# Interdisciplinarity, Interactivity, and Interoperability for Educating the Digerati

By

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**Abstract:**

As networked digital information proliferates and modern society's need to have access to information irrespective of location rises, the education needed for the digerati, defined loosely as the digital intelligentsia, the whole class of *expert* digital information professionals, becomes an important area about which all information professionals should stay informed. This paper describes the three concepts - interdisciplinarity, interactivity, and interoperability - that are an integral part of digital library research and their use in the curriculum development, teaching, and learning of a specific area of study within Library and Information Science (LIS), namely knowledge organization (KO). KO, studied intellectually, self-referentially, and immersively, it is argued, can provide the foundation for the modern digerati.

**Introducing the Digerati**

The Oxford English Dictionary (2005) has a draft entry for the word digerati and defines it as "Those people having professional involvement or (exceptional) expertise in information technology; computing experts regarded as a class.[1]" The word digerati is a combination of 'digital' and 'erati' and; the digerati can be considered akin to the 'literati' that the OED defines as: men of letters, the learned class as a whole. Similarly, the digerati means the class of individuals who have superior problem-solving skills not just in computing and information technology but in the whole gamut of digital and its associated library, information, and media, literacy skills for an over-abundant information environment (Gilster, 1997; Bawden, 2001). Articles in popular newspapers such as the *UK Guardian* (MacLeod, 2005), *San Francisco Chronicle* (Kopytoff, 2005), *The Scotsman* (Jamieson, 2005), and *The New York Times* (Markoff, 2005) use the term digerati to refer to a range of people from computer developers, bloggers, and dot.commers to Internet surfers and often usually limiting the meaning to the digitally literate (just like the literati sometimes means 'well-educated').

In this paper, the term digerati is used in the original sense from William Safire (1992), who quotes Race: "**Digerati**, n.pl., people highly skilled in the processing and

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1 The *OED Online* (2005) provides the following etymology for digerati: "1992 *N.Y. Times* 29 Jan. D7/1 His opinions, though often controversial, are taken seriously among the computer digerati. 1995 *New Scientist* 25 Mar. 45/1 People are increasingly enabled by communications technology to become members of the 'digerati', shipping bits of information around a seamless global medium. 2000 *Independent* 17 Apr. (Monday Review section) 9/2 The book has become an overnight sensation, with many a digerati rushing to download the book before their peers did." The book referenced is Digital Literacy by Paul Gilster (1997).

manipulation of digital information; wealthy or scholarly techno-nerds." (Safire,1992). That is, the digerati are not just the digital intelligentsia, they are also the *manipulators* and *processors* of *digital information*. They are information *professionals* and *experts* and the *digital librarians* (a.k.a. scholarly "techno-nerds"). Besides possessing all the *literacy skills* that Bawden reviews, their repertoire includes the *expert knowledge and the values (ethics) necessary for building the knowledge society*.

This paper assumes that the goal of information studies is the education of a digerati, those who will play key roles in helping to build the knowledge society. It also assumes that besides traditional library values such as access, technology and organization of information are core areas for library and information (LIS) study. It argues for a broader vision of knowledge organization (KO) by assuming that this is a foundational area in the development of the digerati, and explains how one is being implemented, through the KO curriculum, for the education of the digerati at the School of Information Resources and Library Science (SIRLS), University of Arizona, Tucson[2]. The approaches discussed can also be used to educate a wider audience than LIS but this notion is not explored further in this paper.

**Why Knowledge Organization?**

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[2] This paper is based on a presentation at the "Developing a Digital Libraries Education Workshop" held in conjunction with the Joint Conference on Digital Libraries 2005 (JCDL 2005), Denver, Colorado, June 7-11, 2005. See http://dlist.sir.arizona.edu/877/.

A cluster analysis of LIS curricula at American Library Association-accredited US and Canadian programs in 1999 showed that the following areas were the main ones covered in the Master's degree in Library and Information Science (MLIS) curriculum of 44 schools (Beheshti, 1999):

- Technology
- Management
- Organization of information
- Searching and database development
- Collection development
- Mathematical methods and research
- Sociocultural aspects
- Non-print media
- Rare materials and conservation
- Sources of information
- Reference materials
- Archives
- Children literature and services
- Professional issues

The study concluded: "Technology is by far the most intense concept covered in all LIS programs, indicating a change in the MLIS programs from a few years ago. Although it affects every aspect of the curriculum, technology is not the only cause of change…As we move towards the digital information, the concept of organization (of information) is intensely covered by LIS programs" (Beheshti, 1999).

Critics have pointed out that a theoretical introduction to the organization of information is not the same as practical experience in cataloging and many solutions such as alternative modes of delivery for cataloging education, cross-training of reference librarians for cataloging, and the apprentice model have emerged or are being explored in response to the cataloging shortage and the perceived decreased commitment on the part of library schools to bibliographic control of traditional forms and formats. For example, Janet Swan Hill, Director of Technical Services at the University of Colorado, Boulder, in a discussion post on Educat (Hill, 2004), wrote:"-- as a practitioner who hires catalogers, (and who has a long-standing interest in education from that perspective), rather than as an educator, --as an employer in the wilds of Colorado, far from multiple major population centers, and far from most LIS programs…I am coming close to being convinced that distance education may be the last best hope for salvation for making decent cataloging education available across the country." Swan was hearkening back to a theme of change that she had expounded as early as 2002, if not earlier: "Increased availability of cataloging for mainstream titles in mainstream formats highlighted the need to provide catalog access for other materials - rare, or local items, and materials in formats other than books, or to provide better cataloging for material previously given short shrift (e.g. by analyzing contents and series). Technology brought a proliferation of almost metastatic proportions of types of information resources acquired by libraries. Even the basic view of the role of the catalog changed." (Hill, 2002).

Hill does not say that the change is for the worse although the history of digital library research shows a preoccupation with information discovery rather than bibliographic control and in some cases a reinvention of the wheel; but in many of these discussions a narrow vision of cataloging is propounded and there are at least two reasons why a narrow vision of library book cataloging should be abandoned and a broader vision of knowledge organization, with cataloging as one strategy in an arsenal, embraced. One, information science, viewed for our purposes as the computer processing of information, has yielded significant benefits that human only methods such as cataloging do at great costs of labor and low productivity (Osborne, 1942; Graham, 1990). Two, the history of cataloging shows that the cataloging process is also inextricably bound in activities such as bibliography, classification, or indexing and other methods that seek to provide intellectual access to information resources (Merrill, 1914; Mann, 1943). If cataloging is to survive into the 21st century, we must learn from our past and be prepared to incorporate changes (Hsieh-Yee, 2002) such as the new paradigm for the organization of information outlined by Jeng (1993).

All of this means that for LIS students to take their place as the digerati, abstruse and abstract knowledge about organizing information in traditional environments such as libraries and archives, practical skills with digital information, and traditional library values must be better integrated, research used to inform education, and the gap with practice bridged. To do so, three concepts that underlie digital library research, namely interdisciplinarity, interactivity, and interoperability, can be used as axis points for LIS

education. These three concepts can be used in many ways: as approaches to designing a curriculum, as topics to be taught, as aids in the design of thematic immersive experiences, and as values, skills, technologies, and knowledge in their own right.

**Interdisciplinarity**

Much of the recent digital library research, such as the National Science Funded (NSF) Digital Library Initiatives in the United States, has been interdisciplinary. For example, the Alexandria Digital Library brought computer scientists, catalogers, and geologists together to solve the problems related to geo-spatial information organization and retrieval (Alexandria). In the context of education, interdisciplinarity can be defined as the use of methods and tools from other disciplines to solve problems facing the original discipline (Heckhausen, 1972; Klein, 1990; Lattuca, 2001). A plan for interdisciplinary teaching and learning in knowledge organization was first developed in 2002 (Coleman) at the University of Arizona's School of Information Resources & Library Science (SIRLS). Knowledge organization was identified as a core problem area in LIS irrespective of the information environment; in other words, all information environments (libraries, archives, museums, offices, personal computers, and global virtual spaces such as the Internet) face the problem of how best to organize information for access, storage, and retrieval. The plan outlined a sequence of 6 courses that graduate students could take as a suggested course of study in Knowledge Organization (KO). Additionally, student work in these courses are structured in such a way that those who are interested in

specific environments such as digital libraries, archives, and museums, or subject domains such as Earth Sciences, or types of data/information resources such as multimedia or geo-referenced data could complete the KO track courses focusing in-depth on their interests. The definition of KO integrated several traditional LIS areas that have shown a remarkable tendency to diverge: bibliography, cataloging, documentation, indexing and abstracting, classification, subject analysis, and vocabulary control. Relevant areas from newly emerging fields such as information architecture and metadata are also considered to be a part of KO. Other cognates from Information Systems, Computer Science, and Human Computer Interaction, such as database design, electronic markup, schema design, usability, knowledge representation networks, and knowledge visualization techniques, were examined and selected topics (for example, concept maps) incorporated into the 6 courses. Thus, the six courses represent a course of study that brings together solutions for the problem of knowledge organization from a number of disciplines: it familiarizes students with solutions articulated beyond LIS, Computer Science, and traditional disciplines such as Philosophy, to include inter-disciplines such as Cognitive Science, Management Information Systems, Geographic Information Science, and newly emerging disciplines such as Information Design (SIRLS Suggested Course of Study: Knowledge Organization). The courses, in the recommended order, and their catalog descriptions are given in Table 1 and it can be easily seen that the courses draw their topics from a number of different disciplines.

**Interactivity**

There are many conceptual approaches to interactivity and it's synonym, interaction. The concept is most often discussed in the context of user interfaces but there is also a strong tradition of interactivity research in many other contexts, such as educational technology, instructional design, advertising, and online gaming (McMillan and Hwang, 2002). McMillan and Hwang showed that many of the definitional studies of interactivity can be fitted into four categories: interactivity as process, as features, as perception, and as a combination of all three. In the Geotechnical, Rock, and Water Resources Digital library, a NSF project and hereafter referred to as GROW, the concept of "interactivities" was developed (Budhu and Coleman, 2002). Interactivities became the conceptual glue to bind the researchers from many disciplines – engineers creating the digital learning objects, computer programmers and librarians developing the organization and search interfaces to retrieve these objects, and educational evaluation, usability, and information behavior researchers who were trying to assess the usability of the learning objects, digital library interface, and understand user behaviors and task interactions intrinsic to engineering learning. Interactivities are different from mere interactivity and two types of interactivities were identified. Resource interactivities are complex digital objects, that is, learning resources with different types and levels of interactivity, which are determined by the presence or absence of attributes. For example, reciprocity, feedback, immediacy, control, relevancy, synchronicity, choice, immersion, play, flow, multi-dimensionality, control, are all attributes of interactivity in a resource. Contextual interactivities are interactive services such as a glossary, thesaurus or a concept map that

is relevant for the whole domain or across a number of learning resources. Other overarching frameworks for interaction per se are lacking in the digital library research literature but Marchionini (2002) has discussed some of the problems in digital video library research, Coleman and Oxnam (2002) explain why interactional digital libraries are the norm, and Shedroff (1994) is a persuasive proponent of information interaction design as a valuable skill for almost everyone for the next decade (Shedroff,1994). Organization, be it of information or things, is merely one skill in a continuum along which interaction, communication, and ultimately experience itself can be engineered. Table 2 shows how students in the KO track are provided with an immersive and self-referential experience, wherein they experience interaction, and learn about the attributes of interactivity in diverse objects such as interfaces, resources, and web services.

**Interoperability**

In the traditional LIS curriculum, the concept of interoperable information systems is most often dealt with in the context of searching, as technical standards (for example, Z39.50) and for subject systems (vocabulary or semantic interoperability). A more cohesive view of interoperability in the organization of information is emerging (Chan and Zeng, 2002). Nevertheless, it still is an amorphous and changing concept, progressing from machine records for cataloging such as the harmonized MARC 21 format for bibliographic data[3] to a plethora of structured metadata and unstructured

[3] MARC is the acronym for MAchine Readable Cataloging. Both the LC project that sought to develop a

digital records (Coleman, et al. 2004). Advances in natural language processing and search technologies such as Google only make interoperability less transparent and correspondingly harder to understand.

The concept of interoperability is introduced through the Dublin Core (DC) metadata, Z39-85 standard (ANSI/NISO, 2001) in the first course of the KO track, *Organization of Information.* Students learn the basic elements of description in DC and using cross-walks compare it with other standards and traditions such as the Anglo American Cataloging Rules, Second Edition Revised (AACR2R), MARC 21, Encoded Archival Description (EAD), TEI (Text Encoding Initiative), and the US Federal Geographic Data Committee approved Content Standard for Digital Geospatial Metadata (FGDC CSDGM). Through optional exercises using search services such as OAISTER[4] or a digital repository data provider such as dLIST, the open access archive for Library and Information Science, they become aware of the Open Access Initiative-Protocol for Metadata Harvesting (OAI-PMH). They discover first-hand how interoperability in digital information organization works and learn that OAI-PMH true to it's promise, is proving to be a low barrier protocol for content interoperability by sharing their metadata. Exploring further under structured guidance, they unearth the ways in which data and service providers implement the OAI specification. For example, the lack of metadata in

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way of sharing and using bibliographic information through computers and the standard subsequently developed for machine records of bibliographic data are commonly known as MARC. There are national MARC standards such as US MARC, UK MARC, CAN MARC but in 1999 the US and CAN/MARC were harmonized to become MARC 21.

4 OAISTER is a project of the University of Michigan Digital Library Production Services to provide a ons-stop shopping service for hard to find academic, digital resources; it is using the OAI-PMH protocol to

many of the fields and the use of individual classifications and terms for subjects are noted. These are discussed as limitations that affect the quality of search and retrieval services, besides posing a significant barrier to the widespread acceptance and use of digital libraries and repositories by serious scholars. Sometimes, this also leads students to question the need for standards and indeed even, interoperability; often, they point out that a Google search, while it may retrieve lots of hits, in most cases, the answer the user wants is usually found on the first page if not in the first hit itself. If Google can do this without interoperability, why can't libraries? Then, they discover that Google is indeed using OAI-PMH in its searching and ranking algorithms. Differences between everyday life information seeking and advanced scholarship are sometimes difficult to explain to students who've never before had to deal with the research needs of important or deep scholarship. However, in subsequent courses such as the *Theory of Classification*, when they attempt to understand the order of divergent classification schemes and in the course on *Controlled Vocabularies*, explore the disambiguation and mapping of subjects, an epiphany occurs and the importance of different facets of interoperability to information access and architecture is more clearly understood. Students even show themselves capable of complex understandings of the nuances of the open access movement (Suber, 2005), a topic that only creeps in as a somewhat serendipitious discussion.

Another way in which content interoperability is learned as an experience happens quite naturally. The courses in the KO track are taught as distances learning courses. Besides a learning management system such as WebCT or D2L to deliver the courses a complex

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gather metadata and as of 30 Sept. 2005, it has close to 6 million records.

web of other information and communication technologies and tools such as electronic discussion lists (for backup communication should the system fail), editors for document markup, thesauri creation and other software for creating multimedia documents, bibliographies, finding aids, etc. are used. Table 3 lists an example of how the three concepts are used while teaching, and the knowledge, skills and value they each impart.

**Conclusion**

This paper has tried to show how interdisciplinarity, interactivity, and interoperability are woven into the SIRLS curriculum for the Knowledge Organization suggested course of study. While all the techniques highlighted are significant using the web to deliver the learning contributes critically to the development of a digerati mind-set. For developing attitudes and beliefs, the distance learning delivery method offers several advantages over the traditional classroom or hybrid model. Distance learning technologies are connection technologies (Gilbert and Moore, 1998; Gilbert, 1999). They connect people in ways that were not possible before. The development of people skills - communication, collaboration and teamwork, respect for differences - is an integral part of distance learning as is technological skill development through sheer familiarity and force of use and immersion. Admittedly, the same information and communication technologies used in distance learning can also be used to supplement the classroom instruction delivery mode. But the motivation to develop digital skills and values are then no longer present just as the phenomenon of de-individuation and digital immersion are impeded by the

presence of the real (versus the virtual). Distance technologies force students to use multiple channels to process, store, retrieve and recall information but almost all these channels seem a bit surreal as they are removed by either space or time, or both. The surrealism contributes and develops a feeling of being connected globally[5]. Web technologies also enable relatively easy customization of instructional experiences besides facilitating the distribution of multiple adaptations. One caveat must be noted: student learning styles should be tested and identified prior to participation in elearning in order to provide the best individually customized experience.

Irrespective of the mode of delivery used, the incorporation of three concepts from digital library research, interdisciplinarity, interactivity, and interoperability, along several dimensions of knowledge, technical skills and values is a potent pedagogy for the modern digerati. The three concepts have been presented in the context of a specific curriculum of Knowledge Organization for LIS students but their use in the design of a broader education to a wider audience than LIS students is worthy of further exploration.

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[5] Thomas Friedman in *The World is Flat* (2005) uses the word "flat" to mean globally connected, explores how all the playing fields are being leveled by technology (with a networked desktop we can all literally compete globally), and what this means to companies, countries and individuals.

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**Table 1: SIRLS courses in the Knowledge Organization specialization**

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|---|
| Organization of Information: |
| Study of the history, theory and practices of information organization, primarily in traditional and digital libraries. Archives, museums, management information systems, and the Internet (WWW) are also included. Focus on standards and tools that are emerging or used in large text-based collections. |
| Cataloging and Metadata Management: |
| Study of the principles and practices of descriptive cataloging for bibliographic control, resource description, and access. AACR2, MARC, Dublin Core, OAI-PMH, and selected specialized metadata schemes for all forms and formats of materials are covered. |
| Indexing: |
| Theory and practices of indexing and abstracting including the use of computer software for alternative approaches. How indexing differs from other forms of subject analyses in bibliographies, cataloging and classification |
| Controlled Vocabularies: |
| Introduction to knowledge organization systems that use controlled vocabularies and their role in information architecture. Principles, standards (Z39.19), design and maintenance of thesauri using computer software are studied. The use of controlled vocabularies in electronic information environments such as the WWW is explored. |
| Theory of Classification: |
| Study of the theory and principles of classification from the perspectives of many disciplines including, Philosophy, Linguistics, Psychology, Library and Information Science. An international, interdisciplinary perspective to classification is used. |
| Knowledge Structures: |
| Theories about concepts and knowledge structures from Cognitive Science and Information Science. Topics include mental models and schemas, meaning, symbolism, and the individual construction of meaning. |

**Table 2:** Experiencing Interactivity in the Organization of Information course

| **Resources Used (Digital Objects)** | **Experiences With The Attributes Of Interactivity** |
|---|---|
| Multimedia files with audio, video, control (interactivities) | What technologies are needed?<br>What is the user experience?<br>What is the level of user control? |
| Plain text html files (born digital resources) | What are the forms and formats of information in a html file?<br>What is the user experience?<br>Read or scan? |
| Interactive quizzes with immediate feedback (web services) | How does the quiz flow with the topic being learned?<br>How much feedback is sufficient? |

**Table 3: Examples of how the concepts are used while teaching a topic**

| Concept | Teaching | Student Activity (showing values and skills gained) |
|---|---|---|
| Interdisciplinarity | Use examples from at least two or three different disciplines to teach "bibliography" | Search in two different indexing databases to compile a subject bibliography on concepts such as Family, Gender, Race; highlights the problems of different indexing descriptors and the many different disciplinary bases from which these concepts can be explored |
| Interactivity | Use different types of information resources to deliver lecture notes on the topics: interactivities (digital objects with multimedia and varying degrees of feedback, user control) vs. plain text/pdf files | Reading multimedia and digital information files; students write a brief essay on the problem of reading versus scanning and the experience of interaction versus immersion versus imagination |
| Interoperability | Use at least two different systems for delivery of teaching; Breeze for real-time web conferencing (audio and video); D2L for virtual discussion, static and dynamic lecture notes, and student submissions | Using both systems competently for the different tasks; highlights the problem of choice and limitations of various Information and Communication Technologies – notes delivered via one are sometimes available in the other and sometimes not |