

The Unexpected Connection: Serendipity and Human Mediation in Networked Learning

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ABSTRACT

Major changes on the Web in recent years have contributed to an abundance of information for people to harness in their learning. Emerging technologies have instigated the need for critical literacies to support learners on open online networks in the mastering of critical information gathering during their learning journeys. This paper will argue that people will have to adapt to using information in a new way and will advocate the movement by learners into and inside information streams on open online networks. Their own control and aggregation of information, preferably through human mediation, should provide information not only relevant to their learning, but also slightly unexpected. We will highlight why this serendipity is important in a learning context and also take three emerging technologies under the loupe; recommenders, RSS and micro-bloggers, and their effectiveness in supporting serendipitous learning on open online networks.

Keywords

Information literacy, Recommender, RSS, Twitter, Serendipity, Networked learning

Learning in a new environment characterized by complexity

The context of learning has changed dramatically in recent years. In the past the learning experience was determined by three dimensions: the learner, the educator, and the content, but a fourth aspect has increased in prominence in theories and practice of learning: the learning context (Kop, 2011). Bouchard would even go as far as stating that: “For the first time we are understanding the act of learning as a response to changes in the learning environment, rather than as an adaptation to a predetermined learning system.” (Bouchard, 2011a, p. 290). Educators are re-examining their practice in the light of emerging technologies that have provided learners with an explosion of resources. Only ten years ago the book was the major source of information, but the Web is currently developing into a mesh of interlinked resources that can be accessed through communication and collaboration with others. This development increases the volume of information available, adds to the complexity of the educational and learning landscape, but it also invigorates it.

Barnett highlighted that we now live in a world characterized by “super-complexity,” uncertainty and change: “Work, communication, identity, self, knowing and even life: the meaning of fundamental concepts are no longer clear in a world of change” (Barnett, 2002, p. 9). He referred not only to technological change in society and education, but it remains that technological change has undoubtedly created a more complex learning environment than we were used to not so long ago. Learning is at the heart of personal change and transformation and Folke (2010), while discussing “resilience,” reminds us that people have shown to be fairly resilient in adapting to the changed environmental realities of the new information landscape. However, the accelerated pace of technological change has also shown to be problematic and might require professional adaptation from educators and from learners alike. This paper will reflect on changes in information gathering in relation to learning, and the role that recommender systems, RSS and micro-blogging might play in facilitating improvements and innovation in the aggregation and validation of information.

The Web: The nature of the network—Authority and Inequality on the network

We have seen a substantial growth and development of the Web over the past several years. The Web only ten years ago mainly consisted of fairly static content and basic sharing opportunities. This has now changed with the addition of social media, the cloud, the use of Web semantics and mobile and wireless technologies. Content is increasingly produced by users and there has been an exponential growth in the use of social media such as blogs (Smith, 2008), and video-sharing sites such as YouTube. More than 70% of the Web is now user-created (Bloch, 2011) and distributed via personal presence sites such as Facebook and YouTube in addition to micro blogging sites such as Twitter. All this data is stored, used and re-used in different ways and mashed up into new information.

The Web is portrayed as a democratic network on which peer to peer interaction might lead to a creative explosion and participative culture of activity. It should be noted, however, that most new, successful grass-roots developments on the Web have been commercialized and integrated in the corporate world. Increasingly concern is being raised about the influence of commerce on the Web. Lanier (2010) and Mejiias (2009) emphasize the high level of influence by a low number of companies, such as Google and Facebook. Market forces seem to slowly but steadily influence and take control of the new tools. The users are no longer the customers important to the directors of these applications, but their “social graph” has become the product that is “sold” to the advertisers who bring in revenue. The freedom and creative potential of the Web for all and the information available seems to be progressively more influenced by other interests.

This is exemplified by the development of Google. Google accounts for 72.15% of all searches in the USA (Experian Hitwise, 2010) and 90% in the European Union (White & Campbell, 2010), which makes Google’s behavior and its integrity in relation to the access it provides to information crucial to networked learning. It might be a little naïve to expect a search engine to behave in the best possible interest of the searcher, after all as Grimmelmann explains:

Search engines are attention lenses; they bring the online world into focus. They can redirect, reveal, magnify, and distort. They have immense power to help and to hide. We use them, to some extent, always at our own peril. And out of the many ways that search engines can cause harm, the thorniest problems of all stem from their ranking decisions. (Grimmelmann, 2010, p. 435)

We will return to the ranking and recommender systems later on in this paper as they are currently being developed to facilitate learning. As educators it seems to become vital to assess the best possible ways to collect information and voices can be heard advocating a publicly funded search engine, rather than one controlled by commerce to avoid bias in the searches we carry out (White, 2010, Goldman, 2010). As White argued compellingly:

The danger of allowing an advertising company to control the index of human knowledge is too obvious to ignore. The universal index is the shared heritage of humanity. It ought to be owned by us all. No corporation or nation has the right to privatize the index, commercialize the index, censor what they do not like or auction search ranking to the highest bidder. We have public libraries. We need a public search engine. (White, 2010, p. 1)

A body of research is emerging that investigates the Web network itself. Barabasi looked at the mathematics of the Internet and Web as networks and found that they do not perform as “random” networks, but as “scale-free” networks. The difference would be ruled by two characteristics: “growth” and “preferential attachment”, showing that this type of network grows “one node at a time” and that a node must “choose” to what other nodes it will connect. However, at the same time, the more connections a node has, the more likely it is that other nodes will attach to it (Barabasi, 2003, p. 86). This phenomenon creates “hubs”, defined as nodes that have a large number of links directed to them. The early adopter nodes attract a multitude of other nodes, but it is not necessarily their value that is attractive, more likely their popularity and attraction to others. This means that there are clearly power-relations on the network and Barabasi’s research shows that networks are not neutral, which is also emphasized by Bouchard (2011a). Barabasi found in his research that participants on networks are not only selective, but that the nature of networks and the “power curve” prevents network “surfers” from having access to all information at the same level.

Even though it seems on the surface that people have access to any piece of information and resource they would like on the Web, in reality this access is restricted by the structure of the Web and by the ranking of information by search engines (Grimmelmann, 2010; Goldman, 2010). It is clear that the ability to understand the intricacies of the network is required by people to negotiate this structure when learning on these vast disparate information networks. As self-directed learning becomes more prevalent, the need for high levels of critical capabilities, in addition to knowledge of the sub-systems of the Web, are important to be able to access information and resources that are relevant and required to advance learning. It should be questioned, however, whether all adult learners are able to do so without help from knowledgeable others (Kop & Bouchard, 2011). My own research (Kop, 2010) shows that it is the presence and involvement of (knowledgeable) others in an environment characterized by many technological variables and contexts that help learners to make sense of the multitude of resources offered on the Web. In the absence of adult educators, it is imperative to harness the changing affordances and potential of new technologies to this extent.

Human mediation and information flows in open networked learning

People's information habits have "deeply ingrained habitual patterns" (Fischer & Naumer, 2006, p. 2). It seems that people will first and foremost find information from people with whom they have a strong relationship, which are usually found in their circle of family, close friends and their local communities in places such as doctors' surgeries and libraries. The Web is supplementing these "information grounds" and is also creating new structures for obtaining information.

CIBER (2008) highlighted how people acquire information and how information behavior has changed over time. They found that "power-browsing," the clicking of hyperlinks and the skimming of web pages, has replaced traditional chronological reading and longer term critical thinking, and that advanced information searching is lacking. Their research showed low levels of information literacy, in the form of validating information and sources. Information literacy is acquired at a young age and "information behavior" is a developmental process at a deep level that will be very difficult to advance substantially later in life, for instance on a course at university (CIBER, 2008). The abundance of information on the Web has raised concerns about the feasibility for individuals to critically analyze all that is available to ensure reliability and validity and to manage the vast streams of information now available. As Hagel (2006) observed, the more information is available, the less time we have available to go into any depth when analyzing the information as the overpowering amount of information we have to deal with reduces our attention.

We therefore seek people who distribute the information we are interested in; they will get the attention, but we trust them to deliver the information relevant to us. Human behavior is influenced by people in their direct environment, with whom they have strong ties, but also by people with whom they have weaker ties, such as on social networks (Granovetter, 1973) and studies related to information flow between mass media and individuals have been conducted for many years. Katz and Lazearfeld (1955) for instance developed the two-step flow theory related to communication and their research indicated that mass media information is channeled to "masses" through human intermediaries who would have a high level of access to and understanding of the media. With the inception of the Web this form of 'one to many' communication, perhaps via an intermediary, has been supplemented by a form of "many to one to many" communication on digital social networks, where a commercial company has taken over the role of intermediary who controls the flow of information (Mejias, 2009). In networked learning information brokers might be hubs on networks, who recommend information, and to whom people are attracted because of their reputation. Studies using social network analysis show that opinions and beliefs are influenced by these "committed agents," who are not easily influenced themselves, but spread their message and information until a 'tipping point' is reached at which their "followers" adopt their point of view (Granovetter, 1978; Xie et al., 2011, p. 1). People are clearly influenced in their information behavior by these human conduits. The problem of course is that the reputation of these intermediaries is acquired not only because they have proven to supply interesting information, but also through the process described by Barabasi as "preferential attachment." Information brokers become powerful distributors on the network and make choices about the information and resources that are filtered to others (Boyd, 2010). One could argue that it would be more appropriate for this power to reside with the creators of the information, or with the information gatherers themselves as the broker does not have a responsibility to validate the information before distributing it as educators do. The "many to one to many" form might be well-suited to networked learning as long as the commercial intermediary does not have too prominent a role in influencing the information flow. This would mean that the social influence would not come from one or two prominent information brokers, but from a multiple of people to increase the reliability of the information. Social influence has always been important in the access of information on learning networks, but has evolved. Educators are no longer the main information providers with a responsibility to safeguard its quality and who serve learners with a mixture of information not only giving learners what might be exactly relevant in a search, but also the opposite, or perhaps the unexpected to make particular points or to engage learners in a thinking process. We would argue that as educators might not be available during networked learning, it is this mixed supply of information provided through the mediation of people that could advance self-directed networked learning.

Distinguishing the chaff from the wheat

With the emergence of social media web users themselves can now be in control of their information aggregation; they don't necessarily have to use information brokers or educators to validate their information. Networked learning

might take place outside the boundaries of educational institutions and one of the major tasks for any autonomous learner on an open online network is to identify useful elements within the overwhelming volume of unsorted information. Search engines do some sorting (or perhaps sorting to reflect commercial or other interests), and learners need to make connections between these resources in order to engage in thinking and learning, and possibly produce something new to share with others.

As the number of information sources has increased dramatically and information has also become more distributed, the need to work with information in a different way has become indispensable in order to evaluate its quality and maintain some coherence. The openness of the Web has made that people have access to growing numbers of data, not only comprised of basic pieces of writing, but also social interactions and cultural artifacts. As mentioned before, the Web is not a power free and hierarchy free environment, and people have already made a start with organizing their own streams of information and activities using information hubs, human filters, lists, tags and #tags.

An information folksonomy has emerged, a classification system not based on library or academic classification systems, but on the ordering of information sources by people, for instance in the form of key words such as tags and #tags as identifiers. This means that information that users value can be organized and stored in databases and retrieved in the format required. Boyd, however, would like this to go one step further, and believes that people should have access to tools

that allow them to get in flow, that allow them to live inside information structures wherever they are and whatever they are doing. They need tools that allow them to grab what they want and to stay peripherally aware without feeling overwhelmed. (Boyd, 2010, p. 2)

But how can this be done without losing control? And how might these information streams actually promote learning?

The semantics of the web and the storage of information in databases are increasingly important in the identification and categorization of information. Google for instance uses their algorithms to crawl the Web and find relevant information related to the search key words. This use of semantics and database storage makes it possible to personalize information. Computer scientists are currently engaged in developing sophisticated tools to help learners make sense of information. They are developing recommender and ranking systems that work in a similar fashion as the systems that internet firms such as Amazon apply to web-searching and purchasing behavior, and the behavior of “friends” (friends in the sense of social networking friends, or customers who bought the same book before) (Andre, Schraefel, Teevan & Dumais, 2009). One would of course question who decides on the content and the values within the algorithms and also what would be the conceptual drivers behind the algorithms—and would they be any use for learning if any form of human mediation in searching and information provision is lacking?

Learning recommendation based on relevance or serendipity?

An interesting discussion is currently taking place in the literature about the possibility and even the desirability of algorithms, being mathematical formulas, to make decisions about the resources that will be recommended to Web users. Of course to a certain extent the search engine algorithms are influenced by human editors (Goldman, 2010), but an important component to a search is trust; and could we ever trust a machine, even though it is tweaked by humans, to find *really useful* information for us? In the past we might trust educators to make decisions about the resources that could enhance our study, or we would go to the library and browse the shelves ourselves or use library services to find what we needed, but in the extended open networked environment in which people now learn, those behaviors have been shrinking. This was highlighted in research by Pardo and Kloos (2011) who used a virtual computer to analyze the information behavior of their students and found that students only used the university resources for 28.51% of their study. For the other 71.49% they moved outside the institutional boundaries and searched the Web. Our information supply is evolving into a mesh of interlinked online resources that could be powerful in learning if we are able to find what is relevant to the purpose of our search.

Learners take advantage of commercial search engines, based on algorithms that make decisions about information they receive on a daily basis. Search engines, however, don't necessarily cater to advanced intellectual inquiry as their top search results merely reflect the *general* information needs of the population as a whole by bringing up

relevant information based on some key words. Google and Facebook algorithms provide us “with the information that they think we want to see, rather than all we can—and should. . . . The way algorithms work means that the focus is on what we click on most often, rather than providing us with a ‘balanced information diet’ that also include things that are uncomfortable and challenging and that include other points of view” (Zetter, 2011, p. 1).

Heraclitus already highlighted in 500BC that “the unexpected connection is more powerful than one that is obvious” (Huron, 2007) and Gritton (2007) sets out a number of other purposes that people might have for particular searches to complement the directive one facilitated by search engines. These purposes would determine the best tools and search strategies to access the information. A search might be directive, to find a particular piece of information, or it might be capricious in nature, free flowing and characterized by a random move from link to link, or it could be semi-structured looking for inspiration. Another possible option could be characterized by browsing on sites that one might expect to contain interesting information.

Algorithm-based search engines and recommenders are very good at aiding in directive searches, but they are not so good at replicating *serendipity*; the chance of finding a gem of information, unrelated to a focused search, more as a by-product, that stimulates our creativity and thinking to arrive at a particular insight (Falconer, 2010; Andre et al., 2009). Andre et al. (2009) researched serendipity to try to understand how it could be introduced in recommender systems and posited that serendipity consists of two components: the finding of some unexpected, surprising, interesting information, and then by making connections to what is already known, perhaps in a particular domain, a creative insight might follow. They argue that the first part, the inclusion of the finding of unexpected information, might be facilitated through recommender systems, but the second part, the insight that might follow, which is related to learning, is much harder to achieve. As highlighted by Falconer:

The interlinked nature allows for increased opportunities for serendipity, but any automatic “enhancement” of what should be a wander through the park sniffing whichever flower takes our fancy, being told by any external agent what a flower might smell like. No. That’s no longer serendipity, that’s an enhanced search tool or an augmented results parser or whatever you might like to call it. To call it serendipity implies that you believe that some portion of your mind’s complexity, your memories and all the intuitive associations that go to make up you can be split off and embodied in a piece of maths.

Take a good hard look at what cutting edge neuroscience is actually telling us about our minds and how well we understand them. You’ll see that we are nowhere near being able to claim to be able to simulate serendipity, even if it were desirable to do so. (Falconer, 2010, p. 4)

Of course we have to balance the abundance of information with the ability to sift through it and find the best pieces for our learning needs. Algorithm-driven computer applications have so far not been able to automate serendipity, but only managed to go as far as suggesting content that “may be perceived to be serendipitous” (Andre, 2009, p. 309). Some authors highlight that serendipity is an important aspect in searching for information and in the creation of knowledge (Foster & Ford, 2003). Moreover, Gritton (2007, p. 6) argues that, “Serendipitous browsing does however have the potential to reveal connections between ideas that may otherwise go unnoticed, to stimulate ‘out-of-the-box’ thinking, and to challenge our mental models so that new learning can take place. In this regard, serendipity, free association and aimless browsing can lead to serendipitous learning” and is well worth pursuing. Furthermore, serendipitous learning is associated with “gaining new insights, discovering interesting aspects and recognizing new relations, which occur by chance or as by-product of other activities” and are related to people’s interest, prior knowledge and the setting of learning goals (Buchem, 2010, p. 1). If in an educational, or in a “networked learning” context outside formal education, critical and creative thinking is valued and seen to be important to advance learning, serendipity seems an important concept to strive for. After all, there are numerous examples in the literature to show that important discoveries and insights were facilitated by serendipity (Andre et al., 2009). But how could serendipity be stimulated in an autonomous learning environment?

Perhaps the greatest challenge in conducting a fruitful serendipitous investigation would be a change of our search strategies from looking something up and relying on brokers and search engine algorithms to filter our search results, to facilitating more randomness in our information stream. We must take control and find ways of incorporating web-searching into our thinking and reflection processes and pulling these processes into our own technological system that streams our information; the information on which we have decided ourselves, that is related to our own personal context, and from which we can pick and choose ourselves; an unfiltered but manageable store of resources.

Bouchard (2011) believes that even this is not enough, which there is something vital missing from this picture. To be an interesting component in a learning context and for a learner to use the information to create knowledge and to advance his or her learning, it would be desirable for the information not only to be filtered by ourselves, but to also be validated by other human beings:

For the first time, we as human beings are doing something that computers do not, namely recognizing each other as participants in ongoing conversations about the fluid nature of knowledge, and then attributing value to that knowledge as an evolving, changing thing. (Bouchard, 2011a, p. 294)

That is what current social media add to the earlier Web 1.0 developments: opportunities to share and communicate. Not just receiving information from one broker, or the mass media, but from a multitude of people on our network. The challenge would be to manage this stream effectively without being overwhelmed by the volume. New emerging collaborative services, such as micro-blogging tool Twitter and curating tool Scoop-It, facilitate networking, communication and sharing options with others, while information syndication tools, such as RSS aggregators and RSS readers, facilitate advanced search options that could aid in this development. One of the important factors of using these RSS and micro-blogging strategies would be that learners have full control over their information, resources and contacts, and over the access to their information.

RSS—the simple aggregation of information feeds

Rich Site Summary, or more popularly known Really Simple Syndication (RSS) was originally designed in 1997 by the web browser Netscape to customize web pages and to list the changing content on News websites (Downes, 2004). At the time it did not take off, but slowly and surely RSS has grown in popularity. So what does RSS do exactly? It delivers the news, and new developments that interest the user, directly and dynamically to her desktop. If creators of web resources include an RSS identifier to their site, people can subscribe to the stream of content produced on the site or blog, and RSS will then identify new items and display a “headline” from this content in an RSS reader through a regular synchronizing process, which means that the content is displayed together with other chosen feeds to produce a continuous stream of customized information and resources. This is a very convenient and efficient way of browsing through a multitude of new items and of course, the user controls the system; she can add or delete any stream that not quite matches her expectations, or even give a particular rating to some especially favorite ones and store it in one of her favorite bookmarking sites.

Micro-blogging tools for the sharing and amplification of information

The increase in popularity of micro blogging tool Twitter means that RSS links and feeds found through an RSS reader are being “amplified” and redistributed to contacts and followers that people have on their network in the Twitter communication environment. How does this work?

Twitter, a social media application that was first established in 2006, allows users to post messages of no more than 140 characters long and send these to people who are following them. People can follow others who they believe have something interesting to share. Users have started particular practices of including identifier codes in their messages, in the form of @ and #. This ensures that a particular person is identified in a particular message related to him in the case of the @, and that people can identify and search all messages related to a certain subject by using a keyword in combination with a #, producing a hash-tag, and can store this search in the form of a list. In addition, it is possible for users to amplify the same message they received from someone else, and pass it on to his own network of followers through the click of one button, which is called re-tweeting (Boyd et al., 2010). Microblogging messages have evolved to not just include a quick message about a certain topic, but to also contain links to web sites or blog posts, in addition to displaying these items in daily newspapers, which are Twitter aggregators that draw content from a combination of messages and multimedia from different sites. Educators are currently also experimenting with curating tools such as Scoop-It, which provide opportunities to curate messages and information on a particular topic, and add a longer comment than is possible on Twitter.

Of course carrying out a search is a different activity with a different purpose to the aggregation of information through RSS and microblogging or curation, and each of these has its own place in supporting the information needs

of learners. A search facilitated through an algorithm-based search engine provides fast direct answers to a query, while the user-controlled collection of information, mediated by human beings, might add to the validation of the information and to the level of serendipity.

How could these developments affect information behavior in networked learning?

RSS and Twitter offer advanced options for networking, for receiving and sharing information, and it seems that we are in a new era, where on the one hand we reach back to a form of village gossip communication through Twitter (although as was shown during the recent uprisings in Arab nations we can now do this on a global scale), while on the other hand we seem to link this “chattering” with a highly sophisticated form of personalized information aggregation and distribution that makes this combination interesting for learning. In the words of Bouchard:

We are confronted with what is missing from this picture, namely the negotiated construction of knowledge. This is perhaps the most intriguing development resulting from the advent of the network age, although it is more reminiscent of small village cracker-barrel exchanges than futuristic networks: humans need to agree on stuff, but before they can do that, they need to talk about it. (Bouchard, 2011a, p. 294)

Our human social nature makes that we communicate about what keeps us engaged, and in turn we reflect on activities and information and make connections with what is already known. In the process we validate our information and knowledge. The way we can aggregate RSS streams and pass links on to others through tweets and re-tweets means that we can now give ourselves and others access to a serendipitous stream of information. People we follow will send us pieces of information that they find interesting, while re-tweets will give us access to an additional network of people, perhaps with weaker ties to us than the people we follow, and consequently with a different angle to information than our own network. Moreover, the use of #tags to form networks and the incorporation of these in our messages gives us access to an even wider network of informants and information to raise the potential for serendipity. This information can then be stored for future use in social bookmarking applications, such as Delicious and Diigo, which in their turn also offer search and share facilities.

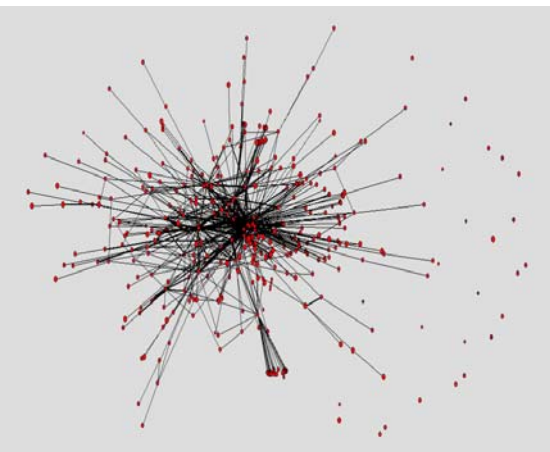


Figure 1. Visualization of the PLENK2010 network

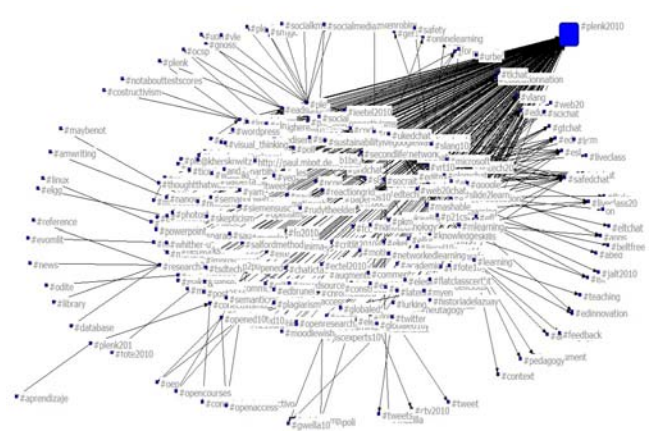


Figure 2. Connections between PLENK2010 Twitter network and other networks through #tag

We had the opportunity to test the extent of the influence of human mediation on information gathering in networked learning through research on a Massive Open Online Course in the Fall of 2010. The course was not organized by one institution that distributed content, but resources and the learning environment were distributed over the Web on blogs and in social networks. RSS and Twitter were used by facilitators and participants to aggregate information related to the subject of the course, Personal Learning Environments, Networks and Knowledge, and as options for communication. The 1641 participants used Twitter extensively, 3402 messages in total, and it was one of the participants communications tools of choice, which increased in use, and was highlighted by participants as important in receiving new and unexpected information. Figure 1 shows a visualization of the PLENK2010 Twitter network and the connection between different participants, while Figure 2 shows how PLENK2010 participants were

involved in other Twitter networks through the use of hash-tags. They highlight that not everyone was connected, represented in the outlying participants in Figure 1, but that some were highly connected in their extensive use of hash-tag networks. This proved to increase the streaming of serendipitous information onto the PLENK2010 network from other networks. The networks which contacts were engaged in were also relevant to the information aggregator, but relevant one step removed, with the potential of “unexpected relevance,” as Jarvis calls serendipity (Jarvis, 2010).

Increasing the level of serendipity on the learning network

These are only some basic indications of the positive effect of micro-blogging tool Twitter on the level of serendipity in open networked learning and that serendipity might be increased through communications with other people. If we were to define what would heighten a “degree of serendipity” on a learning network, it would be using the following factors: 1. The level of control over the information gathering process. 2. The involvement of people. Not only the number of contacts would be important, but also the degree of separation of the contacts and networks from the information gatherer, as it seems a higher level of serendipity is achieved if the information provider is somewhat removed from the information collector, while a higher level of relevance is realized from contacts closer to the collector. 3. The aggregation of information feeds. Not only is the number of feeds important to achieve serendipity, but also the variation of these feeds.

One would expect that the higher the level of control, and the higher the level of micro-blogging re-tweets, #tags networks involved in, and the spread of RSS feeds would be, the higher the likelihood of unexpected and challenging pieces of information and serendipity in the aggregator’s information stream. This level of unexpectedness would also depend on the right level of distance between the aggregator and his contacts or feed/link providers. If the distance is too great, the information becomes too random and could become irrelevant, but if it is very close the level of unexpectedness shrinks. Especially receiving re-tweets would heighten serendipity as these tweets would be provided by contacts of contacts, so still be reasonably close to the aggregator. In the absence of an educator we would welcome a high level of serendipity in the networked learning environment as it would add to the level of critical reflection and analysis and depth of learning.

Conclusion

This paper has highlighted some challenges and opportunities for learners in dealing with the abundance of information available at a time when new technologies are emerging and shaping the new information landscape. The role of the educator might slowly but surely change, from provider of information to provider of guidance about technology used to aggregate information in the most suitable fashion to advance learning. Technologies are now available to empower the learner to take control over the information stream him or herself and start to be proactive in the quest for valuable information. In the words of Boyd: “As we continue to move from a broadcast model of information to a networked one, we will continue to see a reworking of the information landscape. Some of what is unfolding is exciting; some is terrifying” (Boyd, 2010, p. 2), but it is clear that to make the most of emerging technologies learners will have to take an active role in shaping their own learning environment and in controlling information flows and communication tools.

An area for future inquiry would be to research more in-depth how emerging technologies can help people with the process of shaping their kaleidoscope of information most effectively. We need to know how people position themselves at the center of this process and how they can ensure that it provides complex, colorful and shifting patterns that are shaped by human connections and interactions, in order to at times surprise and challenge them. Empirical research to further test a ‘serendipity index’ based on micro-blogging features and RSS feeds might help in predicting the level and increase of serendipity in the information stream.

It will also be important to research how levels of serendipity can be heightened in information gathering and especially if this will at all be possible by automated means through recommender systems. Even though attempts are being made to include serendipity in these new technologies, it seems that this can only be achieved at a very rudimentary level and that recommenders currently mainly provide information relevant to a search term used. The use of RSS and micro-blogging tools, such as Twitter, seem to be more promising in dealing with high volumes of

information as human mediation means that a higher level of serendipitous information is being collected than would be possible in an automated environment.

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