Flickr on a Map provided by Google or Yahoo, and *transformation* of contents, as well as *mashups*, where different sources and applications are aggregated and combined to build up a new service, which is more valuable than each of the original services. A common example for a mashup is PackageMapper.com, where the routes of FedEx packages are visualised using the Google Maps service and the FedEx package tracking service. The concept of *microcontent* also supports this remixability. Microcontent stands for very small chunks of content, or more formally, a finite set of metadata and data pieces describing a small set of ideas, usually only one single idea.

2.1.6 Perpetual beta

As already stated above, features alone are not the driving force of Web 2.0 applications. Users want to know, however, that the software they are using is being continuously developed and that there is an active team integrating enhancements and fixing bugs. Therefore a typical Web 2.0 application does not have version or release numbers, but instead is entitled a *perpetual beta*, constantly evolving, never really leaving the beta state.

2.1.7 *Cooperate, do not control*

Providing platform and facilities for users to generate and share content, collaborate, communicate and publish details about their lives, interests and behaviours, which is typical for social software, implies that users trust application providers. This is to be achieved through the design pattern *cooperate, do not control*, which on the one hand, suggests that within the Web 2.0 environment, users who contribute their data expect to be treated with respect; and on the other hand, stands for being open to the outside. This includes the ability to mash up the services of a Web 2.0 application instead of providing a monolithic service with no possible connection to other platforms.

2.1.8 *Software above the level of a single device*

Last but not least, Web 2.0 should not be a web only for desktop computing, but should allow access through devices different from the standard home or office computer. Web 2.0 not only uses the World Wide Web as its main communication and presentation platform, which is reflected by the slogan *web as platform*, but also provides *software above the level of a single device*. Examples are Wireless Application Protocol (WAP, an internet protocol for mobile devices) interfaces, push services for mobile devices, or touch screen and pen or speech interfaces as input alternatives to keyboards.

2.2 *Web 2.0 timeline*

Weiss (2005) points out that Web 2.0 is not a phenomenon that appeared unexpectedly. He identified a first glance of Web 2.0 at least ideologically in the work of Bush (1945), who designed the Memex device in a thought experiment. Another milestone on the way towards Web 2.0 was the work of Licklider and Taylor (1968), who identified the computer as a communications device. In 1993 the World Wide Web (WWW) was set free from CERN and the success story of the Hypertext Markup Language (HTML) and the Hypertext Transfer Protocol (HTTP), which are the cornerstones of the modern WWW, began. In 1994, the World Wide Web Consortium (W3C) started its work on numerous standards, including those which now prove essential for Web 2.0, such as the eXtensible Markup Language (XML), Cascading Stylesheets (CSS), ECMAScript (aka JavaScript) and the Resource Description Framework (RDF). The first wiki, a concept and platform for collaborative information publishing and management, was created in 1995 by Ward Cunningham. In 1999, the now famous blogging service Blogger (2006) started, and beginning in the year 2000, blogs got more and more attention. Also in 2000, the Rich Site Summary (RSS) format for content syndication was introduced, and the term Representational State Transfer (REST), a simple protocol for the integration of remote software services, was coined by Fielding (2000). In 2001, the Wikipedia project put wikis in a new light. In 2002, the Web 2.0 photo sharing service Flickr became available and the first public web services offering remote services through a standardised Application Programming Interface (API) were deployed, *e.g.*, with the Amazon Web API and the Google Web API. In 2003, del.icio.us, the social bookmarking tool, was opened to the public. In 2004, the term Web 2.0 was disseminated through a new web development conference series. In 2005, the term Ajax (short for Asynchronous JavaScript and XML) was introduced by Garrett (2005) referring to the programmatic communication of a web browser application with a web server without reloading the actual web page.

2.3 Social software and Web 2.0 applications

A typical Web 2.0 phenomenon is *social software*. Social software uses the web as a collaborative medium that allows users to communicate, work together and share and publish their ideas and thoughts – and all this is done bottom-up with an extremely high degree of self-organisation. In theory, this was also possible with the WWW as it was initially defined by Tim Berners-Lee, but the technical complexity of web publishing (e.g., using text or hypertext editors to create web pages and uploading those using specialised clients for file transfer to remote servers) was far too high for the majority of non-technical people. Wikis and blogs – the poster child examples of social software – have solved this problem.

The *wiki* concept is simple and efficient. Using the simple and easy-to-learn wiki syntax, pages can be edited on the fly, within the browser, without need for editing markup source code or using file transfer clients. Links within wikis are bidirectional inside the wiki. Thus, not only the source page, but also the target page knows about the link, which is not the case in the traditional WWW. Links usually conform to a simple format called WikiWords. The content of wikis is rendered using web standards and can be accessed by most current web browsers. Famous examples of wikis in use are Wikipedia and the wiki of Cunningham (2006), who originally coined the term wiki and implemented the first wiki software. The term wiki is derived from the Hawaiian ‘wiki wiki’, which means ‘quickly’.

Blogs are another way to simplify self-publishing on the web. The Web 2.0 community agrees that the term blog was coined by Peter Merholz in 1999 and was initially meant to be a short form for weblog. A default blog provides a simple and intuitive structure as well as an easy to use and efficient interface. Like newspapers, blogs consist of articles, also called blog entries, which are sorted by their publication date, newest first. An article has a title, a publication timestamp, an article body or text and is usually assigned to one or more categories (or tags). Each article can be referenced by a fixed WWW identifier or link, called *permalink*. Using these permalinks, blog entries can be referenced or linked from other blog entries. Using *trackbacks*, the authors of the original articles are automatically notified and the links become bidirectional. The most prominent feature of a blog is the ability for syndication and aggregation of content using the *feeds* provided by blogs. Feeds offer the most recent blog entries in a machine-readable markup language to allow other software to read and use the content of the blog. Several different formats for feeds exist; the most important ones are RSS and the *Atom Syndication Format*. Blogs can instantly be created by average users through any one of the numerous blog platform providers, including big players, such as Google with Blogger (2006), without extensive knowledge of underlying protocols and mechanisms, or by installing blog software like WordPress – Free Blog Tool and Weblog Platform (2006) on a web server.

Furthermore, a whole group of *social bookmarking* tools exist and are used extensively by the Web 2.0 community. A social bookmarking tool is identified as an application used for storing and sharing bookmarks (Hammond *et al.*, 2005). Simple and straightforward implementations, such as del.icio.us (2006), allow storing and sharing of bookmarks as well as annotation and tagging of the hyperlinks. A common feature are tag clouds, which visualise the usage of tags. Moreover, statistical analysis of the tags permits tag recommendation and the detection of related tags, as well as of relations between Universal Resource Identifiers (URIs) and users. Other features include storing

the entire content of bookmarked web pages in a cache for the purposes of later retrieval, indexing, and preserving their content as it appeared at the time of the original bookmarking. This is exemplified by LookSmart's Furl (2006). Since the basic idea is obviously related to that of citation indexes, some services such as BibSonomy (2006) integrate bookmarks and BibTeX references.

Another common term in the Web 2.0 movement is *WebOS* (Adler, 2005). In general, this means that everything that normal users need can be started and run within a web browser. There are several classes of WebOS applications. Most interesting are word processors, such as Writely – The Web Word Processor (2006), which allow collaborative work on documents. These tools include a lot of features, such as exporting to Adobe PDF or Microsoft Word and versioning of the document, as well as the visualisation of changes made to the document over time by different authors. Tools for collaborative spreadsheet creation and maintenance are also available, as are calendars, to-do lists, task organisers and whole online Personal Information Management (PIM) suites. Adding collaborative aspects to PIM, Erickson (2006) uses the term GIM, which stands for group information management. GIM differs from more traditional web-based groupware solutions by integrating Web 2.0 ideas and concepts such as openness, simple access and rights management and more collaborative environments.

Another aspect of WebOS is the availability of instant messaging within browsers, as implemented by meebo.com (2006) and Gtalkr (2006) for multiple instant messaging protocols. Google Mail (GMail) goes a step further and integrates chat logs from Google Talk into the GMail interface for later retrieval and browsing. Pageflakes – The whole Web at your Fingertips! (2006) and Protopage v2 (2006) – offer the ability to create personalised portals or mashups by remixing content of Web 2.0 services, such as weather forecasts, blog feeds, search engine shortcuts and quick links. Such tools are called *Web 2.0 Desktops* or *Ajax Desktops*.

2.4 Technologies for Web 2.0

The most prominent technology and quasi standard is *Ajax*, short for Asynchronous JavaScript and XML. Ajax allows downloading and uploading content from and to a web server using JavaScript from within a web page without reloading the web page as a whole. The content of a page is modified using the Document Object Model (DOM) with JavaScript based on the results of the download or upload process. Ajax communication is most commonly performed using XML. Communication relies on the *REST* model, which was defined by Fielding (2000). REST provides a simple definition of client-server communication using standard web technologies, such as the HTTP. Following the REST view of client-server communication, Web Services are a complicated implementation of the REST model.

Syndication and remixing of content is usually accomplished by using feeds offered in Atom or RSS formats. Atom is XML-based and was especially designed for blogs, while RSS is based on RDF and has run through multiple versions, which are not compatible with one another.

2.5 Web 2.0 and the semantic web

While talking about Web 2.0 technologies, an obvious question turns up: Some aspects are evidently taken from the Semantic Web. Does Web 2.0 have something to do with the Semantic Web? To clarify the connection, we compare the Web 2.0 movement to the definition of the Semantic Web by Tim Berners-Lee, as it was published in the foreword of Fensel *et al.* (2005), identifying not only differences, but also synergies.

According to Berners-Lee, the Semantic Web is the realisation of aspects of the original idea of the web. In the original vision, each web page was meant to describe a specific concept or real-world object. The web pages are interconnected by typed links, which represent relations between the concepts and real-world objects. The web and its structure should support people in their work; it should be a medium for communication between people.

This original idea of Tim Berners-Lee, especially the last part, is the core idea behind the Web 2.0 movement. In a way, Web 2.0 is the collaborative web Berners-Lee has dreamed of, and provides collective intelligence to support people. The typed links are partially integrated in Web 2.0, for instance through folksonomies (*e.g.*, in social bookmarking, defining relations between URIs and users) and trackbacks (defining a relation ‘this article is about ...’).

In his analysis of the then current situation of the web (in 1997), Berners-Lee states that *intuitive hypertext editors* would become available within the next 12 months and that searching the web will no longer be possible without proper and machine-readable metadata. Putting this into perspective today with Web 2.0 in view, the following can be said: Intuitive hypertext editors are still not available (more than eight years later), but blogs have proved a killer application, as they do not assume that people understand hypertext concepts or can handle different protocols and tools for web page maintenance. Furthermore, the web (at least the surface web) is still reasonably searchable without exploiting semantic web metadata, as for example, Google does by applying the PageRank algorithm to rank search results. Proper and machine-readable metadata has not proved useful in Web 2.0 as the time and effort of the users (compared to a folksonomy) do not justify the benefits.

Tim Berners-Lee also talks about a web of subscription-based distribution, which was implemented in Web 2.0 using feeds and *feed aggregators* that combine and remix feeds. The RDF standard, as defined by the W3C, was meant to offer a way to mix and bring together metadata. In Web 2.0, it is used to remix the data itself. The Semantic Web should become – according to Berners-Lee – a *web of trust*, enabled by a number of complicated encryption and signing standards and processes as well of certificates and chains of signed certificates. The concept of trust in the Semantic Web is a very formal one. Web 2.0, by contrast, implements another concept of trust: By reviewing services, applications and providers, by publishing the reviews and by reading reviews of other users, people can assess trustworthiness. While the Semantic Web allows a user to forget about trust and mistrust as browsers and other clients can handle trust issues fully automatically, in Web 2.0, trust is in the responsibility of the user, but the judgements involved are made easier by characteristics of the applications.

Tim Berners-Lee identifies a need for tools that map one’s data to the web. The whole Web 2.0 movement is about data. Data is the driving force in it. The main success criterion of Web 2.0 is that it makes it easier for users to share their data with others.

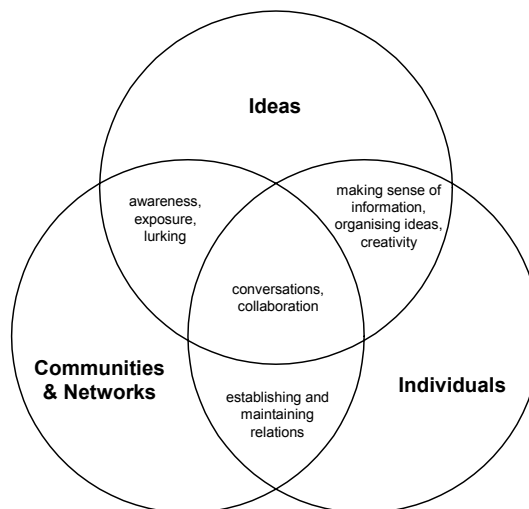
Another concept of Berners-Lee is the *interactive creativity*, which he defines as *creating things on the web together*. This also has been realised in Web 2.0 with numerous social software tools and applications.

Comparing the vision of Berners-Lee with the current state of Web 2.0, it can easily be seen that similar targets have been aimed for. However, there is a major and severe difference between the Semantic Web and Web 2.0: The Semantic Web is a web for machines and software agents, readable, understandable and interpretable by software with no place for misinterpretation, implementing formal and deductive semantics. The Semantic Web is defined by standardisation bodies, such as the W3C and OASIS, and will be adapted further by industry. Web 2.0, on the other hand, is much more focused on people. It reflects the collaborative nature of human society and generates value-added to the traditional WWW. Web 2.0 cannot be pressed into a formal standardisation, it is a flexible, even polymorph concept. The semantics of Web 2.0 – the collective intelligence – are collaborative and inductive. To evaluate and summarise the success of both concepts: While the Semantic Web has been formally defined and partially implemented after the definition phase, Web 2.0 has organically grown out of the WWW and has been recognised as new concept afterwards. Since the aims of both movements are not contrary, however, both communities can profit from each other. As the Semantic Web provides new and well-designed technologies, Web 2.0 will adapt, implement and use them.

3 Web 2.0 for knowledge transfer

Armed with a better understanding of what the whole Web 2.0 movement is all about, we can now proceed to consider its implications for knowledge transfer. We will do so with the help of a general framework for knowledge work analysis (depicted in Figure 1), which was developed by Efimova (2004) specifically to overcome the limitations of most traditional models with regard to the new realities of the web. We have selected this one over other popular models (which typically are either centred on knowledge management processes or break down characteristic Web 2.0 features) because of its better suitability for structuring our discussion of knowledge transfer in a Web 2.0 world.

Figure 1 Framework for knowledge work analysis according to Efimova (2004)



Individual knowledge workers interact with Communities & Networks of people, but also with other resources of knowledge work: Ideas, and the content elements and technologies used to represent and to manipulate them. The point here is to pay proper attention to all the areas of intersection.

3.1 Individuals and Ideas

Where do individuals get their ideas from in the first place? The blurring of the boundaries between face-to-face classes and online courses has not just happened because of particular strategies by educational institutions; indeed, individuals sometimes even act against such strategies by choosing the online version over the classroom in spite of living on campus, simply for reasons of convenience (Pope, 2006). The Web 2.0 philosophy of *less is more*, of pursuing *simplicity and efficiency* with little regard to the conventional way of doing things, caters to this desire for convenience by lowering the (perceived) complexity for users.

Furthermore, the Web 2.0 emphasis on *microcontent*, the *remixability* and *transformation* of content provides the same benefits as the idea of learning objects in traditional eLearning systems, but in a much broader fashion. This is not just an issue of technology: Many members of the Web 2.0 community regard it as their (moral) right to remix content, which of course flies in the face of traditional business models based on restricted access to intellectual property. However, the increasing use of Creative Commons licenses (Creative Commons, 2006) and related efforts, such as Science Commons (2006) and the Open Access movement (Budapest Open Access Initiative, 2006; Open Access Conference – Berlin Declaration, 2006) in academia make such an approach ever more feasible also from an economic and legal perspective. The traditional publishing industry has already made first steps in this direction, too: Primis Publishing (McGraw-Hill's Custom Publishing, 2006), for example, provides ebooks tailored by instructors for their individual courses, combining material from different areas and sources.

Much as content is increasingly seen as continually evolving rather than being frozen in definite versions at certain times, the underlying technologies of Web 2.0 services are typically considered to be in a state of *perpetual beta*. Thus the expectations of individuals are also changing with regard to the technologies they use, again in contrast to traditional, release-based IT support of knowledge transfer.

3.2 Communities & Networks and Ideas

Where communities meet ideas, the central Web 2.0 tenet of *the web as a platform* comes into its own. Again, this concerns both content and technology: While the *peer production* and *co-creation* of content and superimposed structures (typically through *social tagging*) are of course the real drivers behind many Web 2.0 success stories, this principle also extends to composite applications, such as *mashups*. The point here is that signature technologies of Web 2.0, such as *Ajax*, *REST* and *RSS*, make it much easier than ever before for communities to exploit readily available content and services by tying them together in new ways. This lightweight approach is of course ideally suited to quickly and easily create novel functionalities and applications for knowledge transfer on a just-in-time basis, whenever the need arises.

Emergence arises in two forms. First, there is the creative aspect: Through community interaction, more ideas are created than would have been created if the individuals making up the community had worked on their own. Second, there is the establishment of common ideas, a kind of institutionalisation of memes that prove successful at gaining traction.

The Web 2.0 way of doing things also makes it easier to address ever larger segments of the *long tail*. Traditionally, specific knowledge transfer for very small target groups used to be either expensive or not available at all. Web 2.0's nature as a platform allowing easy contributions even by average users, however, leads to both quantitatively more and more specifically targeted content and functionalities for a wider variety of niches than previously, thus conquering the long tail of knowledge transfer.

3.3 *Individuals and Communities & Networks*

Typical Web 2.0 services either are pure *social software* or at least incorporate aspects of it. Irrespective of whether this is their primary purpose or not, they therefore encourage users to establish and maintain relationships. Given the amount of attention that communication features and learning from peers (not just instructors) have received even in the traditional eLearning context over the past few years, it is easy to see that this strong social streak in the Web 2.0 movement directly plays into the hands of any effort to increase knowledge sharing and transfer.

Network effects also stand to become even more important, as students will already have ties with a number of virtual communities by the time they enter an educational establishment, and these students will continue to draw on those throughout their education (Wilson, 2006). Furthermore, network effects, which in the beginning were limited mainly to communication (the prime examples being e-mail and the instant messenger wars), are now not just strengthening their hold in that domain, but increasingly also making themselves felt when it comes to content residing in various systems. This already takes us into the triple intersection of Individuals, Communities & Networks, and Ideas.

3.4 *Individuals, Communities & Networks and Ideas*

At the heart of it all – of the framework for knowledge work analysis of Web 2.0, and of knowledge transfer – are conversations: individuals engaging with the community through ideas. Conversations are of particular importance during the sense-making phase of knowledge transfer and learning, where diversity plays a key role. In fact, this is one of the reasons why some people prefer online discussions to classrooms (Pope, 2006). The trend on the web today is that more and more conversations are not limited to a technological setting (such as a particular discussion forum) or a particular context (such as course) any longer. Instead, threads of a conversation are picked up across the web in various contexts and with the help of different technological means.

Overall, the Web 2.0 approach leads to more sharing taking place. On the one hand, this is due to the fact that new technologies are making it easier – witness the explosive growth of *syndication*. Originally mainly used for *blogs*, RSS is now also employed by sites ranging from community *wikis* to major national newspapers to local commuter route congestion information. On the other hand, more knowledge sharing is also happening because many Web 2.0 sites have strongly emphasised social aspects. What

was once typical only for fairly narrow communities such as Slashdot: News for nerds, Stuff that matters (2006) has now become mainstream and dispersed. Indeed sharing is central to the Web 2.0 philosophy, as evidenced by its slogans *cooperate, don't control, harnessing collective intelligence, and wisdom of crowds*.

In addition to more sharing taking place, the Web 2.0 approach also makes the content being shared more accessible and more useful to individuals. *Trackbacks, folksonomies, mashups, and software above the level of a single device* are obvious examples. On a more abstract level, collaborative filtering/recommender systems, long discussed in technological circles, have finally found broad (and community-driven, bottom-up) adoption, and have proven more effective than traditional editorial processes in many contexts. In economic terms, this means that the transaction costs of procuring suitable content externally are decreasing much more rapidly than the coordination costs of achieving the same within an organisation.

Finally, the whole movement is very much in the spirit of the *law of unintended uses*. Web 2.0 provides an unprecedented breadth of (content and technology) building blocks of fine granularity, and convenient access to suitable glue. As a consequence, its elements constitute a particularly fertile ground for knowledge sharing and transfer, irrespective of whether they were originally envisaged with that end in mind or not.

4 Web 2.0 in an eLearning scenario

In this section, we aim to (a) highlight advantages of social software over traditional eLearning Management Systems, (b) relate the framework for knowledge work analysis to educational settings, (c) report on the findings of preliminary explorative investigations and (d) discuss potentials and pitfalls of Web 2.0 applications in educational contexts.

4.1 Drawbacks of traditional eLearning management systems

Even though traditional eLearning Management Systems (eLMS) are of course appropriate in a number of learning scenarios, several factors limit their usability in educational settings. A lack of interaction and communication support often prevents peers from collaborating effectively in a virtual environment. Social factors, such as trust (Fisman and Khanna, 1999) and motivation, frequently are not sufficiently considered by such systems. The high degree of structure that is dominant in current eLMS often hinders their effective application in creative settings and limits self-directed and responsible behaviour of learners. The processes that come with the implementation of large eLMS (customisation, roll-out, change management, training, *etc.*) are also often prohibitive for small schools with limited budgets. Consequently, traditional eLMS pose a series of problems. We therefore investigate the potentials of integrating lightweight Web 2.0 applications for the purpose of facilitating self-directed, collaborative and responsible learning in educational settings.

4.2 Knowledge work analysis in education

When relating the knowledge work analysis framework to educational settings, the set Individuals relates to students, teachers and tutors. Communities & Networks relate to classes, schools and other educational networks. Ideas relate to the distributed pieces

of knowledge that individuals generate and make sense of. Ideas fuel conversations and collaboration between and within communities. Web 2.0 applications can be conceptualised as a set of applications that represent suitable containers for ideas. They are suitable because of their special capability to equally reach out to individuals and communities evident in Web 2.0 characteristics, such as *microcontent*, *remixability* and *network effects*. In the light of the knowledge work analysis framework, a teacher-class relationship is part of the intersection set of Individuals and Communities & Networks. The same goes for a student-class relationship. However, they may differ in (a) the type of ideas they exchange (theoretical versus practical knowledge) and (b) the way they exchange ideas (*e.g.*, formal versus informal learning). A teacher-teaching material relationship falls under the intersection of Individuals and Ideas, as does a student-teaching material relationship. The relationship between a class of students and teaching materials falls under the intersection of Communities & Networks and Ideas. The conversations and collaboration occurring in a class involving students, teachers and ideas are found at the intersection of all three sets.

4.3 Web 2.0 applications in educational settings

For the purpose of exploring the applicability of Web 2.0 software, we consider qualitative empirical evidence from Web 2.0 applications in three educational settings. We deliberately introduced Web 2.0 applications into our work with students, not just because they seemed appropriate for the job, but also with the intention to identify benefits and drawbacks, to derive interesting research questions, and to get closer to their evaluation. Thus, the scenarios have an explorative character. Apart from obtaining details for our own research, we want to provide ideas for future research questions and to raise awareness for the need to follow a systematic approach when adopting Web 2.0 applications.

Against this background, all three scenarios are organised as follows: First, the educational situation that was supported by a Web 2.0 application is outlined and the reasons for selecting the application are given. Second, the concrete realisation is described. Third, the observed benefits and drawbacks are listed. Finally, one benefit or drawback is singled out as an example of how a systematic evaluation could look like: A research question is formulated and a suggestion for a focused analysis is made.

4.3.1 Scenario 'documentation': student-ideas relationship

Situation

Typically, students and pupils are required to do internships, and companies offer internships. Usually, there is one supervisor at the educational institution sending off the intern and another supervisor who coaches the intern at the company. Both need information about the progress of the intern, since they have to integrate the achievements into assessment, and to decide whether the intern makes a contribution to the company. This requires a continuous observation of the intern, which generally is done by the supervisor at the company where the internship is accomplished. The supervisor from the educational institution is usually informed about the achievements by a report written during internship or by discussions with the intern and/or the other supervisor.

Selected application

With the purpose of reducing expenses for everybody concerned, the Know-Center decided to use blogs for supervision. Blogs were chosen for the following reasons: All supervisors, even remote supervisors, can easily track the progress of the intern and give him/her immediate feedback. Via comments, they can engage in the work of the intern, guide and support him/her, and also provide him/her with content. Also, supervisors can communicate with each other. The intern can easily publish his work and better reflect his progress. Moreover, final reports, if required, can easily be prepared by integrating already existing posts.

Realisation

In 2006, the Know-Center had three interns who were required to operate blogs. Even though not familiar with blogs before, the interns autonomously set up their blogs. First, they published their working plan, which was predefined by the supervisors. At least every two days, the interns had to write about their activities and relate them to the working plan. The supervisors, as well as other employees and colleagues of the interns, regularly gave feedback and communicated with the interns. At the end of the one-month internship, the interns wrote a report on the basis of their posts.

Benefits and drawbacks

From an informal evaluation consisting of a discussion about benefits and drawbacks, we learned the following lessons:

- Interns benefit from immediate feedback and the content provided via blogs.
- Interns find it useful to have an environment where they can manage all relevant information.
- Supervisors like the fact that interns can be reached easily and anytime.
- A personal relationship between intern and supervisor is hard to establish.
- Interns feel stressed by information overload: They find it hard to process all the provided information, select from it, and integrate it.

Research question

From these benefits and drawbacks we, by way of example, pick the last one for deriving a research question: Is there a critical number of contributions to a supervision blog, which guarantee an optimal supervision?

For evaluation purposes, we recommend to consider the following design aspects. Of course, we do not claim completeness and want to state that there exist alternative ways for evaluation, but we do want to show how such a research question could be addressed:

- Supervised students are assigned to groups that differ by the amount of feedback they are given by their supervisors.
- For holding conditions constant, the following restrictions are made: There is only one supervisor giving feedback; feedback is only given in the form of textual

statements (meaning no links or documents); duration of the internship is the same for all students; and all students belong to one group. Of course, these conditions can be varied, but they must not differ between groups.

- For assessing the quality of supervision, first the term must be defined and indicators representing supervision must be found. Such an indicator could consist in the number of feedback items integrated into the final report of the student or in the number of feedback items a student rates to be helpful.

4.3.2 Scenario ‘communication’: teacher-class relationship

Situation

In higher education, students take a lot of courses in parallel. Knowledge apart from that presented in class is also important. Many higher education classes are supported by communication tools used by teachers and students to distribute content related to lectures. These tools include mailing lists, newsgroups (with posts being archived on a news server) and web pages (where mainly teachers and tutors compile additional content and information for the class). All three methods have their own benefits and drawbacks. While mailing lists provide a method for closed discussion, they do not provide an archive of contributions in their original form, like newsgroups do. Web pages can be used as a centralised information point, for which a web browser as client software is sufficient, but do not provide a standardised structure for information management and discussion.

Selected application

Most lectures at the Graz University of Technology offer additional information and content on systems ranging from simple web pages, newsgroups and straightforward online bulletin boards to extensive knowledge and content management or online learning systems. In an effort to achieve harmonisation, we decided to use blogs as our main lecture support system. This allows the presentation of supporting materials using the temporal structure of weblogs and offers comments and trackbacks as feedback methods. Static content, such as course schedules, can be integrated and administered using blog posts linked from a web page menu. Recent changes and additions to the lecture support system are reflected in the blog feeds.

Realisation

Within a class on knowledge technologies for computer science students at the University of Technology Graz in the Summer term of 2006 we set up a blog for teacher-to-student communication. Relevant information was posted as blog entries and students were able to subscribe to blog feeds using their favourite mechanism or tool (*e.g.*, live bookmarks or a blog reader) and could comment on the blog entries. Moreover, a common trackback mechanism allowed students to add information from their own blogs. An additional polling component was installed, allowing students to rate certain statements (for example, ‘The last lesson was far too difficult to understand.’) and to submit suggestions anonymously to the class.

Benefits and drawbacks

Within our experiment, 20 students attended the class. From informal discussions with the students and unstructured written feedback, we learned the following:

- Students did not use blog comments and trackback as feedback channels. They stated that writing comments and blog articles required far too much time for writing.
- The polling system was used more often, because it required just a single click and the feedback was anonymous.
- Students noted that the blog provided a much better interface to additional information than newsgroups and mailing lists and, compared to web pages, had a more intuitive structure.
- The feed mechanism was used by most students and was appreciated a lot, as it integrated nicely with common web browsers and feed readers.
- The teacher noted that the maintenance of a blog for a lecture is far easier than the maintenance of a website, as well as superior, in presentation and functionality, to newsgroups and mailing lists.

Research questions

These findings underline a main benefit of blogs: They provide a simple structure, which many find intuitive and easy to use. In contrast to the students' feedback about the intuitive interface of blogs, they did not use the commenting or the trackback features of the weblog. This raises the following research question: Can the two-way communication between teachers and students in the context of a lecture support system, especially the feedback channel from teachers to students, be enhanced with blogs?

To answer the research question, a more extensive study of this specific aspect of blogs has to be conducted. The following approach could be taken to investigate this research question:

- Set up two different groups of students enrolled in the same course.
- Provide two different support systems to the course: (a) the blog and (b) a more traditional lecture support system such as a mailing list, a newsgroup, a homepage or an eLMS.
- For making the two chosen systems comparable, some aspects must be held constant: The same materials should be provided. Format, quantity and quality of feedback should be alike.
- Since the question is whether the feedback can be enhanced, it must be determined what characteristics define a good feedback. Then these characteristics must be translated into observable indicators. Such indicators could be the estimated degree of helpfulness of comments or, again, the extent to which feedback is picked up by the students.

4.3.3 Scenario 'participation': class-teaching materials relationship

Situation

In many universities, there are courses with a large number of participants attending, especially in the basic studies period where students from different degree programmes are offered the same courses. Usually, lecturers and/or tutors provide different learning materials and accept questions or suggestions from students. Students often have to do project work alone or in teams, guided by a lecturer and/or tutor. Within the teams, students exchange information and perform their own project management. Of course, students exchange learning materials also beyond group work.

Selected application

Wikis appear to be very well suited for this situation. Despite being geographically spread, students who work in a team can easily exchange and integrate information via the wiki, and develop their results together. In the same environment, learning materials can easily be provided and exchanged. Moreover, supervision can also take place via the wiki.

Realisation

At the Graz University of Technology, there is a lecture on software engineering with about 200 students, supported by a tutor working with us. A wiki is provided, and participation is mandatory. Students who work together on a topic – usually ten students constitute a team – set up and use a group site, which allows them to exchange, collect and integrate knowledge; manage their project; and communicate. The tutor uses these sites for monitoring the groups' progress and supporting them. Moreover, lecture notes are provided that can be supplemented and updated by the students themselves.

Benefits and drawbacks

From an informal evaluation about benefits and drawbacks, we learned the following:

- Information artefacts can easily be made available and exchanged via the wiki.
- A concise structuring of complex and comprehensive topics is possible.
- Participation in editing the lecture notes is rather low.
- Supervision is facilitated compared to conventional supervision via consultation hours and e-mail because the tutor gets a good overview and thus can better prepare the answers and support the students.

Research question

The last point leads us to the following research question: Is supervision of team work via a wiki more effective than conventional supervision via consultation hour and e-mail?

An evaluation study could, for example, look like this:

- The working environment for all the students is the same; they organise and carry out their work on the wiki. But regarding supervision, students are divided into two groups: One group is supervised via consultation hours and e-mail and one group is supervised via the wiki.
- Supervision via the wiki is performed by the tutor writing comments on results, providing suggestions, and answering the questions of students (which they also post on the wiki). Of course, the form of supervision can also be organised in different ways. All other circumstances, however, must be equal; for example, the number of students in the group and the kinds of problems they have to deal with.
- Most notably, it must be decided what is meant by effectiveness of supervision and how effectiveness can be measured so that the groups can be compared with each other. Relevant indicators could be the number of repeated questions concerning a certain problem, the satisfaction of the students and of course, the grading of the project reports.

4.4 Potentials and pitfalls of Web 2.0 applications in educational settings

The recent emergence of Web 2.0 applications leads to a plethora of promises by enthusiastic technologists and pedagogues. Arguments include that Web 2.0 applications increase self-directedness and responsibility of students, enable learning beyond the classroom, enhance the critical usage of internet resources and allow for cross-class and cross-school learning. We have investigated these promises by means of explorative analyses that were designed to lay the basis for future empirical research. Although we acknowledge the potentials of Web 2.0 applications in educational settings, we would like to point out potential pitfalls as well.

At the time of writing, many of the most promising Web 2.0 applications have not been around for more than 24 months. Often they are funded by venture capital firms with no profound business models available yet. This leads to a series of problems for educational organisations: By utilising Web 2.0 applications, they relinquish control over some of their technological infrastructure. This increases the reliance of schools on the promises made by start-up companies. The future development of these companies and the services they provide is hardly predictable at the moment. This increases uncertainty for schools and higher education institutions who decide to adopt this technology beyond the stage of pilot applications. A way of hedging this risk would be to install similar technologies on school-owned servers ('owning the content'), which would, however, conflict with some of the introduced characteristics of Web 2.0 applications and limit the ability of schools to profit from those effects, *e.g.*, the *perpetual beta* and *network effects*.

5 Conclusion and future work

Web 2.0 applications open up a broad range of new possibilities for educational institutions, and indeed this is being realised not just by individual instructors employing Web 2.0 tools in their classes, but also by first efforts at integration (elgg.org, 2006). We must, however, also be aware of the limits. Applications and their functionalities might fit the goals of educational organisations, but it will be hard to transmit essential attributes

of Web 2.0 – trust, openness, voluntariness and self-organisation – into many of the existing institutional contexts. As soon as we exploit Web 2.0 applications for organisational purposes, and for that reason define concrete aims and impose structure, there is the danger that the very character of Web 2.0 might get lost in the process. Thus, the greatest challenge will not consist in finding use cases and arranging applications, but rather in maintaining what really defines Web 2.0. Because without trust, openness, voluntariness and self-organisation, these applications will simply not succeed. A particularly promising area for empirical investigations in that direction seems to be workplace learning. Work is already underway in that direction within APOSDLE (2006), the leading European project in this field.

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