IMPLICATIONS OF OPEN EDUCATIONAL RESOURCES FOR YOUR MEMORY OF LINKS

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Abstract

Open contents also open the door for acquiring a large variety and quantity of new knowledge. They are always available for us, and once they are located and selected, we only need to wait as long as necessary to have enough time to learn them. Storing contents on very different ICT devices may contribute to freeze the overload of our memory, but some studies affirm that a smaller cognitive effort is made when we know the contents are ready out there, in the Web. This article is focused into the implications of incorporating different digital open resources in your 'Memory of Links' (MoL). This concept, the MoL, represents the space of memory which needs to be allocated in the brain for storing those links. The seeking and selection processes, the memorization and storage of links, the ability to remember some notions about the stored information and the need of organization of those linked resources in external devices vary according to the different individuals. This fact has been checked through a study carried out with 58 students who were surveyed and interviewed in order to obtain information about the way they filled their MoL. The individuals showed distinct behaviors in respect of the number and type of the stored links, storage devices, structuration of information, link management tools, etc.

Keywords: Open Educational Resources, Memory of Links, Connectivism, Resource Allocation, Skill Acquisition, Lifelong Learning

Introduction

The vast amount of open resources residing in Internet is changing the way we learn (Brown & Adler, 2008). Actually, a huge part of the Internet is open for education. In addition to these contents, which are stored in Web sites that specifically include the word 'open' (Open Knowledge, Open Books, Open Journals, Open Badges, Open CourseWare –OCW– , Massive Open Online Courses –MOOC-, Open Educational Resources –OER– , Open Distance Learning –ODL–…), there is a vast ocean of free resources. The William and Flora Hewlett Foundation defines OER as "teaching, learning, and research resources that reside in the public domain or have been released under an intellectual property license that permits their free use and re-purposing by others. Open educational resources include full courses, course materials, modules, textbooks, streaming videos, tests, software, and any other tools, materials, or techniques used to support access to knowledge" (The William and Flora Hewlett Foundation, 2013:16). Within this paper the term 'open' is used to refer a free access resource. This foundation admits that since more players are adopting 'openness', the definition of 'open' can be diluted (ibíd.). Indeed, there are multiple definitions of open learning. Open learning is a learning model which does not force the students to follow the same path, the same contents, the same thinking, but on the contrary it fosters that each individual can custom-design their own education, build their own syllabus, with different resources, different methodology, different assessment forms and, what is better, at his/her

own pace. From this point of view open contents could be all those assets that can freely take part in the learning experience of an individual.

There is an intense debate to determine whether having so many resources only one click away is damaging learning. After the pioneering work of Bush (1945), Nelson (1965) and others, laying the foundations of the future Web and hypertext, today this facility has changed the search-and-select habits of the people. Carr (2008) is even wondering…, is Google making us stupid? He emphasizes the results of a study whose conclusions indicated that online researchers typically read no more than one or two pages of an article or book before they would 'bounce' out to another site. In a similar vein, the experiments conducted by Sparrow et al. (2011) found that people are less likely to remember information when they are aware of its availability on online search engines. Gray et al. (2006) state that when we try to measure the trends to choose between the internal memory and the information stored in external devices, individuals draw upon one or another store depending on the time which is supposed for retrieving the information, regardless of where it is.

There is no denying that Internet has dramatically changed the state of education over the past 20 years or so. Furthermore, a wide range of secondary type memories, Internet spaces and devices, make possible that individuals choose where they prefer to store their resources. The time required to find the needed information is lower than before the existence of Internet but, at the same time, we spend more time seeking, selecting and archiving a much higher amount of contents. According to Bergman et al. (2009), people have a resistance to deletion. As a result, a very large quantity and variety of resources, including texts, images, videos, music, 3D objects, software, e-mail messages, people comments, etc., must be stored or bookmarked in different ICT devices. Therefore, links between our biological memory and the external resources are being created all the time. In this document the term 'link' is being used in reference to the location of any educational object we have stored or bookmarked (not necessarily an URL online, in the Web, but any educational digital object saved on any ICT device). So, a part of our brain memory, which we call the 'Memory of Links' (MoL), is constantly used for keeping the locations where our most precious assets reside.

Often, we make an effort to remember the location of these resources, that is, to retrieve the link from our MoL. The locations which we are able to recall have become part of our Memory of Links. This association process is near to connectivism (Siemens, 2005). In his book, Downes (2012:325) argues that "connectivism is the thesis that knowledge is distributed across a network of connections". But connectivism does not make emphasis in the importance of remembering the links, and managing and reviewing them for the future learning. These are the important implications that the existence of such a group of open contents has for our MoL.

The MoL concept is only related to memory, whereas distributed cognition (Hutchins, 1995), embodiment (Clark, 2008) and even connectivism (Siemens, 2005) have mainly to do with cognitive reasoning processes which are substituted or helped by the social community or by the machines. Sutton et al. (2010) have studied the collaborative recall phenomenon. They describe an empirical research on socially distributed remembering, aimed at identifying conditions for mnemonic emergence in collaborative groups. Another research is addressing the problem of the massive storage of personal information; people is collecting media and building their 'memories for life', but "this abundance of digital media means that people are now required to organize their personal data, since there is a lack of useful commercial products doing it for them" (van den Hoven, Sas & Whittaker , 2012:2].

The resources, which have been bookmarked or stored, are usually in digital format somewhere; they constitute the extended memory. Probably, you will save them in your physical or virtual hard disk, in a folder of your pendrive, in your phone memory card, or you will bookmark them in your browser favorites, or you will write an entry about them in your

blog or in a social network… or all of these places at the same time. But if there is no link from your MoL towards them, they will have the same usefulness for you as if they did not exist and they will be unable to produce further learning.

These open contents, that we have at our immediate disposal in our ICT devices, allow us to build our custom-made learning path. Thus, free resources make easier to selectively choose the information which is near our preferences. They foster non-formal and lifelong learning. One disadvantage is that the self-selection of contents is usually made without supervision (except in MOOC). There is a risk to browse open contents which are far from the individual's zone of proximal development, referred by Vygostky (1978). That means that the individuals' audacity may take them towards resources which are far from their immediate comprehension range. Fortunately, on the Internet there is an army of people ready to help and intelligent recommender systems are developing quickly. But the memorization problem remains.

In short, the MoL is inside our biological memory and it contains the links or connections to external resources. These addresses may be URLs, but usually the MoL recalls the location in the form of a device, or a part of a device, like a hard disk, a folder, a pendrive, a smarphone card, a browser bookmark or some list of links. All these external resources, as long as they exist and the link continues being part of our MoL, make up our extended memory. The MoL and extended memory concepts have been represented in Fig. 1.

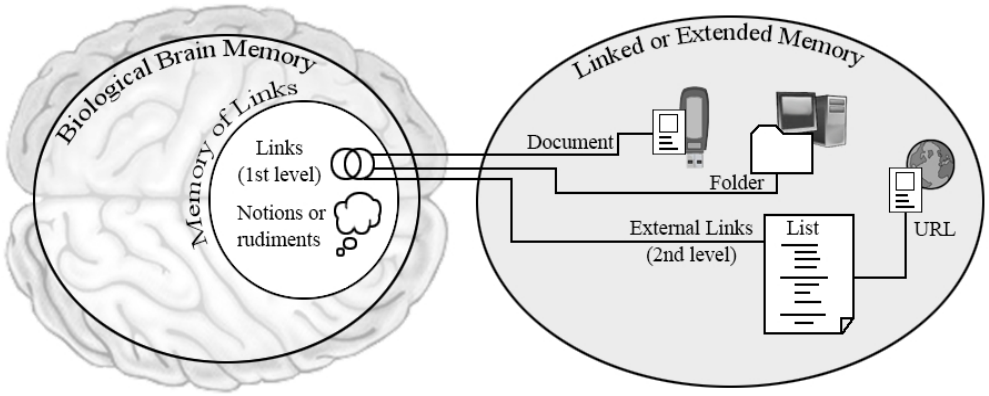

Figure 1. Conceptual representation of MoL as a part of the brain biological memory and its connections with external information (extended memory)

Objectives of the Research

We think that the explained concepts may have an essential importance in the educational progress of an individual. The consequences derived from a poor or inadequate management of the MoL (internal connections) and their associated extended memory (external resources) may suppose a learning disadvantage in the long term. So, it has been intended to shed a bit of light on some questions which are:

- To know how the students proceed when they select and store open educational resources for building their own knowledge. Do they select distinct types of resources? Do the instructor's action serves as a stimulus?
- To know what are the students' preferred methods to organize their selected contents. Do they store or bookmark them? Do they use many devices or storage locations? What is the structure of their extended memory?

Whereas content curation, collaborative filtering and content-based recommender systems are being theoretical and empirically studied, little or nothing is known about the behavior of the users to organize these contents in their brains and how successfully they recall them with learning purposes.

The following study may contribute to clarify this matter.

Methodology

A sample group of 68 volunteer students was initially considered. All of them pertained to the same population and were studying a university education degree. Every student had at least one institutional e-Mail account, access to the institutional Moodle and access to a shared folder in Google Docs. This was important because these tools were used as medium to communicate with them.

The whole group was asked to build their own learning path using open contents. They had to select contents about a theme they did not master. The chosen topic was 'astronomy', which was away from their current studies. The only conditions were two: 1) the set of resources collected by them had to be greater or equal than 10, and 2) the contents should be simple, educational and motivational for them. Initially, the most part of the students knew almost nothing about the topic, only some notion or Web site at best. 10 students acknowledged having some knowledge about astronomy. They were discarded from the sample because they could have already selected resources on this matter. In this way, the bias was removed for the purpose of this research. The final sample (the 58 remaining students) was randomly divided in two equal-sized groups, called 'treatment' and 'control' (n1=n2=29).

Both groups of students had to search and select information from different Web sites during one week for elaborating their astronomy self-learning collection. No instruction was given about the subsequent storage of the selected resources. The treatment group (G1) received 15 interesting astronomy-related links to open contents, including videos, speeches, interactive activities, blogs, etc. These links were delivered by the teacher via e-Mail (5 of them), Moodle (another 5) and through a shared Google Docs folder (the last 5). They included references to digital videos, presentations, blogs, interactive activities, real-time data sites, conventional Web pages, etc., all of them in Internet. The control group (G2) received no link.

As a sample of the links delivered to the treatment group:

- Video: How bigs are the objects floating in our Universe?
  https://www.youtube.com/watch?v=sUqmamlW9cc
- HTML Page: Cassini-Huygens Mission to Saturn
  http://www.nasa.gov/mission_pages/cassini/multimedia
- Interactive App: Google Sky
  http://www.google.com/sky
- Interactive App: 360º Panoramas of Mars
  http://www.panoramas.dk/mars/

Several quantitative data were gathered through a questionnaire applied to all the participants. The resulting Cronbach's alpha coefficient for the whole set of items was 0.8. Additionally, 10 members of the G1 group were interviewed in order to unveil some qualitative data related to their habits and extended memory structure.

Results and discussion

A. Questionnaire results

The questionnaire showed interesting data about the number of different devices the students had used to store the information, the number of links and the type of resources collected. No information was obtained about the number of times each resource had been visited. This last data would have been helpful in a longitudinal study to check the long-term behavior of the students in respect of the stored resources, that is, if they select and store resources and afterwards forget about them, or, on the contrary, they turn to them periodically.

In order to check if the delivery of resources by the teacher had influence into the 'number of resources collected by themselves' (*NumOERThem*) a t-test was used (Table 1). Previously, Kolgomorov-Smirnov and Shapiro-Wilk tests indicated normality for both samples, G1 and G2, in relation to the *NumOERThem* variable. There were no significant differences in respect of variance according to the Levene test. The t-test for two independent variables indicated significant differences in means (sig=0.004). Therefore, there is a high probability to consider that the 15 links delivered by the teacher served as a stimulus to foster the discovery of other resources.

		Levene's Test for Equality of Variances		**t-test for Equality of Means**						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
NumThem	Equal variances assumed	.177	.676	2.965	56	.004	4.68966	1.58160	1.52134	7.85797

Table 1. T-test applied to the number of assets collected by themselves between treatment and control groups.

The resources were downloaded and stored in offline devices or bookmarked or saved in online spaces. These variables did not show significant differences. The percentages are similar in both groups, but when comparing the number of resources stored offline in opposition to online, the percentage was approximately 3 times higher in favor of the online resources.

The number of locations used to store was higher for the G1 group, but it could be due mainly to the influence of the delivery of links by the teacher through 3 different channels. Many students left the resources in the same medium by which they had received them.

The presence of mixed offline and online resources and the existence of a relatively high number of locations where the OERs were stored or bookmarked, for a simple set of astronomy contents, confirms the dimension and complexity that the MoL and extended memory can reach.

Finally, the students collected resources of six different types. Table 2 shows what amount of resources of each type did they collected by themselves. Videos, HTML pages and PDF documents were predominant (it was considered that HTML pages contained text-and-image contents or image galleries).

B. Interview results

The interviews revealed that students' habits differ from one another. Some of them prefer 'offline storing' while others opt for 'online storing'. The first ones usually keep their resources in offline devices as pendrives, hard disks or phone cards. This behaviour has been found for all kind of resources except video, which is usually bookmarked, not downloaded. The participants said that video is complex to download and it occupies a lot of space. The second ones are those who prefer to link in bookmark lists in their browser or leave them in their email inbox or virtual drives. Some of them use indistinctly both mechanism 'offline' and 'online'. They face the greatest challenge to organize their MoL, because they have to remember different places and the possibilities of synchronization among these storage locations are usually limited.

The structure of organization of the OER was also obtained from the personal interviews. They had to explain where the resources were and how. Students acknowledged to have visited the links delivered by the teacher and they described them as very interesting, but they did not move the links from the place in which they had received them. That means that the received links remained in their email box, Moodle space or Google Docs shared folder, respectively. This is very important because, in the future, it will be very difficult for

them to remember where those links were stored. Centralization, synchronization and organization habits were not detected in almost any interviewed student.

However, in respect of the contents they had found by themselves, it was noticed that they organized them in browsers by means of folders of bookmarks. The structure of bookmarks was lineal or in a two-level hierarchy. Some contents were downloaded and stored in pendrives or hard disks, especially PDF. But HTML pages and videos were mainly accessed from their links of reference, not downloaded. Helpful management tools for bookmarks or files were not detected in any interviewed student. Moreover, anyone knew or had used tools like *Diigo*, *EverNote*, *OneNote*, *LastPass*, etc. This absence of use of management tools is a serious handicap for learning because this software is extremely useful to help in the organization of our MoL and extended memory.

Some questions were done about the subject matter related to the resources selected by them. They had some notions of the most part of resources, especially on images and videos, but in relation to texts, sometimes they had no idea of the contents of resources they freely saved or bookmarked. The recall of notions about a resource is as important as the retrieving of the link, because if either of both fails it means that the strength of the link in our memory is weak or null.

Group	***NumOERProf***	***NumOERThem***	***Total***	***StoredOffline***	***StoredOnline***	***NumLoc***	***TypeThey***	
	Number of OER they kept from those 15 delivered by the teacher	***Number of OER collected by themselves***	***Total number of OER they kept (including the teacher's delivery)***	***Number of total OER which were downloaded and stored offline***	***Number of total OER which were bookmarked or saved online***	***Total number of locations used to store the OER****	***Type of OER collected by themselves (average)***	
G1 treat	mean=13.82 (36.6% of total)	mean=23.93 (63.4% of total)	mean= 37.75 (100%)	mean=10.6 (28.0% of total)	mean=27.2 (72.0% of total)	mean=5.6	HTML Pages: Games: Interact. Apps: Maps: PDF Docs: Presentations: Sound/Speech: Videos:	5.6 0 3.5 0.4 4.6 2.2 0 7.6
G2 control	none (0% of total)	mean=19.24 (100% of total)	mean=19.24 (100%)	mean=5.2 (27.2% of total)	mean=14.0 (72.8% of total)	mean=3.4	HTML Pages: Games: Interact. Apps: Maps: PDF Docs: Presentations: Sound/Speech: Videos:	3.9 0 2.0 1.2 4.0 2.6 0 5.5

Table 2. Number and Types of Resources which were stored in MoL/Extended Memory

* The number of locations refers to the place in which the OER has been stored; for example, a folder in a pendrive, phone card, hard disk, a bookmark in a browser, in a virtual drive, an email box, etc.)

Conclusion

The educational MoL is the everyone's internal library of links which are connected to data and knowledge. It is self-made by the individual by means of the memorization of new connections to external resources. It resides in the brain memory and it represents the starting line of future learning processes. Open resources represent a free and available source to extend our MoL and external memory. The individual is responsible for searching, selecting and organizing or storing the resources found. Thus, this voluntary process may foster divergent and generative thinking and also metalearning, thus, better understanding their own learning.

The delivery of interesting resources by the teacher may lead to awaken the curiosity and inquisitiveness of the learner. In our study, those students who received interesting links from the instructor (treatment group) were more active gathering educational assets. Therefore, the instructors have to foster the interest of the students for searching and indexing new resources about our subjects. Perhaps, these collecting processes, in the long term, can even redirect the academic preferences of a student.

The participants used indistinctly an important number of offline and online external memories and devices. It gives an idea of the complexity to manage their whole set of locations. At the same time, they had no habits of information management, neither of centralization, synchronization, updating, reviewing, etc. This fact is in consonance with another research which reveals that personal data are not as well organized as their owners think (Whittaker, Bergmana and Clough, 2010). As if this was not enough, a lot of devices, for example USB memories, digital cameras, etc., have not an Internet connection, and it makes more difficult the extended memory management.

The challenge to deploy new and powerful tools which help us to simplify the requirements of our own MoL is launched.

References:

Bergman, Ofer, Simon Tucker, Ruth Beyth-Marom, Edward Cutler, and Steve Whittaker. "It's not that important: demoting personal information of low subjective importance using GrayArea", in Proceedings of CHI 2009, pp. 269–278, Boston, MA: ACM Press, April 2009.

Brown,John Seely and Richard P. Adler. "Open education, the long tail, and learning 2.0", Educause review, vol. 43, no. 1, pp. 16–20, Feb. 2008. [Online]. Available: http://open.umich.edu/oertoolkit/references/mindsonfire.pdf. [Accesed: May 22, 2014].

Bush, Vannevar. "As we may think", Atlantic Monthly, no. 176, pp. 101–108, July 1945. Reprinted in Vannevar Bush, Interactions, vol. 3, no. 2, pp. 35–67, Mar. 1996.

Carr, Nicholas. "Is Google making us stupid?" The Atlantic, July 2008. [Online] Available: http://www.theatlantic.com/magazine/archive/2008/07/is-google-making-us-stupid/306868/ [Accesed: May 22, 2014].

Clark, Andy. Supersizing the mind: embodiment, action and cognitive extension, New York: Oxford University Press, 2008.

Downes, Stephen. Connectivism and Connective Knowledge, Ottawa: National Research Council Canada, 2012. [Online]. Available: http://www.downes.ca/files/Connective_Knowledge-19May2012.pdf. [Accesed: May 22, 2014].

Gray, Wayne, Chris Sims, Wai-tat Fu, and Michael Schoelles. "The Soft Constraints Hypothesis: A Rational Analysis Approach to Resource Allocation for Interactive Behavior", Psychological Review, vol. 113, no. 3, pp. 461–482, Jul. 2006.

Hutchins, Edwin. Cognition in the Wild, Cambridge, MA: MIT Press, 1995.

Nelson H., Theodor. “A file structure for the complex, the changing and the indeterminate”, in Proceedings of the 1965 20th national conference (ACM '65), L. Winner (Ed.). New York, NY: ACM, pp. 84–100.
Siemens, George. “Connectivism: a learning theory for the digital age”, International Journal of Instructional Technology and Distance Learning, vol. 2, no. 1, Nov. 2005, pp. 3–10.
Sparrow, Betsy, Jenny Liu, and Daniel Wegner. “Google Effects on Memory: Cognitive Consequences of Having Information at Our Fingertips”, Science, vol. 333, no. 6043, pp. 776–778, Aug. 2011.
Sutton, John, Celia Harris, Paul Keil, and Amanda Barnier. “The psychology of memory, extended cognition, and socially distributed remembering”, Phenomenology and the Cognitive Sciences, vol. 9, no. 4, pp. 521–560, Nov. 2010.
The William and Flora Hewlett Foundation. “Open Educational Resources: Breaking the Lockbox on Education”, The William and Flora Hewlett Foundation, Nov. 2013. [Online]. Available:
http://www.hewlett.org/sites/default/files/OER%20White%20Paper%20Nov%2022%202013%20Final_0.pdf. [Accesed: May 22, 2014].
Van den Hoven, Elise, Corina Sas, and Steve Whittaker. “Introduction to this Special Issue on Designing for Personal Memories: Past, Present, and Future”, Human-Computer Interaction, vol. 27, pp.1-12, Apr. 2012.
Vygotsky, Lev. Mind in society: The development of higher psychological processes, Cambridge, MA: Harvard University Press, 1978.
Whittaker, Steve, Ofer Bergman, and Paul Clough. “Easy on that trigger dad: a study of long term family photo retrieval”, Personal and Ubiquitous Computing, vol. 14, no. 1, pp. 31–43, 2010