DEVELOPING CRITICAL THINKING IN ONLINE SEARCH

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Digital skills especially those related to Information Literacy, are today considered fundamental to the education of students, both at school and at university. Searching and evaluating information found on the Internet is surely an important competency. An effective way to develop this competency is to educate students about the development of critical thinking. The article presents a qualitative-quantitative survey conducted during a course in Educational Technologies within a five year Degree program. The outcomes of the survey reveal some interesting behaviors and perceptions of students when they are faced with the Web search process and the characteristics of their critical thinking processes: some aspects of critical thinking are generally wellsupported, but others are acquired only after specific training. Experience shows that if properly motivated by metacognitive reflections and a clear method, students can actually critically evaluate the information presented online, the sources, and the sustainability

of the arguments found. Positive results also occurred when the evaluation process was done in a collaborative modality.

1 Introduction

The theme of the development of digital literacy is becoming increasingly important both in the field of education and at the national and international levels. Within the broad conceptual framework that defines "digital competences" lies the area of Information Literacy: this concerns that set of technical and methodological skills that enable a person to know where and how to search for information, to filter it effectively and above all to evaluate it appropriately (Eisenberg *et al.*, 2010). That this is a crucial issue is confirmed by the extensive literature on the subject: students have difficulty not in using the search engines from the technical point of view, but to manage the quantity and quality of the flow of information to which they are subjected to daily and so are often victims of "information overload" at the cognitive level and even of emotional "information anxiety" (Bawden & Robinson, 2009). This occurs both in the educational field as well as in daily life (Catalano, 2013; Eisenberg 2014;). It is therefore important to foster the development of Gardner's "critical intelligence," and critical thinking (Reichenbach, 2001; Cottrell, 2011) in training and educational settings. In order to develop these skills, during a Technology course of a Master's Degree program, we wanted to create a laboratory to improve information literacy skills and to experiment with targeted activities, both offline and online, to improve the research, selection, evaluation and production of information. At the beginning and at the end of the experience students were administered a questionnaire that provided significant results both on their technical skills of Information Literacy as well as on the development of their critical thinking processes.

2 Digital skills and source assessment

Digital competence is one of the eight key skills for lifelong learning. In its broader sense, it is defined as the ability to use with confidence and a critical spirit social information technologies. From an institutional point of view, the reference concerns the European Commission's Digital Competence Framework (Ferrari *et al.*, 2013): in particular, the first analytical competence is the one that emphasizes the importance of knowing how to access online information, search, locate relevant information, effectively select resources, navigate between different sources, and finally create personal information strategies. The research literature on the subject in fact tends to distinguish between the single research activities, selection / evaluation and information

disclosure (Calvani *et al.*, 2014; Aesaert *et al.*, 2014), while considering them as part of a single process and notes that students often fail to achieve the appropriate levels of mastery in these last ones, while having no problems in using the tools from a technical and operational point of view. It emerges that, among all the skills involved, those of the metacognitive type are the least developed (Calvani *et al.*, 2014; Kong, 2014). To hypothesize that students because they are "digital natives" already have some or all of these skills is risky (Boyd, 2014) because it assumes a strong interpretative imbalance of digital skills more towards the technological-operational component overlooking the metacognitive process-related components and critical thinking. (Reichenbach, 2001) which then effectively guide the activities of selection and evaluation of the sources (Mason & Boldrin, 2008; Tsai & Tsai, 2003; Parmigiani *et al.*, 2016). For this, it is important to encourage the creation of a genuine research method (Garvoille & Buckner, 2009) to promote the development of critical thinking that will enable students to decide, for example, whether the sources from which the online info comes from are valid or reliable, or whether the content being consider is actually supported by objective data. Typically the literature proposes methods that consist of a series of steps that students should follow to make their information search effective and efficient and consists of activities of verifying the authority of the sources and a comparison with other sources at various levels of depth. This implies the re-elaboration of semantic-level information, for example using different keywords that however belong to the same domain of knowledge (Julien & Williamson, 2010). Students actually find the procedure for choosing keywords and redefining their research one of the most critical elements of the whole process (Hoffman *et al.*, 2008).

However, the metacognitive processes that stem from the activity of information research are not uniform: each student uses his / her own research style (Tseng *et al.*, 2014) and as a consequence obtains a different outcome (Wu & Tsai, 2007). For this reason, rather than imposing a rigid methodology, in our experiments we preferred to propose a strategic approach initially based on the analysis and discussion of specific case studies and subsequently on authentic, situational and problem-based tasks: which also involved the ability to adequately summarize the terms of a problem and to set forth their own opinion in a clear and arguable manner. In fact, the latest models for the development of Information Literacy skills consider research activities not as the sole objective but as complementary to the productive-communicative ones (McNicol & Shields, 2014, p. 23). During the experiment we also adopted a collaborative approach with students to reduce the complexity of metacognitive processes involved in information research and information problem solving activities (Raes *et al.*, 2016). In fact, lots of research on metacognition emphasize the value of collaborative work (Greene & Azevedo, 2010; Panadero & Jarvela,

2015): when students deal with a problem in a group, not only do they benefit by the numerous critical perspectives and multiple informational resources provided by others, but they also better manage their own metacognitive processes (OECD, 2015).

3 Methodology and research tools

Forty-eight students enrolled in the second year of a five year degree program with an average age of 29 years participated. The activities were carried out in four successive phases: at the start, a broad spectrum 50 item questionnaire was submitted to broadly test their perceptions and attitudes towards the web, the devices used and the digital skills that they considered necessary for their work and study environment. Afterwards, students participated in an information literacy lab where, besides learning technical skills (advanced search engine research, online data bases, etc.), they learned how to effectively evaluate the quality of documents and Information sources on the web. Students were then asked to take part in activities where they needed to search for information on the Web and to produce a short report to express a personal opinion about three current issues of different emotional depth: 1) the decline in sales of newspapers; 2) The TTIP, 3) the decline in the birth rate and the possible role of immigration in Italy. Students were free to choose the topic to deal with and it's noteworthy to point out how the percentages of the choices reflected the emotional impact expressed by the topic itself, in this case, the topic of immigration. This aspect is particularly relevant as some degree of emotionality is always linked to the development of intrinsic motivation that improves commitment (Vauras *et al.*, 2003). The exploratory investigation also sought to investigate whether the emotional factor affects or not the students' critical thinking performance, and therefore the effectiveness and efficiency of an online search. The various reports produced were then shared online on Moodle and discussed together face-to-face in a dedicated meeting. At the end of the activities, a new questionnaire was submitted to check for any changes in their perceptions and attitudes regarding digital skills and their critical approach to information found online. Other data was derived from an analysis of the textual discussion on the forum. To guide the information and source assessment phases, the students had to verify each time: 1) the correctness of the content also understood as the presence of references to reliable sources, 2) completeness, understood as the degree of coverage of the topic, 3) source update, and lastly 4) comprehensibility, or readability of the information.

The models of reference that were presented to students are those of the "Big 6" Information Literacy Process (Eisenberg *et al.*, 2010) and the one from the

Berkeley Library (Berkeley Library, 2012) "Web page evaluation checklist". The first presents a series of 6 steps ranging from defining the information problem, searching and selecting sources, to synthesizing and self-evaluating the results; the second covers some specific aspects including: verifying the purpose and the functions of the website that is hosting the information (informational, commercial, educational, etc.), it's possible affiliation to some organization to discover the presence of any specific interests or biases and finally the presence of clear references to the author of the information. Attempts were made so that students had to pay more attention especially in the initial stages of the information research, inviting them to clarify what exactly they were looking for, what level of depth of info and what specific support they wanted (text, video, images, data, etc.). In fact, cognitive research seems to demonstrate that a clear representation of the problem in the early stages contributes to its effective resolution (Blessing & Ross, 1996; Chi, 2006). In our case the problem was almost always informative-lexical because search engines like Google anticipate the insertion of keywords that the algorithm then uses to retrieve the Web pages: the more the key words are semantically coherent and specific with respect to the domain of knowledge investigated, the more the results will be consistent and precise by limiting the effects of information overload. It is no surprise to find that experts in a particular domain of knowledge are able to retrieve information more effectively and efficiently precisely because they have a specific lexical vocabulary (Petrucco, 2002).

4 Results

The initial questionnaire reveals that 80% of students are employed and have an average age of 29 years; they are mainly employed as educators in educational services and contexts of pre-school and primary school, services connected to secondary school and working with adults and the elderly. All participants have a computer, 90% a smartphone, 42% a tablet; 91% use Social Networks and still 90% have at least one mobile device. The data is interesting when compared to Istat data (ISTAT, 2014) where it emerges that 44% of males and 42% of 25-34 year olds use the Net from a portable or mobile device and in the age bracket of 25 to 34, 80% have an internet connection and 70% use social networks. We are therefore dealing with a group of very connected students in possession of tech tools above the average of their Italian peers. Over 90% conduct online searches, 80% participate in online discussions, but few (15%) use cloud-based tools (such as Google Drive) as a collaborative tool to work with others as active producers of content. Prior to attending the lab sessions, 70% say they feel confident enough with their research skills and only about 20% feel not very confident; at the end of this intervention,

perceptions remain largely unchanged. However, they are more cautious with regard to their perception of search engine results: 72% believe them to be reliable in part or only partially. From a comparison of the data provided in the inbound and outbound questionnaire with respect to the relationship with sources and information, it emerges that, after the experience gained, the degree of importance attributed respectively to the following significantly increases 1) the authority of the sources; 2) completeness; 3) accuracy and 4) the update of information.
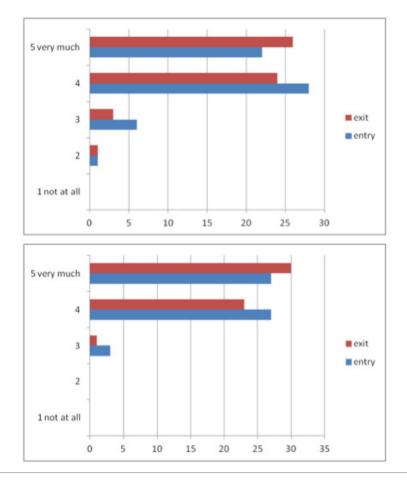

Fig. 1 –Authoritativeness and accuracy of information: comparison of inbound and outbound responses "How important is it to evaluate the authority of the source?" and "How important it is to evaluate the accuracy of information?"

From the analysis of the texts developed in the group, most students (80%) reach a "discreet" level on average, based on a 5-point scale (1 poor, 2 sufficient, 3 discreet, 4 good / and 5 excellent) but very few people reach a "good" or "excellent" level. The overall judgment was drawn on the basis of different weighing criteria: 1) exhibit clarity, 2) logical structuring of contents, 3) quality of argument 4) support of statistical data, 5) contextualization of the problem, 6) completeness of the vision of the problem 7) dialogic explanation of doubts, 8) critical attitude, 9) number of sources. In addition the best performance came from students who chose an emotionally more engaging theme (immigration) than those who chose the other topics. Overall, observing student practices and their discussions in the forum, the criticalities that emerged from their process of acquiring and processing information can be summarized as follows:

- Difficulty initiating an initial reflection on the most relevant keywords and managing the semantic restructuring processes related to the topic to be searched on the search engines, often detecting an insufficient specific strategy based on the investigated domain of inquiry;
- difficulty in applying explicit evaluation criteria in selecting information
- difficulty in integrating in a fluid and logically sustainable manner the information found;
- lack of a choice regarding a preferential format for information use

With regard to the first point, almost all students admit that their search process starts from the Google page and from some keywords entered without much reflection on the terms inserted and without using advanced search options, like OPAC or special and sector specific engines related to the topic to be investigated. From a strategic point of view, they stop at the first pages found by the engines confirming some previous research (Lau & Coiera, 2009), that found that during the navigation and web search process one tends to select the information that confirms what we already know or our opinions and only to memorize the last contents found (the so-called "last click"). Experience shows that, in addition to purely technical aspects, students need to test their critical abilities and that these will be used by them to make decisions (purchasing, health, professional, and political, etc.) and to achieve a certain degree of autonomy in the overall process of building their own knowledge and evaluating the knowledge published on the net. It should also be pointed out that the first approach to the information sought is a delicate orientation phase where the chaotic nature of information and the unstructured form, at least in the dispersion of sources, makes reaching a satisfactory level of clarity and understanding or to know what aspects need further investigation complex.

It was also found that students don't know much or anything at all about

the Creative Commons licenses and how to appropriately deal with content protected by copyright. They also declare that they do not use specific strategies related to the type of information they seek and the most appropriate context (institutional, international and sector type literature, or informal contexts such as blogs or forums, specific databases) and the type of support desired (differentiating the types of files in text, image, audio, video, graphics, and their possible extensions). In fact, one of the most common problems that emerged is that in most cases the strategies are not explicitly disclosed and are not treated as a process where one applies critical thinking. Often they juxtapose the information found to get an answer to the proposed problem, but they do not explicitly use reasoning to falsify the information found. This type of use, that is referred by Popper (1963), provides a scientific attitude to information processing, whereby the student, when evaluating the source and contents found, raises questions that try to refute the information obtained by searching and evaluating the arguments present on the Web, which support the inherent allegations contained in the refutation. In this sense, Information Literacy becomes an area of experience and competence that is not separated from critical thinking or the associated metacognitive processes, so critical thinking is closely related to the process of knowledge initiated by the research. It is not an innate ability, but involves the application of a well-defined critical method. During the information problem solving activity, we also found some difficulties related to the ability to carry out actions to integrate information in order to create a coherent and sustained body of content. The processing of information necessarily involves continually referring to one's domain of reference which, if perceived as a defect, needs to be thoroughly studied.

Conclusion

The development of critical thinking has certainly always been an ever present objective in teaching and education (Maccario, 1999). Today, due to the numerous information we have access to online, the processes of research and evaluation of documents become important contexts where to apply it. The emphasis of our experimentation was aimed at transforming students' information research processes into real pathways of meaningful learning, in which they are able to develop a metacognitive and critical disposition towards the documents found and above all in their subsequent reworking of an argument in their interactions with other people. We have verified that it is important to stimulate collaborative processes between students precisely in order to be able to use the reciprocal dialogue interactions as a stimulus towards critical thinking. The focus of educational actions should therefore be based above all on the stimulation of the formulation of questions that are able to strategically

guide the research process by verifying the reliability, accuracy / completeness and possible bias of the sources and the authors examined. With regard to this last factor, we have verified that it was often present in the students themselves, and not just in the documents, in the form of true confirmation biases (Jonas *et al.*, 2001) or in the tendency to seek confirmation of their beliefs and refuse evidence which contradicts them. An effective antidote to this bias was when there was the possibility of discussing and comparing their opinions with others in the workgroup, although the members of the group were not always able to reach an agreement. In this sense, at the end of the experiment we proposed a reflection with a question that put more than one student in a panic: "Am I actually able to change my opinion if I find evidence that contradicts my deep convictions on a subject I believe is important?

Acknowledgments

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