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Information retrieval educational goals in library and information science and in health sciences [1]

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Abstract. This paper is intended to compare information retrieval (IR) educational goals in different academic and professional areas such as Library and Information Science (LIS) and Health Sciences (HS), analysing and identifying a shift on user seeking goals in the digital era and, eventually, on educational goals as well. It starts with a section on information literacy where several aspects are specified, such as user goals, IR systems, IR skills, information seeking strategies (queries) and user perception of search success. Another section focuses on teaching IR aspects, like IR educational goals, assessment and feedback, and e-resources in LIS and in HS. Teaching in an academic environment for academic audiences is somehow different from teaching for professional audiences even though these are located in an academic environment as well. Those are the issues and particularities that throughout the analysis of information literacy and teaching IR aspects will be explained along the full paper.

Keywords: Information retrieval, educational goals, library and information science, health sciences

1. Introduction

Information retrieval is a core teaching area in Information Science and is also taught in Computer Science and in Informatics Engineering. It is intimately related with the professional area of Information. However, in an information and knowledge society, information retrieval skills are increasingly needed by professionals and academics in many other areas and by every citizen in his daily life, including professional and civic obligations, to satisfy their multiple and frequent information needs.

This paper is structured in two sections. The first section is on information literacy, specifying several aspects focused in IR: user goals, IR systems, IR skills, information seeking strategies (queries) and user perception of search success. The second section focuses on teaching IR: IR educational goals, assessment and feedback, and e-resources in LIS and in HS.

Teaching in an academic environment for academic audiences is somehow different from teaching for professional audiences even though these are located in an academic environment as well, so a distinction between education courses and training courses is established whenever it is needed along the full paper.

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2. Information literacy

2.1. User goals

Everyone produces and consumes information. Nowadays, we consume it on a daily basis and in an increasing volume. We use information all the time – not only the one we produce and the one we receive, but also the one we look for. Looking for, i.e. searching, information has become a routine in a global society wirelessly connected. IR techniques, formerly restricted to computer and information scientists (and some others as well) and to information professionals, are coming out to the streets popping up in several gadgets we use every day: cell phones, PDA/smartphones, netbooks, tablet PC, laptops, e-readers, etc. Search engines like Google made information look really accessible – from something that we all have the right to access it turned into the core of our lives and of our society. Vannevar Bush's [3] vision has become reality. We are addicted to information whether it comes through the internet (email, news, webpages, blogs, etc.), cell phones or broadcast companies, and we love to interact communicating and even publishing information all the time. We suffer from information overload, so we need desperately to know how to retrieve the information we need, and only that one – relevant and pertinent information according to our needs. However, fewer of us know how to achieve success in search results [14,16].

IR skills are essential in several professional areas like library and information science (LIS), computer science (CS), health sciences (HS), business, criminal investigation, etc. IR specialists are educated in degrees in LIS and CS, but users that work in health – physicians, nurses, etc. – have urgent information needs which satisfaction can have an enormous impact in our society. In 1992 Marshall published the results of the Rochester Study [13], developed at the Faculty of Library and Information Science (University of Toronto, Ontario, Canada) in the *Bulletin of the Medical Library Association* (continued by the *Journal of the Medical Library Association*). From September 1990 to March 1991, hospital librarians of the fifteen participating hospitals, at the geographic area of Rochester, NY, have distributed a survey to 448 physicians and received 208 answers. The results are impressing. The conclusion is that physicians consider that the hospital library has a significant impact on clinical decision making, which is clearly reinforced by statistical data presented. Revealing a few examples may illustrate the real impact that information services and systems have in life in general and even in hospital mortality rates: 80% of the respondents consider that accessing library services caused change somewhere in the clinical decision process, 51% changed the selection of tests, 45% changed drug therapy, 19% avoided patient mortality....

Searching for information is a time consuming task and it can be confusing or less motivating when you don't know how to do it. IR specialists are important pieces in the information society as professionals and as trainers of professionals from several other areas such as health sciences. Evidence-based medicine has pushed physicians, since a long time ago, to invest in life-long learning. And it is not by chance that MEDLINE is one of the oldest bibliographic databases. On what concerns HS professionals, this chapter will focus on physicians' profile as information users and as IR trainees. Due to length restraints, nurses and allied health professionals profiles will not be explored.

2.2. IR systems and skills and information seeking strategies – user knowledge and use

Education and training somehow differ on what concerns its focus. Education is focused in theory and training is centered on practice [7]. LIS students learn IR through education programs, while physicians acquire IR skills through training programs usually developed for academic or hospital library users.

Teaching models are also different for education and for training courses. Curricular development should be adapted to the students/users learning expectations. User studies about information behavior and surveys about students' impressions on the information seeking process, before enrolment in an IR course, may help teachers and trainers to develop education or training programs.

Education courses are centered at teaching theoretical concepts: IR fundamentals like models and systems, searching techniques/features, etc. Otherwise, training courses are centered at teaching practical applications, like searching in specific systems without comparing the IR systems explored. In this teaching approach, trainees never learn that the searching technique showed at system A is also present at system B under a different symbol/command. However this approach may be useful to professionals overwhelmed by their work duties, like physicians, that don't have the time to learn IR fundamentals and that rush onto information resources to extract pertinent information to support their clinical practice. Mixing both approaches wisely may have encouraging results.

Giving students or trainees a perspective, deep or brief according to their course profile, on IR fundamentals is always a good idea. It makes them aware of all possible choices and they become more autonomous when discovering an IR system. Modeling the IR process may be a good start for a LIS course. Even, though, without using UML, analyzing the process itself as they know it by the time they enter the course could be an interesting challenge and a start point to explore IR history since Bush's vision with the help of Michael Lesk seven ages, for example [11]. Taking a wider view of the entire information access process could help them to understand the importance of IR and its connection with information analysis tasks (modeling information systems, indexing and abstracting, authority control, thesaurus construction) and also with information storage issues. Knowledge of information systems modeling and of mathematics [12] would be important at this stage. LIS students not always have those skills, but it should be considered by curriculum developers when scratching a new LIS course or reformulating an existing one. For further information see Section 3 of this chapter.

IR models should be explained and explored from the three classic models, never forgetting the alternative ones, to the structured models. Browsing models should also be mentioned [1]. Query and results are two of the concepts that students better perceive. Information needs is the concept that they less remember [4]. Teaching them search syntax is rather important so they can construct quality search strategies and queries that can extract relevant results from IR systems.

2.3. User perception of search success

User perception of search success is one of the most apprehensive problems in IR. Sometimes, due to ignorance of information resources dimension and of search techniques/features it is usual that users don't perceive if they aren't being well succeed in a search when analyzing results. Information exponential growth adds an help to this problem. Even efficient search engines like Google can't assure that a certain query was completely answered. Knowing when to stop may be a harsh task. And time limits are not always the best choice. Even in HS, older information may be just as valuable as recent one. For example, some diseases may have been studied or some drugs may have been tested a long time ago and have never been looked up in recent decades. Probably, that's why MEDLINE has launched information back to 1947 [15].

However, most HS users think they have success when performing a search in a IR system. Perhaps, this is motivated by the quality of the information retrieved (usually from MEDLINE/PubMed) and by its impact on clinical practice as it was already referred above.

3. Teaching IR

3.1. Educational goals

As mentioned above, teacher educational goals should, somehow, match student learning expectations or, at least, the latter should be considered while developing curricular programs.

Recently, in Europe, during the "Bologna Process" of adequacy of higher education degrees, several countries have done a full revision of their courses curricular plan and have also created other courses in the spirit of the Bologna Declaration signed by 29 European countries on 19th June 1999. The adequacy of higher education degrees has implied, in many cases, a change in the selection of the various possible approaches, depending on the scientific–technical domain and on the essence of each curricular unit (CU), to the teaching/learning process. The spotlight that some courses placed on knowledge transmission before Bologna was now turning the to skills development through an active participation of the student inside the teaching/learning process itself. In LIS, the subject area of IR constitutes an exciting challenge in applying the recommendations of Bologna either by belonging to the "core" of LIS either by being an area where there has always been a great research activity.

In Portugal the "Bologna Process" is now concluded. For example, in 2006, at the Department of Information Science of the largest Portuguese polytechnic institute (and one of the best ranked, at a national level, on some world university rankings) – Instituto Politécnico do Porto (IPP) – the degree in Information and Documentation Sciences and Technologies with the duration of 5 years was restructured to a degree with a smaller length of time of 3 years [17]. The degree adequacy was supported by two important works in LIS: *Euroguide LIS* and *European Curriculum Reflections on Library and Information Science* [2,5,6]. In order to, somewhat, cover Information Seeking and Information Retrieval (IS&R) area skills, two courses were created: Information Behavior and Information Retrieval. Student skills were identified according to the *Euroguide in LIS*. For the IR course the following were defined:

Generic skills:

- Understanding and defining information retrieval fundamentals;
- Developing analysis, evaluation and diagnosis skills;
- Applying acquired knowledge on new occasions in order to solve professional problems;
- Implementing projects.

Specific skills:

- Analyzing complex information retrieval queries, constructing search strategies and outputting search results;
- Identifying and selecting information sources;
- Being at ease with every search feature/technique;
- Evaluating IR systems.

The underlying educational goals of this definition, and of the contents defined at the curricular plan, were the knowledge of IR fundamentals and of IR systems, and training in search strategies, just like other authors stated recently [7]. The teaching program that has been carried out, since 2006, puts its accent on seven topics that were found to better suit the educational goals above mentioned:

- Introduction to IR – the IR process;
- IR systems;
- IR models;

- Query operations;
- IR on the World Wide Web;
- User interfaces and visualization;
- Information retrieval systems evaluation.

These topics may be developed in many ways and in many levels of depth according to each teaching context. A tutorial style of delivery will also meet the principles stated on Bologna process.

3.2. Assessment and feedback

Assessment is, to some extent, linked with the teaching methods adopted and with the teaching system selected. In the IR area, an active teaching method is, perhaps, the more obvious option. Mixing multiple teaching methods and combining them in several ways, depending on how each class responds, can create interactivity in very interesting ways inside the classroom. When having an interactive and practice teaching approach, assessment will probably have its focus on practical work – classroom or e-learning exercises, assignments, practice part on final examination etc. All these pretend to recreate real professional life problems to solve inside the teaching/learning environment whether the teaching system selected is the traditional one, e-learning or b-learning.

Developing skills implies that students/trainees have an active role and that teachers/trainers promote interactivity. Communication leads us to interaction, as Shannon showed on his mathematical info-communication theory: when transmitting information in a message, through a transmission medium, the abstract communication channel between sender and receiver allows feedback.

Searching/retrieving information implies, above all, critical thinking. To have success while solving an exercise (what implies the synchronous use of almost every skills above referred to the CU of IR at IPP) a student/trainer shall:

- be able to analyze and translate the content of an information need,
- know several information resources, or know how to access them, and know how to evaluate which ones are more suitable to each case,
- deeply know searching techniques/features that can be used in an IR system,
- know how to construct a query creating quickly several alternatives,
- know how to evaluate results presented by the IR system and how to create a new search strategy if needed.

Having strong conceptual basis in IR, technological aptitude, abstracting capacity, cognitive processing speed, critical thinking and evaluation ability can enable a good performance in IR either at the academic environment either at the professional environment.

Traditional lectures based, exclusively, on a passive teaching method like formal lecture without interaction with the students are less likely to promote skills development or to stimulate reasoning. A mix of several methods like group discussion, forum, interactive lecture supported by audiovisual materials, brainstorming techniques, among others, can easily promote interactivity at the classroom. Mixing traditional teaching system with e-learning, i.e., adopting blended learning or b-learning teaching system can also enable a dynamic and interactive environment accessible all the time.

On digital platforms, communication may be synchronous, just like in the classroom (physical or virtual), or asynchronous. Examples of synchronous communication are Messenger, ICQ, Google Talk, Skype, Second Life (allowing virtual classroom or virtual workplace), etc. Examples of asynchronous communication are email, forums, blogs, Google Sites, etc. [10]. Using e-learning systems demands

the analysis of multiple aspects that should be considered like type of content according to the last update and inner typology. Stable content, like IR fundamentals, that doesn't need to be often updated is suitable to be delivered in more static formats, while unsettled content, like research topics, that needs to be frequently updated should be delivered in more dynamic formats [8].

Stimulating students and placing challenges to them in order to obtain their adherence, either of those considered "deep" ones either of those considered "superficial" ones, is an important asset. A challenge may be placed by the promotion of competitions where winners get a prize as a bonus reflected at the final classification of the student at the course. Usually, students adhere with enthusiasm to this kind of challenge. Testing velocity when solving problems in IR with a chronometer (at an advanced stage of the course) might improve results in examination and, consequently, final classification at the course. This kind of competition proves to increase levels of confidence and to decrease stress at final examination. At the IR course mentioned above as an example this was confirmed, since 2006, by positive approval rates of the students, positive feedback from students when evaluating the course in pedagogical annual blinded surveys (rated with 4.60 in a 0 to 5 scale, with some aspects rated with 4.83), and by good performance on curricular professional practice in the IR area. Feedback from students can also be taken through specific surveys conducted by the CU teacher in order to continuously improve the teaching and learning process in IR. In spite of the positive results achieved at the example being analyzed, this kind of measure will begin to be applied in that course in 2010. The survey results, depending on the questions asked, may lighten up new directions or changes wherever and whenever needed.

In training courses it is usual to ask trainees to give feedback of the course by answering a questionnaire at the end of the course. Usually the duration of these courses is shorter, so the questionnaire will have some other kind of questions like possible professional benefits after taking the course. HS trainees will be interested to evaluate the impact of the course on their performance in clinical practice, but this cannot be well known until a period of time after the course. User satisfaction can also be assessed as well as searching utility to clinical questions, for example. MEDLINE and EMBASE lead physicians preferences, being the former really detached from all other information sources [9].

3.3. e-Resources in LIS and in HS

e-Resources in LIS (selected list):

- IFLA – International Federation of Library Associations
  http://www.ifla.org/
- Internet Library for Librarians – portal since 1994
  http://www.itcompany.com/inforetriever/
- Librarian's Index to the Internet – since 1995
  http://www.ipl.org/index.html
- Library of Congress (LC) portal to librarians
  http://www.loc.gov/library/
- LISA – Library and Information Science Abstracts
  http://www.csa.com/factsheets/lisa-set-c.php
- LISTA
  http://www.libraryresearch.com/
- Medical Library Association (MLA)
  http://www.mlanet.org/
- National Library of Medicine (NLM)

http://www.nlm.nih.gov/
- ODLIS – Online Dictionary for Library and Information Science
  http://lu.com/odlis/index.cfm

e-Resources in HS (selected list):

- Arizona Health Sciences Library – e-Journal Locator
  http://zp9vv3zm2k.search.serialssolutions.com/?V=1.0&L=ZP9VV3ZM2K&N=100&S=T_AZ&C=A
- BioPortal – Ontologies used in biomedical communities
  http://bioportal.bioontology.org/
- CiNAHL
  http://www.ebscohost.com/cinahl/
- EMBASE – Excerpta Medica Database
  http://www.embase.com/
- Environmental Health & Toxicology – portal
  http://sis.nlm.nih.gov/enviro.html
- Intute / Medicine – UK universities portal
  http://www.intute.ac.uk/medicine/
- Intute/Nursing, midwifery and allied Health – UK universities portal
  http://www.intute.ac.uk/nmah/
- MEDLINE/PubMed
  http://www.ncbi.nlm.nih.gov/pubmed
- Merriam–Webster's Medical Dictionary
  http://www2.merriam-webster.com/cgi-bin/mwmedsamp?book=Medical&va=sample
- National Centers for Biomedical Computing (NCBC)
  http://www.ncbcs.org/
- National Institute of Health (NIH)
  http://www.nih.gov/
- PDQ – Physician Data Query
  USA National Cancer Institute (NCI) comprehensive cancer database.
  http://www.cancer.gov/cancertopics/pdq/cancerdatabase
- PLoS – Public Library of Science
  http://www.plos.org/
- PLoS Medicine – open-access journal published by PLoS
  http://www.plosmedicine.org/home.action
- TOXNET – Toxicology Data Network
  http://toxnet.nlm.nih.gov/

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