

**Web 2.0 technologies for learning: The current landscape –  
opportunities, challenges and tensions.  
Supplementary materials**

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## Introduction

These supplementary materials accompany the report 'Web 2.0 technologies for learning: the current landscape – opportunities, challenges and tensions', which is the first report from research commissioned by Becta into Web 2.0 technologies for learning at Key Stages 3 and 4. It is based on a review of the current literature and thinking around Web 2.0 and its potential in education. Further reports based on empirical research into Web 2.0 use in education are due later in 2008.

The main report can be downloaded from the project [webpage](http://partners.becta.org.uk/index.php?section=rh&catcode=_re_mr_02&rid=14543) [http://partners.becta.org.uk/index.php?section=rh&catcode=\_re\_mr\_02&rid=14543]:

## Appendix 1: The evolution of Web 2.0

- **Web 0: The personal computer**
- **Web 1.0: The receptive computer**
- **Web 1.5: The emancipatory computer**
- **Web 2.0: The social computer**

The emergence of what has become known as 'Web 2.0' is traced below in relation to the general growth of personal computing. That history is organised in terms of four periods.

### Web 0: The personal computer

The technology acronym 'PC' is inherited from the era when it became apparent that anyone might own a computer: in short, the technology had become 'personal'. Prior to the PC, computers were actually much more social than they were personal: much more an experience with others than a solitary experience. At that time, the technology came in a large cabinet that often attracted an agreeable buzz of sociable activity around its presence. However, physical components of the hardware became smaller, faster and cheaper. Moreover, software evolved to make using it more accessible. So the computer migrated from the 'machine room' to the office desktop and from there to the various spare rooms of domestic life. Now it seems to be everywhere, including, of course, the classroom.

Yet its entry into education has not been easy. At this early point, many teachers became wary of this all-too-personal technology. Not least because research observers of its use in both work and play were documenting a rather compulsive pattern of engagement (Kidder, 1984; Levy, 1984; Shotton, 1989; Turkle, 1984; Weizenbaum, 1976). Some feared this might put young people at risk of retreating into a socially reclusive world of games and programming (Boden, 1977; Bontink, 1986; Simmons, 1985). Educators wrote about how this might lead to a mechanistic

model of human mentality being fostered in the classroom (Murphy and Pardeck, 1985; Sloan 1984). Typical of such personal computer concerns at the time, Kreuger, Karger and Barwick (1989) cautioned against technology cultivating within learners 'thought in isolation' (p. 113), predicting that 'What is learned, then, is passivity and alienation from oneself and others, and that the most fruitful relationships with people will be as passive and impersonal as the solitary interaction with the computer' (p. 114). In short, a worry about the personal computer as an isolating technology was a common thread in educational critiques during this 'Web 0' period (cf. Baker, 1985; Moore, 1993). Delight in eroding such concerns has been a recurrent theme among internet enthusiasts.

### **Web 1.0: The receptive computer**

In parallel with a diffusion of inexpensive desktop technology came the development of the internet: a resource that would destabilise any tendency of computers to isolate. From an early point, the internet was a technology for sharing. It was stimulated by the appetite of research scientists for trafficking text and data across a network of computers. As often happens with new technology (cf. Noble 1991), the real elaboration of this networked sharing arose from military research needs. These led to the creation of the larger scale network (the Arpanet) that, crucially, drew in the wider academic community of higher education. It was upon this infrastructure that Tim Berners-Lee conceived of a set of protocols and designs for easing that exchange of files: the consequences of which suggested the descriptive phrase 'world wide web'.

The image of this first internet might suggest a set of nodes: sites joined to each other in this web that allowed a two-way exchange of useful digital material. Today, this could be talked about as a network structure that was largely 'peer to peer'. In such a structure, it is not surprising that some nodes began to be highlighted as of special importance. Indeed, some nodes would become significant key points in the traffic flow. Here might be assembled centralised repositories for information: perhaps of value to the whole community of sites joined up this way. Opportunities for financial income, or opportunities for prestige could cultivate a site's ambition to acquire this importance. As the internet extended to include more mainstream commercial interests – beyond those simply demanded by the research community – so it was to be expected that more such focal sites would populate the network. However, their main purpose was only to deliver products in the familiar one-way traffic of commerce. This delivery-and-receipt internet structure was the dominant experience of early World Wide Web use. Accordingly the receptive computer on this early internet might define the very first version of the web and, therefore, encourage the label 'Web 1.0'.

It cannot be said that the internet of this period was an entirely delivery-only, or passive experience for the user. Evidently, email was a popular application from an early point. Indeed, it was quickly recognised as a 'killer application' – a single activity that drew in a significant population of users. Indeed, email communication is documented within university teaching and learning from the early 1980s (Crook, 1988). Similarly initiatives such as the 'Times Network for Schools' (TTNS) resourced primary and secondary teachers for the development of email-based links with distant classrooms, particularly where cross-cultural connections were possible (Pollitt, 1987).

Nevertheless, the actual experience of email retains a 'delivery' quality. Text message files are routed to mailboxes rather than any other type of file might be downloaded. The distinctive aspect of email is the manner in which the tools empower each and every individual user to become the source of file transfers. Yet, as social activity, the practice remains rather mechanical in a way that metaphors of 'post' and 'deliver' imply.

A step towards a more comprehensive socialising of the internet arose as email traffic fractured into discussion lists ('listservs') or bulletin boards: popular forms of text communication that allowed users to join a community within which members could post text contributions to a shared mailbox. Also, at about the same time, there emerged a species of networked software that helped people collaborate when they were geographically or temporally dispersed. It became known as 'groupware' (Johansen, 1988). It established a set of practices for using technology that became known as 'computer supported collaborative work' (CSCW, Grudin, 1994) or 'computer supported collaborative learning' (CSCL, in for example, O'Malley, 1994). However, groupware thrived on *local* networks. Such coordination needed to migrate to the internet more widely and thereby shape much larger communities of users.

### **Web 1.5: The emancipatory computer**

The emancipation that characterises recent internet development is one that extends the groupware idea to a more articulated version of a socialising network. To introduce the direction of such recent internet growth, we can make good use of the words of an experienced technology observer, Thomas Erickson. He comments 'Something curious is happening on the World Wide Web. It is undergoing a slow transformation from an abstract, chaotic, information web into what I call a social hypertext'. This observation expresses a modern sense of a transformation (new 'versions' of the web), coupled with a feeling that this new organism is emancipatory – through the possibilities it creates for communication.

So Erickson recognises that one consequence of this extended communication is new opportunities to pursue various interests and inquiries in the internet arena. 'Rather than composing queries for search engines or going to likely places to

browse, something that many ordinary users find foreign and daunting, people can instead pose the question: Who would know?' An important point is being made here about the social navigation of information space: namely, that while it may be new for computer networks, 'it is an old and familiar way of finding things out in the real world'. However, as Erickson shrewdly points out, the real world version of pestering other people for help comes at a price: 'I accrue a social debt to them'. While, on the other hand, in a (computer) environment (where users thoughtfully make their knowledge visible to all) 'the ability to find out what someone else is doing, without mutual knowledge of what's happening is a boon to both parties.'

Finally, Erickson makes a further point. It concerns the risks that arise from an individual developing a Web identity – particularly where that individual has an institutional or organisational persona as well as the more informal one that might be visible on the Internet. 'On the positive side it enables new search strategies based on our social knowledge, it lowers the social cost of accessing and sharing information, and it makes the web a more interesting and engaging place. On the negative side, it creates a host of new opportunities for social gaffes, and defines a new realm in which tensions between organizations and individuals may be manifested.'

Thomas Erickson has been quoted at length because his remarks capture well the heart of what is now termed 'Web 2.0'. But Erickson's remarks are also cited here for a further reason: namely, their vintage, for they were written over 10 years ago (Erickson, 1996). So they furnish a useful reminder. They are a reminder that some of the activities currently happening on the Web resonate with things human beings have *always* strived to do. These are not activities somehow freshly hatched by technology. For instance, people have always creatively acted to elaborate and project personal identity (Goffman, 1959) and they have always sought ways of conversationally coordinating with others (Tomasello, 1996).

The appetites for projecting identity and social coordination are at the core of what is being termed here 'Web 1.5'. This represents a move towards further emancipating the individual user: suggesting that the modern web was reached via a smoother transition than is implied by the '1.0/2.0' binary divide. To promote enterprise, internet regulation allowed the purchase of unique domain names of web 'addresses'. The relatively low cost of owning an internet address meant that individual users could establish their own website and on that site develop their own activity, visible to all. Moreover, universities in particular were quick to provide internet space upon which staff and students could build a 'home page'. These pages advertised an individual's interests and professional activity – a form of self-presentation that attracted a degree of interest from social science researchers (Bates and Lu, 1997; Dumont and Frindte, 2005; Yates and Orlikowski, 1996; Walters, 1996; Wynn and Katz, 1997). Their observations have revealed the care

and strategy that Internet users may invest in crafting a story about themselves in web-readable format.

The message to be taken from these observations is clear. If a centrally defining feature of Web 2.0 is its participatory nature (as argued below), then there is nothing very new about this orientation to the internet. If there is something new here, it's a matter of scale. Furthermore, there is nothing new because it expresses ways that human beings will always tend to act with new cultural resources. So, perhaps it should come as no surprise that they want to use the internet to communicate with each other and to project their personal identities – when the development of access and tools make this possible.

## **Web 2.0: The social computer**

The observations above about the transition to Web 2.0 risk provoking ponderous debates about the discontinuity implied in a 1.0/2.0 vernacular. On the one hand, there are grounds for arguing that the transformation towards a strongly 'social' computing experience has not been simply incremental or linear. Whether that transformation has actually been step-like, that is, sharply discontinuous, is a debate that can be sidestepped here. The best thing may be simply to accept the '2.0' label. This may be done on the grounds that it fixes in language something that has crossed a threshold of popular awareness. Something that does need to be articulated, theorised, and creatively applied within wider areas of cultural practice, such as education. So accepting the label is what will be done here.

On the 'PC' or personalised view of technology, the web might seem to offer the individual user merely a very large, richly populated, extra hard disk. Yet it is not simply 'more data' that defines the impact of the internet. It is the *socialising* of personal computer use that turns out to be so striking. It is not just that people can – from their spare rooms or classrooms – now access a bigger bank of digital information. What is really intriguing is that they can also access a vast community of other people. Moreover, there is an ever-present invitation to take whatever is a preferred or 'personal' computer activity and to socialise it. That is, coordinate with what some of that vast networked community of others are themselves getting up to. For the learner, this coordination may bring new insights, new knowledge, and new motivation.

If such a participatory experience was slow to gain prominence in Web 1.0, this may reflect its relatively small user community and the level of technical competence that doing these things assumed. However, infrastructural and software advances on the Internet were to change such limitations of access and diffusion. In an interesting interplay, these technical developments would actively stimulate growth in the

Internet user base. They were developments that would both open up access to certain social exchanges and, in doing so, cultivate what might become a critical mass of user participation.

So, Web 2.0 is about a human interest in pursuing just this kind of social interaction. Unsurprisingly, talk of a second 'version' web leaves some bystanders suspecting hype, while, from aficionados, it attracts vigorous arguments about its proper definition. Yet, despite these irritations, the phrase does offer a kind of anchor for discussing a disparate range of developments.



## Appendix 2: The current Web 2.0 ecology

- **Trading**
- **Media sharing**
- **Media manipulation**
- **Conversational arenas**
- **Online gaming and virtual worlds**
- **Social networking**
- **Blogging**
- **Social bookmarking**
- **Recommender systems**
- **Collaborative editing**
- **Wikis**
- **Syndication**

This Appendix offers a further description of core Web 2.0 activities, supplementing Table 1 in the main document. However, some boundaries between the activities in that table can appear blurred. In particular, some Web 2.0 applications are evolving to centralise and integrate activities that were previously offered as discrete services. Social networking sites are a case in point. Increasingly, their design accommodates at one site much of the functionality that is typically described under separate headings of the sort used here. This may represent a second form of migration for users. If the first move was from the multi-application desktop to the unified browser, the second appears to be from disparate browser services to one key browser application (such as Facebook). That is, an application that furnishes at one site, blogs, photo libraries, email, collaborative spaces, and so on.

### Trading

Buying and selling are activities with a long internet history. In relation to empowering user participation, Amazon and eBay were created and thrived long before Facebook and Wikipedia. While interpersonal interaction and knowledge sharing may be more deeply rooted human dispositions, it was shopping that drove early innovation towards mass involvement with internet.

eBay in particular has been a highly visible success. Nevertheless it remains a somewhat isolated example of trading de-coupled from the retail marketplace and realised as a bottom-up, community experience. It may be an example of a niche in which competition is hard. If someone has an item to sell, it is natural to go to the biggest online trading forum. On the other hand, it is likely that eBay raised levels of awareness about the ease with which the internet could reconfigure traditional forms of activity (such as buying and selling) – turning them into versions over which the participants had more control. While eBay may remain the dominant realisation of

this idea, it is clear that a great deal of improvised trading does take place, perhaps mediated by postings in all the places that the internet now offers and perhaps managed by online debit/credit services such as Paypal. Also in the participatory spirit of Web 2.0 there are sites that allow users free advertising of items they have for sale or rent. The best known of these, Craigslist, seems permanently in the top 10 most popular websites.

## **Media sharing**

An early and controversial consequence of the ability to *upload* to the internet was a lively trading of digitally-formatted music. Sites emerged that acted as brokers or distribution points for this traffic and a great deal of concern has been generated about violation of copyright and loss of retail sales. This uploading has extended to include broadcast video and film, thereby drawing the anger of other sectors of the media industry.

The public perception of this media sharing has been dominated by discussion of the legality of such activity and, then, the claimed threat it poses to a buoyant economy of artistic production. What has attracted rather less attention is the growth of creative work in new media by amateurs operating outside the industry, particularly in the video realm. This possibility has been fuelled by the emergence of inexpensive recording technology – such as that commonplace now on many mobile phones. Well known examples of sites that organise such user publications are Flickr for photographs and YouTube for video. In the latter case, the potential for growth seem considerable, given that Google elected to pay £889 million for the company when YouTube was only 18 months old and not yet making a striking profit.

Again, the strength of these sites for collating and cultivating individual creativity is often masked by the various controversies that are thrown up by their activity. Flickr has had to struggle against users who see its potential for distributing pornography; YouTube has had to manage the legal challenges arising from users uploading video material without holding the copyright. However, such difficulties should not conceal the fact that there are a great many unproblematic successes within this tradition of shared content. A good example is slideshare.com – a service that allows people to publish their slide shows (such as PowerPoint) and gain access to the collections of others.

## **Media manipulation**

The capacity for trading and sharing media files has stimulated a growth in the amateur production of such material. To meet these interests a number of tools have appeared. To some extent these mirror the traditional tools that professionals have always used with these media: ways to realise splicing, editing, dubbing, and so forth. Others tools encourage mixing of ready-made items taken, as it were, from the

internet shelf (Fotoflexer.com for example, or Animoto.com). It may be that the cut and paste experience of composing with digital text editing tools has encouraged a bricklayer approach to production in audio and video media. Certainly, there has emerged the lively practice of the web 'mashup': a practice that celebrates the potential of taking existing media items and 'mashing' them together to make a new product – that product typically being accessible through a web browser.

The traditional video/audio editing suite of tools has been complemented by a further toolset that is more matched to the paged format of the Web 2.0 environment. These permit individual users to create a type of mashup which is based on the idea of 'microcontent'. This is content that is extracted as a small part of some web page and then reused. These tools allow the gathering and integrating of these fragments to produce new publications and new ownership.

An increasingly popular form of mashup involves the user constructing links between one set of material and its spatial location. If the material can be described in terms of geographical coordinates (say from GPS) then it can be mashed with output from Google maps to create an image that locates each item in the set within a single map display.

## **Conversational arenas**

The internet has supported tools for conversation from an early point. Email and text chat systems are widely used and remain key resources for the informal communication that glues together Web 2.0 activity. What is perhaps surprising within this increasingly high bandwidth, multimedia environment is that there has been somewhat modest growth in live conversation that is mediated by video and audio. Even in the asynchronous communication arenas of Web 2.0, there is a limited amount of conversation that is conducted through audio and video. This is the case even though audio and video channels may be made available in the applications. The lasting popularity of written conversation (chat) is a reminder of the distinctive properties of text: in particular, how its permanence and accessibility supports an easy extraction of relevance and meaning for the browsing user.

## **Online gaming and virtual worlds**

Gaming has always defined a niche for internet activity. So, unsurprisingly, it has emerged as a force in Web 2.0. That is, many internet users achieve their participatory involvement with the Web through shared interest and experience in computer gaming. In other words, this is one area where growing collaborative knowledge is well developed (Jenkins, 2006; Jennings, 2007).

The key format in a context of Web 2.0 is the online, multi-player game. It takes the form of a networked game that allows geographically distributed users to take part in a structured exchange. The themes that define these structures are often of the

traditional warring and confrontational formats, although they can be calmer – such as the much-admired Sims in which users can collaborate in designing a whole social community online.

However, the most high profile online activities of this more immersive sort are the virtual worlds, such as Second Life. Enthusiasts are keen to stress that these are not simply another sort of gaming (they are another sort of living). In respect of the recurring target of 'participation', these designs should score highly because of what they allow. The user acquires a screen persona (an 'avatar') that can move fluently in and out of custom-designed environments that afford various kinds of interaction and display. For instance, concerts, meetings, relationships and educational practices can all be managed in such spaces. And this is happening. Yet, despite the apparent depth of participation that such virtual world systems allow, they remain of modest impact compared to other Web 2.0 activities. This may reflect the cumbersome processes (at present) whereby users realise even simple acts of communication and sharing when operating in these worlds. Or, more simply, it may reflect the lack of a critical number of active users – a crucial matter for the evolution of a Web 2.0 service. However, it is likely that virtual environments of this kind will grow in significance as the technology develops to accommodate more sophisticated ambitions for joint activity.

## **Social networking**

Social network websites provide users with a general-purpose structure within which they can interact with other people. Whether those people turn out to be a cohort of existing friends or a cohort of strangers depends on the different motives for wanting to network. One motivation is the well established tradition of organised dating. Less strategic perhaps, a very successful early site was based on *reuniting* friends – taking particular advantage of people's nostalgic interest in re-making contacts from school or college. Evidently, anyone with that ambition needs a structure in which they can identify themselves and their interests and then explore conversation.

An early elaboration of this kind of promiscuous be-friending arose when individuals seeking to develop their *celebrity* status established identities on such networking sites. From there they could commercially promote their activities (music, in particular) and even open up casual conversation with their admirers.

However, a great deal of social networking is as much an elaboration of existing friendship communities, rather than the building of new relationships. The first distinct social network site appears to have been sixdegrees.com, founded in 1997. It allowed users personal profiles and lists of their friends. However, it may have arrived too early – missing the significant expansion of internet users. It failed to maintain momentum through a critical mass of subscriptions and so closed after three years. Classmates.com provided links targeted at former high school contacts.

A variety of contact sites based around business also evolved from 2000 onwards – notably Ryze.com, LinkedIn.com and Tribe.net. Sites also began to service still more specialised groups, creating a platform for users with interests such as religion and sport. Even sites built mainly to share media began to incorporate modest versions of these friendship-cultivating arenas for their users. From this mix of activities, three sites surfaced to dominate the social networking interest: Myspace with its special focus on music, Facebook with its orientation to undergraduate communities, and Bebo for teenagers.

The successful site Facebook began by engaging with college students. An institutional email address was required to join and its structure for conversation echoed these college affiliations. It allowed students to keep in contact with their peers at other institutions. Online linking also allowed friends within a single institution to cultivate and protect a more continuous social exchange than they might previously have managed offline. Under these circumstances, members might invest a great deal of effort in building a profile of themselves based on photographs, messages, and visible links to their friends. Some research illustrates that Facebook plays a significant role in firming up existing offline relationships as much as it cultivates new online ones (Ellison Steinfield and Lampe, 2007).

Of particular interest has been the emergence of topic-defined social groups, whereby members can link with others that have some similar interest. As services such as Facebook extend their membership and increasingly incorporate games and other online activities, they come to feel like very comprehensive and self-contained social worlds. For many young people who have Web 2.0 involvement, these social networking sites may be their main anchor for computer-based recreational activity.

## **Blogging**

The weblog or blog has become one of the most widely recognised forms of Web 2.0 activity. Its format resembles a journal or diary. Although entries may be “posted” by more than one person, they are usually in the ownership of a single individual. They may be purely reflective and autobiographical in tone or they may focus on topics that are of special interest to the blog-owning individual. When this is something as general as 'politics' or 'educational technology' then the entries can cover a wide range of themes. A blog may attract significant public attention if the author happens to have access to events of wide interest that are otherwise not being represented in the mainstream news. In short, because the bloggers' views enjoy easy access on the long tail of internet publishing, they may rise to the surface of a wider public consciousness.

While blogs have undoubtedly achieved a high profile of visibility, care is needed in judging the scale of the activity. One survey of a set of major blog hosting sites reports that 66 per cent of those surveyed had not been updated in two months

(Perseus, 2003). Around a quarter of blogs were apparently one-day wonders with postings on the set-up day only. Web services make it very easy to establish a blog. Other more subtle human resources are needed for individuals to sustain its momentum. Moreover, some of the appeal of this journal keeping is migrating to a 'lite' version, with micro-blogging applications such as Twitter.com that assemble much more minimalist records of users' thoughts and actions.

Blogs take advantage of this immediacy of publication; however, they have additional features that make them an effective format for readers. Typically they will involve links to other internet material and, increasingly, they may incorporate other media such as pictures or video. (Hence 'audioblogging', or 'moblogging' if posted material is from a mobile phone. And if video is the main medium, one refers to 'vlogs'). Convention dictates that the most recent entry is positioned at the top of the page. Readers can attach their own comment to the text of any entry on view. Note that this does not make the blog an even-handed conversation, because the blogger's own entries remain the primary focus for any exchange that might develop in this post-and-comment way.

A 'blogroll' may be present – listing a number of other bloggers that this individual reads and recommends. A trackback facility allows one blogger to notify another that have cited a posting by that individual. This whole framework for commentary and communication takes place in the so-called 'blogosphere'. Search engines exist in which the contents of this space for discussion can be searched.

As an authoritative resource for personal research or inquiry, blogs present certain problems. In particular, their content may be changed by its author and so citations to an entry can turn out to have disappeared, or have been edited when they are re-visited. The device of a 'permalink' is an attempt to give an entry a permanent address even if that entry is moved to another location by the author.

However, the blog format for web participation has emerged as one of the best known and most powerful in its influence within wider public affairs. Its attraction must have much to do with the ease with which individuals can become visible authors and the richness of page design that some blogging services now offer. While this may seem merely to echo the personal 'home page' tradition, the ease with which postings in the blogosphere can be found must create a strong motivation to participate. This visibility is partly a matter of powerful search engines (such as technorati.com) but it also arises from the syndication methods (see below) whereby interested users can be actively informed of new entries in blogs that they admire.

## **Social bookmarking**

The bookmark is a metaphor that is familiar to internet users. When a web page is found that deserves to be remembered or revisited, then a browser allows the

address and title of that page to be saved. This familiar practice has been extended in a way that socialises it. First, there are web services that allow users to lodge their bookmark in a location that can be read by others (that is, on a central internet server that is widely readable). However, this only becomes really valuable when the user also attaches category labels to that bookmarked page in order to describe it. Such labels are commonly known as 'tags'. There is no prescription as to what the appropriate set of tags should be. Indeed it is central to this form of Web 2.0 sharing that the user find their own preferred tags. However, strategies are now emerging to organise or cluster these tags and to create visual representations of them that assist the user in navigation.

This practice need not apply exclusively to web pages. Other material on the internet can be tagged both when it is created and when it is found. For example, photographs uploaded to Flickr or videos on YouTube can be labelled this way by their owners. News items on the BBC website can be tagged by readers. Or scholarly articles found on the Web can be labelled in terms of their connection to scholarly interests (though CiteULike.com for example). This activity creates what is termed a 'tag cloud' which may be centred on an individual (and thereby express their interests). Alternatively, it may be centred on other internet items such as a page, a picture, or a published article (and thereby express its content or concerns).

The form of categorising that emerges from such activity has become known as a 'folksonomy' – distinguishing it from the more formal and ordered traditions of taxonomy. They are often rendered on web pages tag words in fonts of various sizes to reflect their prominence: that is, 'tag clouds'. Many websites incorporate buttons that allow users to submit this URL to a website (such as digg.com) that will integrate the item according to the user's suggested tags. Needless to say, there are a wide variety of tools that help users identify and navigate such descriptive systems. In a report to the UK agency JISC, Tudhope, Koch and Heery (2006) recommend that social tagging is a useful form of systematising tool but that it should not replace existing formal classification schemes.

## **Recommender systems**

Social bookmarking and the item tagging it involves produces what might be described as user 'recommendations'. In parallel with this social tagging, there are *automatic* systems that do similar work. They strive to extract useful knowledge from a monitoring of what individuals are observed to do and select. Perhaps the most widely experienced example would be an internet bookseller that maintains a database of books bought by each customer. The system refers to this at each new point of selecting a book to consider online. At this moment of choice, the customer is given a set of recommendations for further books that they might appreciate. These titles will be those that were chosen by other customers who purchased the book currently being considered.

Retail trading on the internet is a family of activities for which these recommender systems will work well. However, they also work well for the personalised exploration of more educational collections of documents. The most widespread to consider are libraries. The issuing mechanism of libraries involves similar record keeping. Of course those records refer to book *borrowing* rather than book purchasing but the same recommendation calculations can be performed. Such a system might make useful reading suggestions to students based on an overlap of interests detected from complementary selections made by other students.

Recently this kind of recommendation service has been designed to work with databases formed from a user's musical listening choices. The news aggregating service Digg.com organises a 'friends' system whereby the opinions of individuals are coordinated in a way that can be shown to work for participants (Lerman, 2006).

### **Collaborative editing**

A very direct and traditional mode of collaborative activity is based around joint authorship. As the functionality of the browser has become more sophisticated, so it has become realistic to implement editing and calculation operations more typical of standalone authoring tools. This coupled with the easy provision of document storage on central file servers permits users to work on documents while geographically separated. These 'documents' may be traditional pieces of writing and recording but they may also be more exploratory representations as in the case of such collaborative visualisations served by Thinkature.com, Mind42.com or Keyuda.com.

### **Wikis**

A wiki is a collection of websites that, linked together, create a knowledge repository. The wiki allows collaborative editing whereby any user can add or amend content and do so with a web browser. Changes of this kind are versioned so that it is possible (by 'rollback') to revert to previous versions of a page if an edit needs to be undone. Pages are strongly linked together by traditional hyperlinks. 'Semantic wikis' encourage the nature of links to be defined (for example, some item X 'lives at' Y where X is linked to Y). This allows the semantic structure of linking to be processed by computational devices.

Wikipedia is one of the best known traditional wikis. It is an online encyclopaedia to which any user can make contributions or alterations to any entry. It is not the only form of such community knowledge building. For example, the lesser known everything2.com uses a bulletin board format. However, Wikipedia exemplifies a design format that is now generic: namely, the wiki.

In other words, Wikipedia is not a unique item. There are other collections of expertise that are often more focused but which are constructed according to the



same collaborative and democratic principles. Any internet user can set up a wiki by taking advantage of web services providing the necessary design tools and the storage space. Such wikis might be embedded within larger web-based services run by that user. Moreover, any user is able to make a new entry to a wiki that has been set up in this way. And, finally, any existing entry is available for updating and editing.

Having said that, opportunities for widespread editing of established entries can be challenging to maintain. Typically, a wiki system will keep copies of pages and this allows the restoring of originals in the event of accidental damage. However, the infamous Seigenthaler incident illustrates that a hoax edit to a biographical entry (journalist, John Seigenthaler) can go undetected for months. Evidently, *malicious* damage (including misrepresentations, product placement, and propaganda) is a more substantial worry than playful experiment. As it happens, it seems to be easier to correct an entry than to maliciously damage it (Viegas *et al.*, 2004). Moreover, there appears to be a significant community of users who monitor open editing with great vigilance. However, there is evidence that coordination and correction costs are increasing in Wikipedia (Kittur, Suh, Pendleton and Chi, 2007).

Yet it is fair to say that wiki pages are increasingly found to be locked, as the owners of sites work to manage the evolution of content. Close statistical analysis of Wikipedia activity indicates that, despite its advantages of size, and 'swarm' intelligence, there are increasing costs associated with managing the coordination and conflict that arise from this expanding collection of user-generated material (Kittur, Suh, Pendleton and Chi, 2007).

Wikipedia started in 2001. It grew from an attempt to create an online encyclopaedia with the more traditional design (nupedia). That is, contributing authors were selected and were required to have proven expertise. However, the initiative was hard to maintain and it ended in 2003. The contrasting pace and popularity of its successor is a strong signal that a looser form of collaborative knowledge building has strong appeal to many Internet users. Moreover, the level of vandalism and distortion that must have been expected for such an initiative has not proved to be an issue. Not only does the work grow through the diligent entries of contributors but there is often a lively discussion page associated with individual nodes in the Wikipedia system. Recent developments suggest an increased interest in systems of organised peer review for material that is to enter a community resource of this kind.

## **Syndication**

Many of the examples of Web 2.0 tools outlined above involve sites that are dynamic – their contents undergo constant change. In such a fluid environment it becomes difficult for users to keep pace with the changes that matter to them. For this reason, there have evolved notification methods that reduce the need to monitor sites simply

in case they carry new material that may be of interest. This process is termed 'syndication' and is achieved by sites that are RSS-enabled. A user identifies this status via a simple icon that will be visible on such sites. The language used to express such strategies for relating to web material sometimes invokes the marketing distinction between 'push' and 'pull' approaches. Users of syndication systems are effectively having web content 'pushed' to them rather than they themselves having to 'pull' it through standard delivery channels.

If the syndication icon is selected by a visitor to the site, then it will become possible to 'feed' to that visitor regular summaries of new material on the site. At least it will be if their own networked computer is equipped with a piece of software called an 'aggregator' or if they make use of an aggregating extension built into most web browsers. What is fed is a link address to the new information but also a brief summary that allows the receiving user to decide if they want to follow up this alert. Clearly, this is a way of managing what could otherwise become an oppressive volume of internet information.

The phenomenon of podcasting – whereby an audio or video file is sent directly to a user's computer – is a species of syndication. What is particularly interesting about podcasting is how it has stimulated production. It has encouraged individual users to develop audio and video material with some expectation that it will find an *audience* through the syndication process.

## **Appendix 3: Six technology drivers for Web 2.0**

- 1 Widening internet access**
- 2 Greater fluency of interaction**
- 3 The browser as universal application**
- 4 Managing data on an epic scale**
- 5 Endless shelves in the Internet marketplace**
- 6 Publication space for user-generated content**

A number of factors have come together to give a strong sense of step-change into the Web 2.0 internet. To force them into a list-like summary inevitably will imply historical sequence or priority of importance but this would be misleading. The growth has been organic rather than tightly sequential. These shaping factors have interleaved to bring about a change that is systemic rather than linear.

### **1) Widening internet access.**

Central to many Web 2.0 activities is the scale of user participation. That is, these activities increase their impact as more and more people join in. It is not unlike the early telephone. The much-cited observation of Alexander Graham Bell that “One day every town will have one” is a reminder that the exact potential of a technology to reconfigure everyday life need not be immediately recognised. In relation to configurations that cause a technology to serve personal communication, the typical pattern is one of a downhill snowball. Once a starting mass of individual users is in place, it is in the interests of new users to join in. So it has been in relation to the internet as a communication medium.

However, the possibility of access depends upon cost and convenience. The cost of personal computers has famously fallen year on year. Moreover, broadband internet connectivity has become increasingly straightforward – perhaps as something included in packages that were marketed to the larger interest in cable and satellite broadcasting.

### **2) Greater fluency of interaction**

By this is meant ubiquity of access and speed of interaction. Ubiquity is a feature that has become more apparent recently. 3G telephony, laptop computers and wireless networking have all made the internet a ubiquitous experience. Users can now find connections on the move and with minimal hardware. As one commentator describes this pervasive access: “..losing it can feel like being stranded. Constant connectivity has changed what it means to participate in life” (Grant, Own, Sayers and Facer, 2006). This may be a rather colourful description of Web 2.0 engagement but it becomes quite credible if 'connectivity' is allowed to include that which arises from mobile phones. The appetite for being connected to others has surely been

stimulated by these phones. For many, it is an appetite that will surely spread into the distinctive forms of connection among people that are now afforded by Web 2.0 designs.

'Fluency', in the sense of fast and convivial interaction, has also been extended through a growth in broadband services. Broadband means connections to the internet that are potentially fixed price, always on, and which deliver data at high speeds. Transmission speed has been particularly important for the growth of interest in viewing video online and receiving media broadcasting (such as radio and television). Traffic in rich media is another significant feature in Web 2.0.

### **3) The web browser becomes a universal platform**

There have been significant advances in software design. In particular, the growth of what are known as Rich Internet Applications. The best known tools for delivering these are AJAX and Flash. What has thereby evolved is a set of browser-based applications that look and feel like traditional desktop applications – word processors, spreadsheets, mail clients and so on.

Where these new technologies have particular impact is in relation to the problem of quickly refreshing the contents of a browser and, in particular, doing so selectively so that only parts of the page are involved. Related to this are functions that allow the user to enter text onto a web page's white space. This is the most straightforward and empowering example of this new functionality. Cunningham's simple notion of a wiki (see below) as a website for pursuing this in a collaborative and public way was a very influential development this basic authoring possibility (Leuf and Cunningham, 2001).

The outcome of these developments is web pages that are far more versatile in their appearance and in the interactions that they offer a user. In short, activities that had previously required stand-alone programs can now be replicated in the window of the web browser. This is very attractive to the typical user. There is less pressure to purchase a whole library of specialised applications for their PC. They may have occasionally to do some modest downloads to add functionality to their browser but these – like most Web 2.0 internet applications – are free of charge.

This migration of desirable user activities to the Web has been complementary to the increased ubiquity of access mentioned above. If what you want to do is done in a browser window (read mail, write a document, play a game etc.), then you only need to find a connection point somewhere (public terminal, friend's laptop, mobile phone, PDA etc.). The browser becomes the universal 'platform' for what people mainly want to do on computers. Software comes to operate 'above the level of the single device' (O'Reilly, 2005), meaning that is made to be accessible on any web-enabled interface.

This migration away from the desktop, with its multitude of applications, to the singular web browser implies another kind of structural change. The roaming user can only exploit the ubiquity of the browser if the data they might want to interact with is similarly accessible. This can only happen if relevant data is held centrally and no longer crammed onto the user's own personal device. Increasingly, this is the usage model that underlies Web 2.0 designs. The cost of large storage devices has fallen sufficiently that commercial services can afford to be generous in the data space that allow individual users to control. This was clearly the early model for email management. But it is now the way in which users may manage their calendars, their collections of photographs, their diaries and, increasingly, their text and data documents.

One way to summarise these changes is to highlight a shift from client-side (user) to server-side (website) computational activity. This applies to both storage and processing. Thus, not only will the Web 2.0 user store more of their material on a central server, the growth of AJAX and other programming tools have allowed the server side to take on more of the processing that would previously been carried out on the user's own computer.

It is important to stress that this is not simply a point about browsers creating a new convenience of personal computer use. The Web 2.0 point is that the more data gravitates to the 'centre' in this sense, the more it is potentially available for interrogation and integration by central services. And the more this is arranged to happen, the more the user may be coordinated with others doing related things. At least this is the case if the individual user elects that their data should be readable in this manner – a point which introduces two key Web 2.0 themes – 'epic scale' data and 'long tails'. These are considered in the next sections.

#### **4) Managing data on an 'epic scale'**

Data storage has become very inexpensive. Service providers can now contemplate storing large numbers of user files and extensive records of user activity. Many internet services now actively invite you to store your personal data on their central drives. This might be in the form of documents: text you have written, pictures you have taken, and so on. But it could also be in the form of (online) choices that you have made. In such cases, the user may not even register that they have left a centrally-recorded trace of their activity in this way. That choice could be as coarse as the information that they have visited a certain page, or that they have purchased a certain item (a book say) or downloaded a particular file (a piece of music for instance). Or it could be far more considered and it could certainly be consciously offered by the user. For example, the user may not only leave a trace of visiting a certain web page they might take up an opportunity to apply a descriptive category label to that page, or provide a rating for something they had read or purchased there.

The significance of all this 'epic scale' of data is found in what arises from the integration and aggregation that it allows. It is easy to see that ratings and categories can be averaged and described. This is valuable knowledge that can be extracted from consumer activity. But the data in this case is constantly growing. Moreover, this is growth in data that helps the individual user as well as being of value to the larger population of users. Thus the choices and ratings and decisions of each particular user can be explored in a more pattern-like manner. Those patterns can then be creatively integrated with the patterns of others. If applications are offered that position the individual user to explore that data – then the returns for the exploratory user can be quite rich. Certainly they can be rich for the individual consumer and the individual researcher but also, of course, for the marketing manager anxious to target advertising or identify new potential for product design.

What can be taken from such integration of data is potentially very attractive to users. For instance, the online purchase of a book is made more intriguing if the retailer shares with you the purchases that have been made by other people who bought this book. The utility of this situation then starts to fuel its growth. The more users who are effectively contributing data about their actions (book purchases for instance), the more attractive the information becomes. Such 'network effects' thereby contribute to expanding the constituency of web users. Over and above the enhanced access arising from ubiquity of connection, broadband services, and affordable technology, this added value of integrating user data becomes a more subtle basis of internet growth and Web 2.0 activity within it.

## **5) Endless shelves in the internet marketplace**

Chris Anderson's book *The Long Tail* (2006) has become a significant anchor point for understanding what users are doing on the Internet and for conceptualising a significant part of what is meant by Web 2.0. This tail is the extending right hand side of the graph that describes a power function. Basically, to the left of this graphical shape there is a rapidly descending hillside curve; this settles into and very slightly sloped plain.

Anderson constructs a distinctive vision of what is happening for internet transactions in terms of this long tailed shape. He illustrates the point in relation to conventional buying and selling. It is well known that in a given retail domain (say books), 20 per cent of the items account for 80 per cent of the sales. Put this another way, there are a large number of items (say 80 per cent of the book titles published) that do not sell very well and probably do not generate significant profit. The graph of popularity (sales) against items suggests a long tail pattern.

However, this 20:80 rule only applies when there are obstacles to fluid transactions – which is the case for the example of books. These items demand a lot of shelf space in real shops. However, in internet shops they do not. The consequences are clear in

a comparison that Anderson makes. A prominent shopping mall book retailer maintains a stock of around 130,000 titles. However, 25 per cent of the sales reported by this leading internet retailer are for books that are not in the set of 130,000. What this suggests is that there is a significant appetite for the titles that are not normally visible (that is, not on shelf). It suggests that significant business can be done on the long tail of popularity or interest.

At the heart of this example is the simple truth that, on the internet, the overheads of making visible a potentially low-interest or low-popularity item are no greater than they would be if the item was high-interest or high-popularity. This applies to book retailing – every title is as accessible and as available as every other. But it also applies to more abstract and social activities, such as the published thoughts of individual internet users. So, if I open a web page to publish my perspectives on political affairs, you can access my page as easily as you can access a page that displays the editorial of a national newspaper. Of course you might not stumble across my page as easily as you find the newspaper website. But if you do happen to know the web address that I use, then my thoughts are as easy to find and read as any other published thoughts – however institutionally powerful.

This 'flattening' of the transactional space is something else at the heart of Web 2.0. It becomes a part of the reason for detecting a discontinuity. This is because the scale of participation has now increased sufficiently for that long tail of expressive activity to be exerting interesting effects.

## **6) Publication space for user-generated content**

This last observation leads naturally to the final factor in this list and perhaps the one that is most widely recognised and discussed. Again it arises from the availability of inexpensive central file space, coupled with fast transmission speeds for large (perhaps more interesting) files, coupled with new software for manipulating digital content. All of this has led to an explosion of material on the web that has simply been put there by individual users. The technical developments outlined earlier in this section have included tools that make it easier for users to upload files – rather than simply downloading them. Given the availability of cheap server-side storage, this form of data publication and sharing has flourished.

At first it may have been hosted under the structure of 'home pages' mentioned earlier. To some extent this personal niche design has returned – although the host is less likely to be a university or workplace website and more likely to be a commercial web publishing service.

Although the identity marking of the 'home page' idea has always been a theme on the Web, the large-scale posting of user-generated content was pioneered by the site Flickr.com, which invited users to post their photographs. While early postings

were dominated by work that suggested a keen enthusiasm for photography, the site increasingly attracted a wider and more playful user base. This growth was perhaps facilitated by the spread of mobile phones equipped with cameras. Yet from the start, this was a file 'sharing' (not simply a file hosting) repository. The point was that other users might find, admire, borrow and comment upon the material shared in this way.

Modern mobile phones often have video capture captured as well as the potential to take photographs. Unsurprisingly, video sharing sites emerged to echo the success of Flickr with still images, the most dramatically successful of which has been YouTube. Again, the site provides a modest facility for commentary and rating by other users and, of course, a powerful search facility. Although there is much on this site that is original and generated by individual users, the site increasingly is home to clips copied from DVD or broadcast sources and to various forms of viral advertising video planted on the site by enterprising marketing agents. More recently, other video sharing sites have emerged that are less generic in their content and, instead, gather video clips with a particular thematic focus. A good example is [teachertube.com](http://teachertube.com) which shares material relevant to teaching and learning.

Identifying Flickr for images and YouTube for videos might seem to encourage categorising user-generated content sites by reference to which of such expressive formats they chose to host. In which case, other obvious distinctions in addition to images and video would be text and music. However, these formats have not migrated into specialised hosting sites that are exactly comparable to Flickr and YouTube.

It is interesting that there is no site of any significant prominence that shares poems, or short stories, or other genre of writing that might be organised into systems comparable to Flickr and YouTube. The two design structures that dominate the organisation of user-generated written texts are wikis and blogs. The former concerns non-fictional writing and organises user contributions in the thematic terms typical of encyclopaedias. Blogs, on the other hand, offer a structure of 'entries' that is governed more by the diary or personal journal format. Typically, a single author makes such entries in an unfolding temporal sequence. Sometimes this is thematic with the blog having a focal topic. Sometimes it is much closer to a diary with the blogger (diarist) wandering through a wider range of interests and accounts.

The case of music is dominated by the sharing of commercially produced items rather than the creation of new material by individual users. Considering the pioneering content sharing sites (say, Flickr and YouTube), their vast uptake probably reflected that fact that *music* sharing had already established itself as a popular web-based practice. Even though such music files were often 'user-generated' only in the narrowest of senses of copying commercially recorded tracks.



However, this should not suggest that Web 2.0 technologies have not stimulated the sharing of user-generated music, in the more interesting sense of items composed and/or performed by those doing the sharing. To some extent this has been mediated by those users creating distinct websites branded in the manner of any other product promoted on the internet. However, this would define a somewhat Web 1.0 approach to sharing – simply because it implies a purely product-delivery model. Moreover, it is a model that often develops more into selling than sharing. A more Web 2.0 solution has been to integrate the sharing of new music with the social exchange that is typical of so-called 'social networking' sites – such as MySpace.com and Facebook.com. Increasingly, contemporary bands and individual performers develop their popularity through internet word-of-mouth effects. That is, conversations about their work that are stimulated by making it accessible in a social networking community. By online 'befriending' the owner of such material can offer other users access to it and engage in a conversation around it.

These sites arguably have become the crucible of much Web 2.0 exchange around user-generated content. It seems that a great deal of the content that users wish to generate is centred around their own social lives. That is, pictures of themselves, their families, friends, vacations and favourite possessions. Any text they wish to write is often reflective around these themes and although it could migrate to a blog, the comprehensive and easy organising tools of a social networking site make it the natural home for this great wealth of personal content: material that the internet has brought into an arena of public viewing and public conversation.

An over-arching point to be made in relation to this activity is that much of it invites the use of online tools that produce, edit, refine or elaborate the digital content in question – for example, tools to manipulate music, images, diagrams, maps, plans, and the whole range of genre for writing. Again, there is a process of iterative development here. As the interest in production and sharing gained strength, so there emerged an appetite for tools that would ease or enrich the creative process. As those tools appeared, so there was a boost for the interest in creating things that could use them. However, the fact that these tools are internet based (rather than desktop based) means that the creative process can be shared among different users. Increasingly, there are openings for the co-creation of user content.