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Changing anatomies of Information Literacy at the postgraduate level: refinements of models and shifts in assessment

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Abstract

This paper will identify the fundamental principles that might inform a theoretical approach to Information Literacy (IL) at the postgraduate level. These are based on the following premisses:

- the aims of postgraduate/doctoral studies are different in comparison to earlier educational levels and involve specific challenges due to the heterogeneity of student population
- IL frameworks have to acknowledge and address these challenges by adjusting to specific needs of postgraduate students operating in new information environments
- profound changes in information environments and patterns of generation and use of scientific information necessitate new modes of assessment

Postgraduate education predominantly focuses on methods and standards of scientific research work. An important precondition for efficient research is the successful application of proper methodology in finding, managing and generating information. Therefore, information literacy as the ability of finding, using and evaluating information can be perceived as central to learning and research. The focus of IL at postgraduate levels is primarily on the universe of scientific information, which has gone through tremendous changes over the last decade, particularly as a result of the appearance of Web 2.0 (e.g. Science 2.0, Research 2.0). It has created opportunities for new and alternative forms of research and scholarship that are different from traditional ways of using academic publication or disseminating research results. Such changes necessitate the reshaping of the basic concepts and focal points of IL at the postgraduate level which will take into account the new and experimental forms of scholarly communication and the dynamic nature of current information environments. First we will discuss the changes in information landscapes brought about by Web 2.0 and then look into the ways in which the premisses of scientific work have been affected by these new developments. Finally, we will demonstrate the need for the re-conceptualization of IL at the postgraduate level and propose new IL principles of assessment that will account for this transformation.

Key words: information literacy, postgraduate studies, scholarly communication, Science 2.0

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Introduction

The nature of doctoral/postgraduate education stems from the importance it places on the training of its participants for future field-specific academic research. Thus the education at this level significantly differs from former ones since it focuses on knowledge specialization and it has to account for heterogeneity among postgraduate students concerning their prior educational experiences, demographics and field-specific objectives.

Teaching students in the scientific method and culture has long been recognized as the major focus of postgraduate education. Postgraduate students are expected to acquire inventories of scientific skills and competencies related to the efficient application of various procedures involved in conducting scientific inquiry, such as the ability to ask valid questions and gather and analyze information, the capacity to evaluate and upgrade original ideas, to process them from the stage of their origination to the producing of proofs and arguments, and finally to defend them and communicate to peers and to the wider society. The principal objective of any PhD programme is to prepare students to conduct original scholarly research for the purposes of the dissertation as well as later (Fleming-May & Yuro, 2009). Coursework on research methodology is an indispensable element of the majority of doctoral programmes, but so far it focuses more on specific methodologies and theoretical frameworks, the design and conducting of experiments and data analysis, than on search strategies, evaluation of the quality of information or the skills required for working with research tools such as databases and indexes. However, it is exactly the competencies related to finding, evaluating and using of information that constitute the very basis of scientific activities and are therefore essential for every researcher. According to all that, information literacy, as the ability of finding, using and evaluating information, is often perceived as central to learning and research (Bent, Gannon-Leary & Webb, 2007) and defined as an integral part of the research process (Eisenberg & Berkowitz, 1990; Kuhlthau, 1993). The close relation between IL and research was recently explicitly expressed in the Researcher Development Framework (Vitae, 2010), a tool for supporting the career development of researchers. Within the Framework, IL is characterized as comprising knowledge, skills and competencies required by researchers for the effective handling of research information and data.

IL for postgraduate students differs from IL for other students because it must conform to the particular nature of research work (Withworth, McIndoe & Withworth, 2011). Furthermore, in contrast to IL at earlier educational levels, it is focused on the universe of scientific information e.g. various types of scholarly publications, strategies of finding, using and disseminating scholarly information. This corresponds with the perception that undergraduate students are more like consumers of knowledge, while graduate students are like producers of knowledge (Flaming-May & Yuro, 2009). Postgraduate students are expected to conduct their research more independently as well as to acquire and manage a greater volume of scholarly information. The interdependency between investigation skills and IL is emphasized by Mutula (2009) who sees IL as the ability to seek, organize and apply information and states that without these abilities research cannot be conducted. In other words, IL is absolutely necessary at all levels of higher education, but particularly so for future researchers and it should be clarified how IL at postgraduate levels can best conform to the special requirements involved at this advanced educational stage.

IL at the postgraduate level

The above-mentioned specific objectives of postgraduate studies and the diversity in student population impose questions concerning the content, structure and nature of IL for postgraduate students. The heterogeneity related to content and character of diverse disciplines that the students were trained in is accompanied by its demographic aspect. The question of disciplinary orientation is expressed in discussions relating to the dichotomy between generic vs. context-specific IL (Grafstein, 2002; Holschuh Simmons, 2002; Norgaard, 2004). Taking into

consideration the research orientation of doctoral studies and their context-dependency (i.e. what may be applicable in science is not directly transferable to humanities or social sciences and vice versa), an epistemological discussion could be an acceptable starting point for defining satisfactory IL framework at post-gradual educational levels.

The purpose of any IL framework is to help understand the concept, define the approach to IL and model its implementation. Some frameworks even outline the specific skills and competencies that students are expected to develop. The majority of IL frameworks such as the ACRL Information Literacy Competency Standards for Higher Education (ALA, 2000), the Seven Pillars (SCONUL, 1999) or the Big Blue framework for information skills (2002), are considered transferable, generic and applicable across a wide range of contexts, which conflicts with the epistemological approach according to which it is necessary to take into account the specific features of particular scientific disciplines. The understanding of IL as a neutral component unaffected by the social setting, learning environment or methods is therefore rather problematic.

IL has its roots in the activities of particular groups and communities; it evolves in disciplinary and other kinds of contexts and is practiced by communities using their corresponding technologies (Špiranec & Banek Zorica, 2010). Hence, information seeking practices are determined by the context in which they are carried out. The importance of context was recognized by authors as Marcum (2002) or Kapitzke (2003), who argued that it is necessary to include the various contexts of information knowledge production in the discussions on IL. Indeed, the variability in the dynamics and modes of information and knowledge production inherent to different scientific disciplines seriously challenges the usefulness or efficacy of predominantly generic frameworks. A more encompassing approach which would account for the different levels of specialization and disciplinary, field and subject orientation – the major features of postgraduate studies - would be more acceptable. Epistemic views, such as the theory of scientific paradigms by T. A. Kuhn (1970), offer a valid argument for such interpretation. In Kuhn's view, scientific methods and procedures vary from one field of inquiry to another. Techniques for investigating phenomena or acquiring new knowledge as well as the features of information environments and knowledge organization systems are different for every discipline. Scientific disciplines have different epistemological structures, therefore the research process, the type of questions or the sources of inquiry are not identical, and the same applies to the type of discourse and style of arguments that are presented, the mechanisms of knowledge generation or the way resources are cited. According to Grafstein (2002) knowledge of the subject matter and language of disciplinary discourse has important implications for the ability to acquire and synthesize new information within a discipline. Therefore, generic IL frameworks designed to be applied across a wide range of contexts are discordant with the very nature and aims of postgraduate programmes and modern science in general. This aspect has also been highlighted by current discussions occasioned by the introduction of a definition of IL which identifies it as a socio-technical practice. According to this definition, IL cannot be regarded independently of knowledge domains, but must refer to the social, ideological and physical contexts and environments in which information and technical artifacts are used (Tuominen, Savolainen & Talja, 2005). To sum up, the IL training and curricula at the postgraduate level should take into account epistemic assumptions and particular research practices used by various communities, and reflect the close connectedness which exists between research practices and the specific features of different communities. Therefore, the shortcomings of overly broad and generic frameworks and standards are particularly evident at the postgraduate level, where diversification in relation to the field-specific content and overall social context renders such unified frameworks unsuitable.

Another particular that makes necessary the re-conceptualizations of IL at the postgraduate level is the very dynamics of contemporary science and research. The last decade has brought about fundamental changes concerning the ways researchers discover and access relevant information resources and at the same time create and manage new information resources.

Since scientific work is inseparable from information and knowledge and this 'trinity' lies at the very heart of the new developments stimulated by technology - particularly in the case of Web 2.0 - it should be analyzed how the restructuring of information spaces and creation of new communication patterns and information cultures has affected scientific processes, and in addition, IL.

Science 2.0

Our basic proposition here is that views on IL at the postgraduate level should be determined by the developments in science and research. Numerous authors refer to the changing configurations of science and scientific work as the processes resulting from technological innovations. (Thorin, 2003; Nentwich, 2003; de Sompel, Payette, Erickson, Lagoze & Warner, 2004; Arms & Larsen, 2007; Borgman, 2007; Waldrop, 2008; Odlyzko, 2009; Procter et al., 2010). There is no doubt that science has been changed and metamorphosed by the use of technologies, in particular networked technologies. However, the fundamental principles of science remained unaffected by major technological innovations; computing systems and the Internet simply scaled up and sophisticated traditional models of document collection, organization, dissemination, document retrieval and delivery capabilities. Therefore, changes in science made possible by ICTs and networks resemble more the process of evolution than revolution. However, the appearance of Web 2.0 represents a more radical development which has the potential to change the very principles of scientific activities and scholarly communication (Waldrop, 2008; Luzon, 2009; Nikam & Babu, 2009; Odlyzko, 2009; Procter et al., 2010; Warden, 2010; Lievrouw, 2011). Web 2.0 announces brand new models of scientific communication in which it will be possible for researchers to create, annotate, review, re-use and represent information in entirely new ways and stimulate innovations through scholarly communication practices – e.g. by publishing their research results at all stages of research and openly sharing their research sources (Procter et al., 2010). The term Science 2.0 refers to new approaches to research which promote collaborative knowledge construction and rely on providing online access to raw results, theories, ideas and so forth, so that others can comment on them (Luzon, 2009).

The conceptual distinction between "*science*" and "*science 2.0*" may be derived from the distinction between *Web* and *Web 2.0*; it can of course be expressed in terms of their differing technological aspects, but the real contrast between the two is related to the interactive, participative, collaborative and social nature of Web 2.0. The same may be said about *science* and *science 2.0*: although new potentials and possibilities of scientific work rely on enormous technological advances, the real progress is associated with the changed nature of science. The very terminology denoting the Web 2.0 phenomena – communication, critiquing, suggesting, sharing ideas — is related to the fundamentals of science and reflects the capacity of Web 2.0 to transform it (Spiranec, Babic, & Leskovic, 2009). Web 2.0 services and applications, such as wikis, weblogs, social networks, RSS and aggregators, permit scientists to create enriched conversations as well as digital modes of expressions, and participate in forms of information communication that represent a radical alternative to the traditional system of scholarly communication. While *science 1.0* is characterized by text and the document-centric paradigm, science in Web 2.0 environment makes people and communities the new central focus of various scientific processes.

This being said, it becomes evident that the production, consumption and communication of scientific information will very likely change with the progress of Web 2.0. Alternative ways of scientific communication, those informal, become explicit and recorded through blogs, wikis and other forms of „2.0 expression". Diverse Web 2.0 services make possible the formalization and recording of informal practices and transform the scientist from a reader into a *prosumer*, the one who *pro*duces and con*sumes* at the same time (Stock, 2007). Furthermore, under the influence of the Web 2.0 paradigm, previously adopted knowledge organization systems are being supplanted by user-centred models, such as folksonomies. According to Stock (2007), scientific processes will benefit from tagging since tagging provides a valuable source of

authentic term material and enriches access points to scientific material. Further possibilities of accessing content, disseminating scientific information or initiating information exchange refer to social navigation or collaborative filtering systems, reviews and comments or recommendation systems. These provide a useful alternative tool for the evaluation of scientific work, an often criticized aspect of traditional science.

Despite the potentials and interesting possibilities related to the application of Web 2.0 technologies in science, optimistic views are expressed mainly in opinion papers while research evidence suggests that Web 2.0 will not produce any radical changes in scholarly communication in the short or medium term. For example, the research findings by Proctor et al. (2010) suggest that only some Web 2.0 services, mainly the generic, intuitive and easy-to-use services which are being created upon existing practices, are on the rise. At the same time, many researchers are not willing to make use of the new forms of scholarly communications because they are distrustful of resources that have not been subjected to traditional peer review (Procter et al., 2010). Similar research results can be found in other studies (Harley, Krzys Acord, Earl-Novell, Lawrence & King, 2010; Researchers of tomorrow, 2011). However, the first longitudinal data show indications that the use (active or passive) of some social media and networking tools in research is slightly on the increase among Generation Y doctoral students (Researchers of tomorrow, 2011). Other authors also refer to the evidence showing that many postgraduate and postdoctoral researchers are changing the ways in which they acquire and share research information; including taking advantage of Web 2.0 technologies to 'pre-publish' research papers (RIN, 2010).

There is no doubt that prominent and successful Science 2.0 projects are gaining recognition and that scientists' participation in Web 2.0 is not in any way insignificant and will likely continue to increase. It has been reported that many of the scholarly tools are experiencing dramatic growth, and it seems highly probable that this growth will continue as the "born–digital" generation moves into tenured positions (Priem, 2010). Arms and Larsen (2007) predict a more intensive uptake and identify younger scholars as early adopters of innovations such as Web search engines, Google Scholar, Wikipedia, and blog science. However, predictions about the wider acceptance of Web 2.0 tools and services among researchers are not based exclusively on the generational perspective or limited by the view that only younger researchers are fond of new possibilities. According to a report commissioned by the Research Information Network (RIN, 2010, p. 49): "(…) scholars express considerable enthusiasm for change and an understanding that benefits may come from relatively unconstrained early dissemination and discussion of their ideas and their findings".

Information literacy at the postgraduate level is strongly oriented towards scientific information and scholarly communication. For this reason, innovative configurations of scientific discourses arising from Web 2.0 technologies should be duly considered in relation to IL programmes at the postgraduate level. Right now, IL education is predominantly still based on frameworks developed before the appearance and diffusion of Web 2.0 services and technologies in science and research. Such condition has been described by Markless (2010) who expressed concerns about "(…) the way in which traditional IL frameworks were applied in the digital learning environment, without much change in emphasis, despite the evidence from research on the impact of the digital environment and Web 2.0 on student learning and information behavior" (p. 26). It is therefore necessary to re-conceptualize IL with regard to Science 2.0 developments and determine the principles which will inform relevant IL training at the postgraduate level

New IL frameworks compatible with Science 2.0

According to Weller, Mainz, Mainz and Paulsen (2007), the relations between Web 2.0 and scientific work have to be differentiated into several dimensions:

- new patterns of public relations related to scientific and research activities (blogs, podcasts etc.)

- collective knowledge generation and management
- new structures of scientific communication (dissemination and discussion of scientific contents, finding and accessing scientific information (Weller et al., 2007).

At least two of these categories, the generation and management of knowledge as well as the processes of scientific communication, have an immediate impact on IL at the postgraduate level and both show. As discussed in the previous section, the tendency and prospect for transformation and change as a result of the application of Web 2.0 in the scholarly domain. The collaborative model of knowledge production, mash-up practice and anonymity creates information spaces where authenticity, trustworthiness, authority and reliability have to be continually questioned, particularly for research purposes. The application of collective intelligence in science results in the breakdown of traditional assumptions about scientific expertise and the transformation of rigid scientific processes by means of considerably more open-ended processes of communication (Jenkins, 2006). P. Walsh (2003, as cited in Jenkins, 2006) suggests that the expert paradigm (which dominates the traditional "Science 1.0"), applies rules on how to access and process information, rules that have long been established by traditional disciplines. By contrast, both strengths and weaknesses of the collective intelligence (which characterizes Web 2.0) lie in the fact that it is disorderly, undisciplined and unruly, and ignores authority and order (ibid.). The Internet has enabled instant access to answers, but at the same time it has given rise to new uncertainties over the accuracy of provided answers, access to contradictory answers and persistent difficulties in finding timely answers to some issues (Wheeler, 2008). These dilemmas directly affect IL, particularly at the postgraduate level, where IL and research come into strong correlation. Due to new information and research environments which researchers and postgraduate students currently face, it is necessary to concentrate on specific aspects of IL programs and curricula offered at the postgraduate level, taking into account a stronger focus on controversial points within new landscapes of research, the broadening of scientific communication, increased focus on communities increased focus on concepts.

Focus on controversial points in new research environments

How to locate high quality information, evaluate and organize scholarly information, the issues of authority and the increase of plagiarism are matters of major concern for researchers in general. Scientific data and research were traditionally confined within firmly established and dependable sites of research, such as journals or academic databases, which made activities like locating or evaluating scientific information convenient, transparent and reliable. Contrary to this, today researchers do not operate in centrally managed and structured information environments any more. The research process has spread to sites of information not authenticated by traditional information gatekeepers and to publications or other non-traditional scholarly sources which do not bear the imprimatur of publishers, but may still be of scientific value. Borgmann (2007) also refers to this: "While the ultimate responsibility always has fallen to the reader for determining the quality of a document and whether it was worth citing, more institutional mechanisms existed for guidance. Those indicators included publication channels, selection by libraries, and citation rates. With fewer external quality clues available, individuals must make more sophisticated judgments about whether to trust a document or a source." (p. 85). The bearing of these conditions on IL models at the postgraduate level is twofold: firstly, the circulation of scientific information no longer proceeds along strictly defined routes. Secondly, the appearance of unruly sources necessitates their evaluation by means of new metric models which must enable the establishment of authority, significance, and even scholarly validity of such sources. Naturally, evaluation guidelines, criteria and rubrics which the scientist applies in the evaluation process do exist (Burkhardt, Mc Donald & Rathemacher, 2010; Hunt & Birks, 2008; Tate, 2010), but Web 2.0 brings about uncommon and sometimes highly complex twists to this process. The very advantages of social media, i.e. their immediacy, interactivity, and capacity to accumulate and put various kinds of content in new contextual patterns, make the evaluation of information derived from social media sources

a demanding task and call for the defining of new criteria e.g. for how to evaluate a blog or wiki (Tate, 2010).

Furthermore, existing IL frameworks, such as the SCONUL (1999) Seven Pillars or ACRL (2000) Competency Standards, are based on an environment where the flow of information follows explicitly defined routes. These frameworks have been designed so as to envision and support research processes which unfold systematically, in a linear and sequential manner. According to Markless (2009), IL models presuppose a linear process, although researchers rarely follow a fixed sequence of steps in their search for information, particularly under the circumstances characteristic of the Science 2.0 environment. Similarly, Purdue (2003) and Jacobs (2008) point out that the research process is never systematic but provisional, and subject to constant change. Therefore, the application of frameworks based on a linear approach within scholarly processes which are inherently random, iterative and non-linear is obviously rather unsatisfactory. Some other similar critical observations describe the concepts and methodology characteristic of standards such as the ACRL as highly skill-oriented. The use of a set of standards as a framework significantly reduces a complex structure of competencies and knowledge to limited and isolated units (Webber & Johnston, 2000). This means that the currently existing courses for PhD students are predominantly oriented towards resource discovery (search strategies, use of academic databases, search statements, reference management software and so forth), or consist of heavily structured sequences of small steps (Streatfield, Allen & Wilson, 2010). Therefore, an IL framework which would address issues relevant to researchers and scientists operating in contemporary information environments should move:

- from sequential towards non-linear approaches
- from information access techniques and processes towards evaluation

Widening of elements of scientific communication: as to where to find scientific information and how to communicate them

Scholarly communication preceding the appearance of the Internet required intermediation by publishers, libraries and so on. However, intermediation is no longer the prerequisite for finding or accessing scholarly information. Even when consulting authoritative sources, the researcher is not limited to traditional scholarly domains (e.g. peer-reviewed publications, academic databases), but potentially may make use of blogs, self-published items, and presentations within the search for high-quality information. It is quite possible for the most thought-provoking or inspirational hypothesis to come from a blog entry or a wiki. Taking alternative courses may even reduce some difficulties related to traditional peer-review under the condition that such alternatives include open an open peer-review model based on a participative, reader-generated approach (Harley & Accord, 2011). Although current figures (RIN, 2010) show that so far relatively small groups of scientist make frequent and innovative use of Web 2.0 in communicating research, future prospects in this context should not be neglected. IL courses could therefore introduce postgraduate students and researchers to new forms of expression and non-traditional scholarly output in order to help them make informed decisions on whether to use particular alternative forms of accessing and disseminating their research findings in any given case. In general, training in information seeking or citation of sources, which prevail in postgraduate IL sessions, predominantly refers to traditional library resources and conventional elements of scholarly communication. IL should not be restricted to the sphere of libraries and customary resources and the usual channels of information searching and retrieval. Changes in the scholarly domain are possible and according to the opinion of some authors will quite likely happen (Weller et al., 2007; Waldrop, 2008; Nikam & Babu, 2009; Odlyzko, 2009; Warden, 2010; Priem, 2010). Postgraduate researchers should therefore be introduced to new information spaces and instructed in how to express themselves in this new context, how to organize resources for themselves and contribute to these new environments not just as users of information, but as creators and co-creators as well. This not only includes the creation of scientific content, but also the ability to take part in user-oriented organizational

practices, such as tagging and creation of research-focused digital collection of links, the collaborative managing of web links and bibliographic data. New opportunities will probably greatly influence future research processes since through their application some shortcomings of traditional science activities and procedures may be overcome, e.g. the static structure of journals, the delay in dialogs and peer-review. It would be useful for researchers and postgraduate students to include within IL frameworks, at least in general terms, instruction related to alternative forms of scholarly communication and transform the focus of these IL frameworks:

- from 'gatekept' to self-published information
- from finding towards communicating information.

Focus on communities

Information literacy in existing models and frameworks or courses offered at the postgraduate level is characterized by their primary concern with documents. They represent the centre of information activities and processes, being the predominant object of searching, accessing, evaluation, use. For example, a random analysis of the available IL courses shows that in their content they concentrate on literature searching, finding resources such as books, journals or articles, correct citation styles, using citation indexes, relevant information sources of individual disciplines and reference managers. Although the idea of community has always been essential to science and scientific processes, IL frameworks have so far rendered the researcher as an individual who mainly works with documents or a collection of documents and papers. An analysis of the ACRL Standards (Harris, 2008) shows that the discussion of community is almost entirely neglected in the Standards, which thus do not account for the fact that people and communities; today more than ever, due to the collaborative and participative Web 2.0 environment; are sources of information as well. Still, as mentioned previously, within IL standards information is usually treated as an object to be located and used by the individual. The collaborative aspect of accessing, evaluating and creating information - which has always lain at the very heart of science - will become a more critical aspect in researchers' careers. Due to the infusion of technology into all spheres of research, scientists increasingly rely on networks of personal contact for accessing and acquiring information. Various communication channels like interpersonal communication and networks at different levels, including membership groups or invisible colleges are becoming a growingly important source of information (Jankowski, 2009, Lievrouw, 2011). According to Harris (2008), communities offer great opportunities for new learning and discovery which often result in more or less ordered displays of information and knowledge. In this context, information is often created, disseminated, and utilized by members with the purpose of advancing the goals of the group which is particularly important in research environments. Harris (ibid.) therefore criticizes the absence of the issue of community in the existing IL standards and their central focus on the individual, who is seemingly able to learn and subsequently perform outside of the context or environment. The recognition of the importance of communities corresponds with the communicative approach to IL proposed by Sundin (2008), as opposed to the still prevalent source approach which insists upon the presentation of different types or genres of information sources. Therefore, questions of how to navigate communities should be appropriately included in IL models and; bearing in mind the communicative aspect of science; made the central plank of IL models at the postgraduate level. A major aspect of transformation of IL frameworks refers to the shift:

- from document-centred towards community-centred models.

Focus on concepts

The conceptual approach to IL teaching was debated in early discussions on IL. The initiators of these discussions (Gibson, 1995; Tiefel, 1995) criticized the fact that a considerable amount of library teaching focuses on mechanical search skills which is in direct contradiction with the need for reflective and critical thinking and the conceptual understanding of information

creation, dissemination and use, which IL claims to promote. With the recent dramatic increase of available information, taking a conceptual approach to IL teaching becomes imperative (Wong, 2010). A conceptual approach to IL aimed at the understanding of information environments and their dynamic nature is absolutely indispensable for postgraduate students whose research activities involve the necessity of making decisions about using new and alternative forms of finding, disseminating or communicating information. However, established programmes of IL training do not reflect those theoretical IL assumptions that emphasize the conceptual approach. Thus the predominantly tool-based approach applied in practical IL implementations in higher education is highly remindful of the library-instruction paradigm, which focused on particular resources (Markless, 2009). The findings of the RIN study from 2008 indicate that the important dimensions of research-related information skills and competencies, such as being able to engage with and understand the scholarly information system, are not included in postgraduate IL programmes (Research Information Network, 2008). Furthermore, the report shows a strong focus on the application of tools such as search engines, academic databases, portals and gateways. Much of the training provided in relation to information seeking, citing and the evaluation of research information is focused on very specific tools such as *EndNote* or *RefWorks*. A recent study by Streatfield, Allan and Wilson (2010) confirmed these findings by determining that libraries concentrate their training on traditional library topics such as information seeking, citing sources and introducing researchers to library services, rather than dealing with more general issues and concepts like managing research information, copyright issues or open access.

A shift of the focus of IL from tools and the methods of using them towards concepts and issues is particularly important for future scientists who already work in structurally undefined information environments with various alternative and experimental forms of disseminating and organizing research data. Therefore, the creation of conceptual maps outlining new information landscapes and the identification and interpretation of rationalities within those information spaces should certainly be included in IL programs (Spiranec & Banek Zorica, 2010). Some issues that have been addressed by this reorientation include the necessity to determine the abilities required for interpretations of information environments, negotiations and the use of multiple information paths. The awareness and understanding of socio-cultural conditions essential for the production, mediation and consumption of scholarly information have been included. Further have the understanding of ethical research principles demanded in transient and hybrid digital environments been addressed. This reorientation can only be accomplished through the shift of the focus of IL programmes:

- from tools towards concepts.

Assessment models

Assessing student learning is becoming a growing concern for the institutions of higher education. The assessment of IL primarily depends on the use of standards which, at the pragmatic level, enable the effective integration of IL attributes into formal educational curricula. Still, some authors strongly criticize the defining of such a unified set of IL standards (Webber & Johnston, 2000; Elmborg, 2006; Jacobs, 2008) So far, standardized assessment models, as well as some generic models like the SCONUL Seven Pillars model, have been focusing on tools, resources and sequences of steps, starting by recognizing one's information needs, proceeding through finding and evaluating information and finally ending up using information. Obviously, such assessment models are not satisfactory, especially if we bear in mind the complexity of information spaces which are characterized by many novel and alternative forms of dissemination and communication of scholarly information. Markless (2009) has already suggested a range of new IL focal points which accentuate students' abilities of interpretation, such as the formulating of proper research questions, information sense-making, the applying of variant approaches in finding and using information.

The issues brought out by Markless (ibid.) should certainly be considered in relation to assessment procedures, but should also extend beyond that and include other aspects that are especially relevant for researchers and postgraduate students who have to cope with highly complex and dynamic environments. Hence, IL postgraduate students are expected to:

- be able to constantly rethink, revise and modify their information research and include alternative forms of information dissemination, in a critical and meaningful way
- be aware of the issues surrounding the trustworthiness of data and know how to express doubt over the provenance or accuracy of posted information
- understand that knowledge is dialogic and therefore be able to navigate across diverse communities and work out compromises over differing points of view
- gain insight into resource-oriented models of organizing information and knowledge representation (e.g. classification systems, controlled vocabularies) as well as into user-oriented models (the processes of use and assignment of user-created objective or subjective tags)
- be aware of both positive and negative aspects of creating scholar identity in the digital environment (maintaining good reputation and research prestige online)
- be able to take part in both formal scholarly communication of information (e.g. publish their articles in peer-reviewed journals) and informal communication channels (e.g. share their ideas over informal networks of communication, participate in social media networks which offer access to unverified data and preliminary ideas and theories).

The inclusion of these elements into IL assessment requires the re-conceptualization of the current tool-oriented models which insist on the existence of a linear sequence of steps, which is considerably easier to manage and measure than any of the processes implied by the issues listed above. How to assess information processes and IL if there is not some unique or preferred path to information; how to measure the capacities for non-linear decision-making or one's ability to participate in or contribute to communities and networks? The definition of learning outcomes that would account for these very issues should provide the necessary framework for IL assessment at the postgraduate level in the upcoming period.

Conclusion

Current developments in the information universe can be perceived as the principal drive for shifts in perceptions in science and research, and consequently in perceptions of IL at the postgraduate level. In this new context, IL is strongly focused on the universe of scientific information, which underwent revolutionary transformations in the last decade, particularly as a result of the appearance of Web 2.0 (e.g. Science 2.0, Research 2.0). While it is important to remain critical of much of the hyperbole surrounding Web 2.0, one cannot ignore the surfacing of the innovative configurations of scientific discourses which potentially could lead to new forms of scholarship. Even skeptical authors (Procter et al., 2010) who categorically state that Web 2.0 services will not displace the established media and information channels in science recognize the power of Web 2.0 services and technologies and estimate that they will supplement the traditional ones. In the context of other, positive, views on the new developments in science it is emphasized that Web 2.0 will produce a much more efficient system which will serve the scholarly community and the general population far better than the present one, based on Gutenberg's invention (Nikam & Babu, 2009). Current IL processes and practices are based on linear tool-based paradigms and still indicate IL's strong orientation towards Gutenberg's information universe. Modern complexities, dynamics and variability of disseminating and publishing scientific information seriously challenge the adequacy of conventional paradigms.

Specific and intricate features that characterize novel landscapes of research make necessary the reconfigurations of perceptions on IL. On the other hand, the values, ethos and mission of scientific work have remained intact, and the new environment did not cancel the

need for scientific truth based on high-quality research and valid data. Bringing together these two seemingly opposing facts should be the principal objective of IL at the postgraduate level. In order to adhere to the fundamental principles of scholarly work, IL should shift its focus from retrieval to evaluation and minimize the risks of conducting research in spaces of scientific information characterized by increased complexity and the appearance of new and alternative forms of scientific output (e.g. wikis, blogs, social bookmarking sites, etc.). New models should focus less on resource discovery, in order to concentrate on evaluation, information management and authority issues. Due to the dynamics of research environments which postgraduate students have to prepare for, the philosophies underpinning IL frameworks at the postgraduate level should incorporate the following transitions:

- from retrieval towards evaluation
- from sequential towards non-linear processes
- from finding towards communicating information
- from document-centeredness towards community-centeredness
- from tools towards concepts.

In order for IL at postgraduate level to remain relevant, its models should reflect the new principles of research work and alternative forms of scientific communication. Adhering to existing generic and tool-based frameworks will lead to failure in terms of not preparing the future generations of researchers for information environments which they have to deal with and work in.

References

ACRL (Association of College and Research Libraries) (2000). Information literacy competency standards for higher education. Retrieved from: http://www.ala.org/ala/mgrps/divs/acrl/advocacy/infolit/standards/steps/index.cfm

Andretta, S. (2005). *Information literacy: a practitioner's guide.* Oxford: Chandos Publishing.

Arms, W. & Larsen, R. (2007). *The Future of Scholarly Communication: Building the Infrastructure for Cyberscholarship*. Phoenix, AZ: National Science Foundation & British Joint Information Systems Committee. Retrieved 22 August 2010, from: http://www.sis.pitt.edu/~repwkshop/NSF-JISC-report.pdf

Bent, M., Gannon-Leary, P. & Webb, J. (2007). Information Literacy in a researcher's learning life: the seven ages of research. *New Review of Information Networking, 13* (2), 81-99.

Big Blue Final Report (2002). Retrieved from http://www.library.mmu.ac.uk/bigblue/finalreport.html

Borgman, C. L. (2007). *Scholarship in the digital age: Information, infrastructure, and the Internet*. Cambridge, Mass: MIT Press.

Burkhardt, J.M., McDonald, M.C. & Rathemacher, A.J. (2010). *Teaching information literacy: 50 standards-made exercises for college students*. 2nd ed. Chicago: ALA.

Eisenberg, M. & Berkowitz, R.E. (1990). *Information Problem Solving: The Big Six Approach to Library and Information Skills Instruction*. Norwood, NJ: Ablex

Elmborg, J. (2006). Critical Information Literacy: Implications for Instructional Practice. *Journal of Academic Librarianship, 32* (2), 192 – 199.

Fleming-May, R. & Yuro, L. (2009). From Student to Scholar: The Academic Library and Social Sciences PhD Students' Transformation. *Portal: Libraries and the Academy, 9*(2), 199-221.

Gibson, C. (1995). Critical Thinking: Implications for Instruction. *RQ 35*, 30–31.

Grafstein, A. (2002). A Discipline-Based Approach to Information Literacy. *Journal of Academic Librarianship, 28*, 197-204.

Harley, D., Krzys Acord, S., Earl-Novell, S., Lawrence, S. & King, C.J. (2010). *Assessing the Future Landscape of Scholarly Communication: An Exploration of Faculty Values and Needs in Seven Disciplines*. Center for Studies in Higher Education, UC Berkeley. Retrieved from: http://escholarship.org/uc/cshe_fsc

Harley, D. & Acord, S. K. (2011). *Peer Review in Academic Promotion and Publishing: Its Meaning, Locus, and Future*. UC Berkeley: Center for Studies in Higher Education. Retrieved from: http://escholarship.org/uc/item/1xv148c8

Harris, B. R. (2008). Communities as necessity in information literacy development: challenging the standards. *The Journal of Academic Librarianship, 34*(3), 248-255.

Holschuh Simmons, M. (2005). Librarians as disciplinary discourse mediators: using genre theory to move toward critical information literacy. *Portal: Libraries and the Academy, 5*(3), 297-311.

Hunt, F. & Birks, J. (2008). *More hands-on information literacy activities*. New York; London: Neal-Schuman Publishers Inc.

Jacobs, H. (2008). Information Literacy and Reflective Pedagogical Praxis. *Journal of Academic Librarianship, 34*(3), 256-262.

Jankowski, N. (2009). The Contours and Challenges of e-Research. In N.W. Jankowski (Ed.), *E-research: transformation in scholarly practice* (pp. 3 – 35). New York: Routledge.

Jenkins, H. (2006). *Convergence culture: where old and new media collide*. New York, London: University Press.

Kapitzke, C. (2003). Information Literacy: A Positivist Epistemology and a Politics of Outformation. *Educational Theory, 53*(1), 37-53.

Kuhlthau, C.C. (1993). *Seeking Meaning: A Process Approach to Library and Information Services*. Norwood, NJ. : Ablex Publishing Corporation

Kuhn, T.A. (1970). *The structure of scientific revolutions*. Chicago: University of Chicago Press.

Marcum, J. W. (2002). Rethinking information literacy. *Library Quarterly, 72*(1), 1-26.

Lievrouw, L.A. (2011). Social Media and the Production of Knowledge: A Return to Little Science? *Social Epistemology*, *24*(3), 219-237.

Luzon, M.J. (2009). Scholarly hyperwriting: The function of links in academic weblogs. *Journal of the American Society for Information Science and Technology. 60*(1), 75-89.

Markless, S. (2009). A New Conception of Information Literacy for the Digital Learning Evironment in Higher Education. *Nordic Journal of Information Literacy in Higher Education*, *1*(1), 25-40.

Mutula, S. M. (2009). Challenges of postgraduate research: Global context, African perspectives. In D.N. Ocholla & D. Jacobs (Eds.). *Proceedings of DLIS 10th Annual Conference* (pp. 80-94). Retrieved from: http://www.lis.uzulu.ac.za/research/conferences/10th%20DLIS%20conferenceFeb%202010.pdf

Nentwich, M. (2003). *Cyberscience: Research in the age of the Internet*. Vienna: Austrian Academy of Sciences Press. Retrieved from: http://hw.oeaw.ac.at/3188-7.

Nikam, K. & Babu R. (2009). Moving from script to Science 2.0 for scholarly communication. *Webology, 6*(1). Retrieved from: http://webology.ir/2009/v6n1/a68.html

Norgaard, R. (2004). Writing Information Literacy in the Classroom. *Reference & User Services Quarterly, 43*(3), 220-226.

Odlyzko, A. (2009). *The future of scientific communication*. Retrieved from: http://www.dtc.umn.edu/~odlyzko/doc/future.scientific.comm.pdf

Priem, J. & Hemminger, B. (2010). Scientometrics 2.0: New metrics of scholarly impact on the social Web. *First Monday, 15*(7). Retrieved from: http://firstmonday.org/htbin/cgiwrap/bin/ojs/index.php/fm/article/view/2874/2570

Procter, R., Williams, R., Stewart, J., Poschen, M., Snee, H. & Asgari-Targhi, M. (2010). Adoption and use of Web 2.0 in scholarly communications. *Philosophical Transactions of the Royal society. 368*, 4039-4056.

Researchers of Tomorrow: A three year (BL/JISC) study tracking the research behaviour of 'Generation Y' doctoral students (2011.) Retrieved from: http://www.jisc.ac.uk/media/7/9/2/%7B792D13D2-B491-43E2-B0F5-40A31AEAF333%7DResearchers%20of%20Tomorrow%20Year%202%20report%20PDF.pdf

RIN (Research Information Network) (2008). *Mind the skills gap: information-handling training for researchers.* Retrieved from: http://www.rin.ac.uk/training-research-info

RIN (Research Information Network) (2010). If you build it, will they come? How researchers perceive and use web 2.0. Retrieved from: http://www.rin.ac.uk/our-work/communicatingand-disseminating-research/use-and-relevance-web-20-researchers

SCONUL Advisory Committee on Information Literacy (1999). Information skills in higher education: a SCONUL position paper. Retrieved from: http://www.sconul.ac.uk/groups/information_literacy/papers/Seven_pillars2.pdf

de Sompel, H.V., Payette, S., Erickson, J., Lagoze, C. & Warner, S. (2004). Rethinking scholarly communication. Building the system that scholars deserve. *D-Lib Magazine, 10*(9).

Spiranec, S., & Banek Zorica, M. (2010). Information Li.), *E-research: transformation in scholarly practice* teracy 2.0: hype or discourse refinement*? Journal of Documentation, 66*(1)*,* 140-153.

Spiranec, S., Babic, A, & Leskovic, A. (2009). New access structures to scientific information: the case of Science 2.0. In H. Stancic (Ed.). *Digital Resources and Knowledge Sharing* (pp. 451-461). Zagreb: Department of Information Sciences, Faculty of Humanities and Social Sciences, University of Zagreb.

Stock, W.G. (2007). Folksonomies and science communication: a mash-up of professional science databases and Web 2.0 services. *Information Services and use. 27*, 97-103.

Streatfield, D., Allan, W. & Wilson, T. (2010). Information literacy training for postgraduate and postdoctoral researchers; a national survey and its implications. *Libri: International Journal of Libraries and Information Services*, *60*(3*)*, 230-240.

Sundin, O. (2008). Negotiations on information seeking expertise: a study of web-based tutorials for information literacy. *Journal of Documentation*, *64*(1)*,* 24-44.

Tate, M. A. (2010). *Web Wisdom How to Evaluate and Create Information Quality on the Web.* 2nd Ed.. Boca Raton, Fla. : CRC Press.

Thorin, S.E. (2003). Global Changes in Scholarly Communication. In S.C. Hsianghoo, P.W.T. Poon & C. McNaught (Eds.). *eLearning and Digital Publishing*. Dordrecht: H. S. Ching, P. W. T.

Poon & C. McNaught. Retrieved from: http://www.springerlink.com/content/w873x131171x2421/

Tiefel, V. (1995). Library user education: examining its past, projecting its future. *Library Trends 44*(2), 318-338.

Tuominen, K., Savolainen, R. & Talja, S. (2005). Information literacy as a sociotechnical Practice. *The Library Quarterly*, *75*(3)*,* 329-345.

Vitae (2011). *Researcher Development Framework*. Retrieved from: http://www.vitae.ac.uk/researchers/428241/Researcher-Development-Framework.html

Waldrop, M.M. (2008). Science 2.0: is open access science the future? *Scientific American,* Retrieved from: http://www.sciam.com/article.cfm?id=science-2-point-0

Warden, R. (2010). The Internet and science communication: blurring the boundaries. *E-cancer, 4*(203).

Weller, K., Mainz, D., Mainz, I. & Paulsen, I. (2007). Wissenschaft 2.0? Social Software im Einsatz fuer die Wissenschaft. In M. Ockenfeld (Ed.), *Information in Wissenschaft, Bildung und Wirtschaft. Proceedings der 29. Online-Tagung der DGI* (pp. 121-136). Frankfurt am Main: DGI.

Withworth, A., McIndoe, S. & Withworth, C. (2011). Teaching Media and Information literacy to Postgraduate researchers. *ITALICS*, *10*(1)*.* Retrieved from: http://www.ics.heacademy.ac.uk/italics/vol10iss1.htm

Wheeler, B. (2008). In Search of Certitude. *Educause Review, 43*(3), 14–34.

Wong, G.K. (2010). Facilitating Students' Intellectual Growth in Information Literacy Teaching. Refe*rence User Services Quarterly, 50*(2), 114-119.