The Web as a learning environment

Focus on contents vs. focus on the search process

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Abstract The Web is widely used, in educational settings, typically as a repository of contents to be learned. Within this approach, the Web-searching process tends to be perceived merely as an obstacle on the way to the contents. This paper suggests instead that searching the Web requires information problem solving competences which are in themselves key requisites for literacy in a knowledge society and deserve to be fostered as explicit goals in educational settings. Given the complexity of the competences involved, it is suggested that educational intervention focus on practice with information problems which should be thin in content, but rich in opportunities for bringing to the foreground and refining some critical areas of the information problem solving process.

1 Introduction

The Information and Communication Technologies (henceforth, ICTs) influence not only the way single persons and groups construct and organize their knowledge, but even the structure of knowledge itself. In this respect, the Web is exemplary. It proposes a representation of knowledge as scattered in several and unsettled conceptual networks, in which disciplinary boundaries are flimsy, far away from traditional encyclopedic classification. Information on the Web, in addition to mirroring the breadth and fast pace of change in today's knowledge, shows many new features: it uses multiple communicative codes; it is interactive; it can be easily modified and reused; it comes from many different sources, with different goals, on a variety of topics; its quality is highly variable; most of all, it can be quickly and easily accessed by means of search engines and hypertextual links.

All these elements concur to build an information landscape which has nothing of the symmetry associated with words like network or web, and rather resembles a

picture by Pollock or a labyrinth described by Borges. Not casually, this unfamiliar environment has been conceptualized, since its inception, in metaphorical terms.

If one takes into account the most widespread metaphors of the Web [1, 2], at least of the Web 1.0 which is the focus of this paper, two main patterns emerge. The first corresponds to a focus on the information contained in the Web, and consider the Web as a *container*, a *virtual library*, an *encyclopedia*. It is a static and tangible view, which gives value to the *places* one can arrive at, and to the quality of the information they deliver. A second cluster of metaphors corresponds instead to a more dynamic and abstract view of the Web as a *space* for traveling. In this case, not just the destination places are valued, but rather the *paths* one walks to reach them, and the quality of the journey.

In considering how the Web can be used as a tool for accessing remote information in educational settings, the container or library metaphor correspond to a focus on the *contents* the learner is required to access, while the travel space metaphor suggests rather a focus of the *processes* activated by the learner.

These two visions can easily and fruitfully coexist. However, if one vision prevails over the other, differences will emerge in the way the Web is used and in the type of learning that is activated. In the travel vision, for instance, being able to navigate the web sea is in itself a desirable competence and the journey is view as a key learning experience, while in the vision of the web as a container navigation is something the student *has* to learn only to overcome obstacles and reach content-rich destinations.

This reflection paper, based on research and teacher education activities carried out on this theme since 2002 and in part accounted for in [3,4], explores some implications of both visions for Web-based learning activities, and suggests that the journey metaphor may be especially appropriate to address a set of skills which are crucial to the cognitive flexibility required in a knowledge society.

2 Focus on Web contents

Following a typical path with new technologies, the Web has been appropriated on the model of pre-existing tools. Unsurprisingly, in educational contexts the Web has rapidly become a tempting alternative to books as a source for topical research tasks. The same sort of task which had once required the students to laboriously collect information from encyclopedias and textbooks can be now accomplished with far less effort, on a variety of subjects, and a few clicks of a mouse are enough to produce a text or presentation which one may choose to regard as one's own.

While it does make general sense to look at the Web as an information container, this attitude is not necessarily the most fruitful from an educational point of view. Since information on the Web is copious an easily reusable, there is a very concrete risk of plagiarism, superficiality or cognitive indolence, especially when the research subject is uninspiring and the task is too vague and requires the student simply to collect, (maybe) restructure and present information.

In itself, there is nothing wrong in acquiring information, which is indeed a resource for knowing. But knowledge is not just the result of summing up

information, it is a matter of connecting, rather than collecting [5]. Information needs to be digested, absorbed, integrated with previous knowledge and reused to produce new understanding.

To this goal, if the Web-as-container has to become an useful resource for learning, collecting information ought not to be the bottom line, but rather a point of departure for answering questions, building hypotheses, taking decisions, comparing, understanding. In other words, for reaching conclusions which do not already exists as pre-packaged items in the collected information. For example, asking the students to carry out a research project on Leonardo's inventions is different from asking them to discuss and compare, on the basis of the information they can collect, which of Leonardo's inventions have been the most influential and why.

This approach is the rationale behind the so-called *WebQuests*. This term, which has been coined by Bernie Dodge [6], refers to highly structured learning activities in which information on the Web is the basis for various tasks and problem-solving activities: e.g., preparing the itinerary for a journey to a foreign country, while respecting some time and money constraints; designing a playground for the school; discussing the implications of different options for solving the problem of acid rain. The webquest.org website is host to hundreds of proposals, organized according to school level and subject matter. Some or these proposals are quite stimulating, others may appear a bit artificial. In the whole, however, WebQuests do constitute a rich source of inspiration for teachers who wish to integrate the use of the Web in their classroom.

However, in a typical WebQuest the use of the Web is somewhat limited, since the student is provided with a pre-selected list of websites to use as a search space. Moreover, students usually receive detailed direction through the whole learning task and are not accorded a large autonomy. In other words, focus of the activity is the *reuse* of information, while the *journey* to acquire this information is perceived as a waste of time or diversion: Dodge explicitly writes "Because pointers to resources are included, the learner is not left to wander through webspace completely adrift" [6]. This is a quite understandable choice in case of complex tasks with focus on contents. However, safe navigation on pre-defined routes and step-by-step guidance along the path may not help fostering the competences and self-confidence required to find the way by oneself and to build one's own maps and connections to navigate the Web [7]. One may wonder whether it might sometimes be worth swapping complex research themes for simpler, more process-oriented inquiries, mainly aimed at fostering autonomous information problem solving competences. Because the *salt of the Web*, what the Web delivers best, is indeed is the opportunity for the user to find by her- or himself the needed information, on the most different topics.

3 Focus on the search process

When one considers the Web mainly as a huge virtual library, it becomes easy to overlook another most innovative feature of this environment: the way it provides access to information. The billions of pages that make up the Web would be of little use if it weren't possible to sift through them by means of hypertext links and search

engines. Turning attention on the way people find information on the Web means shifting focus from information as a *product* to information as a *process*, from the destination to the *journey* that leads to that destination.

Learning how to move through information to reach a goal is indeed crucial to a profitable use of the Web even if one regards the Web primarily as a container. In this case, however, the search process is just a prerequisite for accessing valuable contents. The attitude we suggest in this paper is instead to regard the information problem solving process as valuable *in itself*, as an opportunity for activating a range of competences which, maybe in different forms, have *always* been key components of advanced literacy [8], but are slow to be incorporated into school curricula [9], especially in educational settings based on a view of learning as transferring sanctioned contents from books and lectures into the minds of the learners, that is a view which is discredited in theory but still widespread in practice [5: 14-18].

Research on Web searching activities (a survey of approaches in [10]) suggests that information problem solving on the Web is a highly dynamic process, in which sequences of actions (browsing in Web-sites, using search engines, examining documents) are rapidly and frequently iterated [11]. Differences in age, Web experience, domain knowledge, cognitive style and also type of problem are all factors that deeply influence the success rate and strategies of people trying to solve an information problem on the Web [11-15].

A key difference between expert and novices lies, according to [12], in the monitoring process: while experts plan their searching with a clear view of their goals and of the way information is organized on the Web, novices have no overarching strategy and are mainly driven by what they can see on the screen, that is by the external representation of the data. In addition to the overall monitoring of the process, [9] identify as critical areas the translation of the problem into questions, the choice of search terms, the choice among search results and the evaluation of the sources of information. It is worth noting how most of the competences identified in the problem solving model represent high-level skills which are both important and difficult to master already in a context of pre-digital literacy. The process that emerges from these studies is a dynamic and complex activity with multiple components, in which ICT specific skills integrate with a constellation of more general literacy competences, as synthesised in figure 1.

How can all these competences be acquired? Several experiences of educational intervention on Web searching have been carried out in recent years (a review in [9, 16, 17]), and some inconsistencies in the results of direct instruction suggest that sound information search habits on the Web cannot be taught once and for all [18] and that learning the technicalities of the Web should go hand in hand with the development of the competences, strategies and attitudes that lay at the basis of a knowledgeable use of information resources.

Considered the complexity of information problem solving on the Web, but also the fruitfulness of the underlying processes, our suggestion is to approach it in educational settings through frequent and unassuming practices which are thin in content, but rich in opportunities for focusing on the critical areas.

Obviously, Web-search in the classroom requires some basic know-how about using search engines and browsers, and about the way information is made available on the Web. At the same time, the prerequisites for starting are minimal.

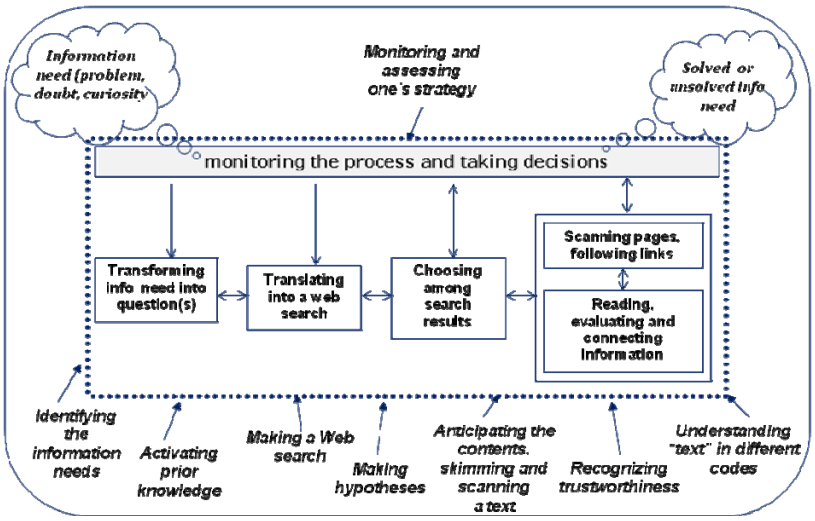

Fig. 1 – A model of the information problem solving process on the web.

4 Highlights on the process

Let us imagine to engage a group of students with questions out of pure curiosity: "You are traveling to Easter Island in February. Will you take your swimsuit with you?"; "For what reason are red and bleu the colors of the Genoa Football Club?"; "Was Einstein indeed a bad student?"; "What is the name of the Botswana currency and why is it called so?". These and similar questions have been tried out with small groups of Italian teachers and students in the years 2002-2006 [3, 4].

The themes are not especially relevant in themselves and it is of little concern whether the students will later be able to remember the answers. The questions do not require specialized content knowledge, nor advanced Web proficiency. However, searching the Web for an answer will elicit some nontrivial competences, as long as the Web does not hold explicit answers or the possible answers contradict each other (this was true for those questions, at least in Italian, at the time of our experiences).

All the proposed activities will require the user to choose a search strategy and, typically, ask a question to the Web by means of a search engine. The questions will probably range (or evolve) from one-word search strings (just "Genoa" or "Botswana" or "Einstein") to more complex ones with a narrower focus. The student will then browse the results and figure out which items in the list are more promising, open a few web pages and skim their content to decide whether or not to read further. When a page seems to deserve more attention, the student will then look deeper to identify key passages. Or the student may realize that the search string was inadequate in the first place and choose a new one or an entirely different strategy. He or she might develop an hypothesis about the answer (e.g., that Einstein indeed was a bad student) and look for cues to confirm it (e.g., Einstein's school reports). Along the way, curiosity may spur the student to deviate from the main question and follow new links, and it may even happen to get lost, or to make more interesting

discoveries than one would have foreseen (e.g., about the British origins of the Genoa Football Club). The students will differ widely in their strategies. Some of them will aim at locating a pre-defined "correct answer", while others will be more focused on building by themselves hypotheses of possible answers [4, 19]. Some other student will just say: "I looked in the Genoa website" or "in Wikipedia, and it does not say anything. Also, there is nothing on the subject on the Web". Others will say "This site shows Einstein's school report, it's full of 4 and 5, he was indeed a bad student". But if the teacher manages to establish a climate of curiosity and reluctance to accept skin-deep answers – for example by asking the students to investigate whether the mark system in Einstein's report was the same as the Italian mark system – the process enacted through a Web-search activity will activate a rich set of competences.

In the following are presented some highlights of critical competences which can easily be brought to the foreground and refined while examining small, manageable tasks.

Activating multiple reading strategies Reading on the web elicits a wide range of reading competences: e.g., browsing search results and deciding whether or not to click on a link, on the basis of the anticipated content; *skimming* the text for getting the general meaning, or *scanning* it to locate a piece of information. A recent analysis highlights for example how a reading task on the web shows a higher incidence of forward inferential reasoning and requires multi-layered reading processes across the hypertextual space of the Web, compared with reading on paper [20].

Recognizing trustworthiness The search string "Einstein was not a good student" returns, at the moment we write, about 400 results, while than the string "Einstein was a good student" returns just 5. However, this is not a good reason for buying the first option, as further investigation will show. Contradictions, of which the Web abounds, show easily the need for assessing the reliability of a piece of information. Information should be judged, compared to other sources and sometimes recognized as biased, unreliable or downright deceitful. Information assessment skills are important not only because the Web often contains unreliable sources, but because reading critically is *in itself* a competence that deserves to be fostered. In this respect, the variable quality of information on the web, and even the presence of misinformation, instead of being regarded as a problem, can rather be regarded as an opportunity for real-life practice in critical literacy and lie detecting [21].

Building hypotheses While navigating on the Web, at any moment the user is faced with choices to make on the basis of hypotheses on the contents of the Web or on possible answers to his information need. *Shall I read before this or that? Shall I rephrase my search? Is this site reliable?* Or, with focus on the main search question, *May it be that the colors of Genoa are related with the town's coat of arms?* According to Cunningham et al. [22], the Web is a place in which the inferential process of *abduction* is continuously called into action. Abduction is a form of inference that tries to find the best possible explanation to some observed, maybe unusual fact. It was first defined by Charles Peirce [23] and is currently

regarded as a cornerstone of cognition both as a conscious inferential process at the basis of new discoveries and as a largely unconscious process at the border between perception and cognition [24]. For example, when a user discovers that Botswana's currency is named 'pula', which means 'rain' in the local language, she or he could wonder whether rain might be especially valuable in Botswana, and then look for information on the country's climate. The Web can thus be a place for raising awareness of a cognitive tool which is crucial to cognition and learning, but has been neglected in most scholarly tradition [25] and hence in educational practice.

Identifying information needs and asking questions The most distinctive feature of the Web, compared with paper-based material, is that the user has to ask questions to gain access to information. In a way, the Web restores the natural order of things: asking comes before answering. We use the verb "to restore" because learning at school is typically a matter of acquiring *answers*. This is a shame, because asking questions is a powerful tool for lifelong learning: it reveals awareness of one's information need and also interest in overcoming one's incomplete understanding, which are two key requirements for furthering one's understanding [26, 27, 28].

On the Web, asking questions is easy, almost unavoidable, and does not put one's face at risk. Moreover, no harm is done if the question is trivial or ill-formulated. Incremental refinement of the search string is always possible, without risk of being judged. The Web thus becomes a 'cognitive partner' [29] for a whole range of interrogations, from simple factual questions (who?, when?, where?, how much?) to more complex inquiries involving explanations and choices.

In the whole, the Web is an excellent environment for cultivating doubt and curiosity, that is for *initiating* the learning process. Eventually, the learner might even discover that the Web is not always the best place for finding answers.

5 Conclusions

A 2005 survey, conducted on a sample of 38 13-17 years old heavy users of the Web in the U.S. and Australia, highlighted how only 55% of them were able to perform easy information retrieval tasks [30]. Insufficient reading skills, unsophisticated research strategies and a low patience level were identified as the main cause of their poor performance.

Another 2002 survey – which, ironically, is no longer available on the Web – revealed that more than ¾ out of a sample of 1000 British pupils aged 7-16 were able to explain the meaning of "home page", while less than 10% were able to explain what is a "foreword" in a book.

These somewhat unsettling data highlight both the pervasive diffusion of a relatively young technology and need for improving the users' level of mastery.

Indeed, in countries like the U.S. or U.K., where Internet access is commonly available both at home and at school, teachers are lamenting that the Web has become the only source of information used by the students for their schoolwork, with the paradoxical effect that if something does not exist on the Web, it is perceived as not existing at all.

Several factors influence the trend towards the use of the Web as the main source of information at school, first of all ease of access, speed, interactivity, multimediality. Another factor may be the lack of an information literacy curriculum explicitly aimed at making the students familiar with and able at integrating a variety of information sources, from traditional libraries to journals, books, newspapers and, obviously, the Web. But the main reason behind the centrality of the Web at school may also be connected with the teachers' habit of giving class- and homework tasks which mainly require the students to collect and reproduce information. As Salomon [31] puts it, "Fascinated by the information highway, and quite unknowingly, we are drawn back to greatly esteem factual information, assuming that it is the major source of knowledge".

With regard to the over-reliance of teachers on *reproductive* tasks, it should be noted how some characters the Web speak directly against a culture of schooling which exclusive focus on *contents*. The huge number of web pages and their fast pace of change are both signals of a fact that is true independently from the Web, but the Web makes more apparent: that knowledge in the age of information is an enormous, fast-changing body. Taking in this datum would lead to deep rethinking of educational practice and focus on key cultural and cognitive tools which stand as basis for autonomous learning of new contents. A focus on the *process* of Web searching and navigating – as suggested throughout this paper – emerges therefore as especially fruitful for educational intervention on learning competences.

References

1. P.P. Maglio and T. Matlock, Metaphors we surf the web by, *Workshop on Personalized and Social Navigation in Information Space* (1998); http://www.almaden.ibm.com/u/pmaglio/pubs/meta4surf.pdf.

2. L. Ratzan, Making sense of the Web: a metaphorical approach, *Information Research*, **6**(1) (2000); http://informationr.net/ir/6-1/paper85.html.

3. M. Ferraris, Navigare sul WWW a scuola. Ma per andare dove? [Navigating on the WWW at school. To go where?], *TD-Tecnologie Didattiche*, **28**, 29-41 (2003).

4. F. Caviglia and M. Ferraris, Web-searching for learning: observing proficient web users working out an information problem, *Proc. IADIS Conference on Cognition and Exploratory Learning in Digital Age*, (2006), pp. 440-442, 2006.

5. C. Bereiter, *Education and Mind in the Knowledge Age*, (Erlbaum, Mahwah, N.J, 2002).

6. B. Dodge, Some Thoughts About WebQuests, (1997); http://webquest.sdsu.edu/about_webquests.html.

7. N.C. Burbules, Aporias, Webs, and Passages: Doubt as an Opportunity to Learn, *Curriculum Inquiry*, **30**(2), 171-187 (2000).

8. D.J.J. Leu, C. K. Kinzer, J. Coiro and D. Cammack in: *Theoretical Models and Processes of Reading*, edited by R. B. Ruddell & N. Unrau (International Reading Association, Newark, 2004), pp. 1568-1611.

9. A. Walraven, S. Brand-Gruwel, and H.P.A. Boshuizen, Information-problem solving: A review of problems students encounter and instructional solutions, *Computers in Human Behavior* (2007); http://dx.doi.org/10.1016/j.chb.2007.01.030.

10. Y. Mansourian and A.D. Madden, Methodological approaches in web search research, *The Electronic Library*, **25**(1), 90-101 (2007).

11. C. Hölscher and G. Strube, Web search behavior of Internet experts and newbies, *Computer Networks*, **33**, 337-346 (2000).

12. R. Navarro-Prieto, M. Scaife, and Y. Rogers, Cognitive strategies in web searching, *Proc. of the 5th Conference on Human Factors & the Web* (1999); http://zing.ncsl.nist.gov/hfweb/proceedings/proceedings.en.html.

13. D. Bilal and J. Kirby, Differences and similarities in information seeking: children and adults as Web users, *Information Processing and Management*, **38**, 649-670 (2002).

14. C. Monereo, M. Fuentes, and S. Sánchez, Internet search and navigation strategies used by experts and beginners, *Interactive Educational Multimedia*, **1**, 24-34 (2000).

15. N. Ford, D. Miller, and N. Moss, The role of individual differences in Internet searching: An empirical study, *Journal of the American Society for Information Science and Technology*, **52**(12), 1049-1066 (2001).

16. E. Kuiper, M. Volman, and J. Terwel, The Web as an Information Resource in K-12 Education: Strategies for Supporting Students in Searching and Processing Information, *Review of Educational Research*, **75**(3), 285-328 (2005).

17. S. Brand-Gruwel and P. Gerjets, Instructional support for enhancing students' information problem solving ability, *Computers in Human Behavior* (2007); http://dx.doi.org/10.1016/j.chb.2007.01.020.

18. E. Kuiper, M. Volman, and J. Terwel, Integrating critical Web skills and content knowledge: development and evaluation of a 5th grade educational program, *Computers in Human Behavior* (2007); http://dx.doi.org/ 10.1016/j.chb.2007.01.022.

19. R.M.C. Wallace, J. Kupperman, J. Krajcik and E. Soloway, Science on the Web: Students Online in a Sixth-Grade Classroom, *Journal of the Learning Sciences*, **9**(1), 75-104 (2000).

20. J. Coiro and E. Dobler, Exploring the Online Reading Comprehension Strategies Used by Sixth-Grade Skilled Readers to Search for and Locate Information on the Internet, *Reading Research Quarterly*, **42**(2), 214-257 (2007).

21. F. Caviglia, Lie Detecting as a Step Towards Critical Literacy, *L1-Educational Studies in Language and Literature*, **2**(3), 179-220 (2002).

22. D.J. Cunningham, A. Arici, J. Schreiber and K. Lee, Navigating the world wide web: The role of abductive reasoning, *International Journal of Applied Semiotics*, **3**(2), 39-58 (2002).

23. C.S. Peirce, *Collected Papers of Charles Sanders Peirce*. Harvard, MA: Harvard University Press, 1931.

24. S. Paavola, Peircean abduction: Instinct or inference?, *Semiotica*, **153**(1/4), 131-154 (2005).

25. L. Magnani, N.J. Nersessian, and P. Thagard, Preface to special issue "Model-based reasoning in science: learning and discovery," *Foundations of Science*, **5**(2), 121-127 (2000).

26. N. Postman and C. Weingartner, *Teaching As a Subversive Activity*, (Delacorte Press, New York, 1969).

27. H.G. Gadamer, *Truth And Method*, (Continuum, New York, 2004).

28. H. Weinrich, Vers la constitution d'une competence interrogative [Towards the foundation of an interrogative competence], *Zielsprache Französisch*, **2**, 57-64 (1983).

29. G. Salomon, D. Perkins, and T. Globerson, Partners in Cognition: Extending Human Intelligence with Intelligent Technologies, *Educational Researcher*, **20**(3), 2-9 (1991).

30. *Jakob Nielsen's*, Usability of Websites for Teenagers (2005); http://www.useit.com/alertbox/teenagers.html.

31. G. Salomon, Novel constructivist learning environments and novel technologies: some issues to be concerned with, *Research Dialogue in Learning and Instruction*, **1**(1), 3-12 (1998).