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How important is computing technology for library and information science research?

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ABSTRACT

Computers in library and information science (LIS) research have been an object of study or a tool for research for at least fifty years, but how central are computers to the discipline now? This research analyses the titles, abstracts, and keywords of forty years of articles in LIS-classified journals for trends related to computing technologies. The proportion of Scopus LIS articles mentioning some aspect of computing in their title, abstract, or keywords increased steadily from 1986 to 2000, then stabilised at about two thirds, indicating a continuing dominance of computers in most LIS research. Within this general trend, many computer-related terms have peaked and then declined in popularity. For example, the proportion of Scopus LIS article titles, abstracts, or keywords that included the terms "computer" or "computing" decreased fairly steadily from about 20% in 1975 to 5% in 2013, and the proportion explicitly mentioning the web peaked at 18% in 2002. Parallel analyses suggest that computing is substantially less important in two related disciplines: education and communication, and so it should be seen as a key aspect of the LIS identity.

1. Introduction

The recent history of LIS research has clearly been affected by computers, from computing systems in libraries to the rise of the personal computer and the web. Nevertheless, no study has attempted to quantify just how great this influence is, although there have been investigations into the history of computers, the history of LIS research, and even the history of computers in LIS research.

1.1. Problem statement

A number of bibliometric studies have shown that computing or web-related topics have been important to LIS at specific points in time but there is no evidence about how important or central computing technologies are in LIS research. A previous study used a bibliometric approach to analyse the whole of LIS over 100 years, tracking changes in the use of keywords in article titles over time and found many computing-related keywords to increase and then decrease in frequency (Larivière, Sugimoto, & Cronin, 2012) but did not analyse computing overall as a single entity. The current study fills this gap with an analysis of the extent to which computers, the web and computing are explicitly mentioned in LIS journal articles.

Although almost all modern research probably uses computers, from word processing papers to analysing statistics with software, most uses are not important enough to be mentioned in a published article. For example, it would be strange to report that an article was written in Microsoft Word or that the graphs were drawn by Microsoft Excel. In contrast, research is sometimes about an aspect of computing (e.g., designing or evaluating hardware or software). Moreover, aspects of computing technology can also be important enough to be mentioned in the title, keyword, or abstract of research that is not primarily about computing. Such mentions may occur, for example, if technology makes the research possible even though the study is not about it. The present study is based upon the simplifying assumptions that if a computing technology is mentioned in the title of an article then it is likely to be *central* to the article and if it is mentioned in the title, abstract or keywords then it is likely to be *important* in some way for the article. The following research questions drive the investigation.

- What is the proportion of LIS articles that computing is *important for*, and how has this changed over time?
- What is the proportion of LIS articles that computing is *central to*, and how has this changed over time?
- How does LIS compare to similar disciplines in terms of the importance of computing?
- Which topics have fallen in and out of fashion in computing related and non-computing-related LIS research over the past 40 years?

Answering these questions can give a fuller understanding of the relative importance of computing that can help the discipline to plan the amount of computing that should be contained in its educational

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curricula, debate the merits of the current balance of computing-related research, and predict the likely relevance of computing in the future.

2. Literature review

Histories of computing sometimes start with the abacus (Ifrah, Harding, Bellos, & Wood, 2000) or mass automation techniques, such as the commercial mechanical calculating machines of over a century ago (e.g., Campbell-Kelly & Aspray, 2004). Research and development for electronic calculating machines and stored program computers were boosted significantly by the urgent code-breaking needs of the Second World War and the post-war years saw the rise of a small number of expensive flexible computers in research organisations and large companies. As power, reliability, and the availability of trained technicians increased, computers started to be used more widely in the business and government sectors. A revolutionary transformation occurred when it became possible to build small personal computers, making them much cheaper and therefore capable of taking on an increasing range of office tasks. It also became practical for individuals to own their own computer at this stage. The next revolution was the development of the web and the infrastructure to deliver it via the Internet through phone lines, and then to smart devices (Bergman, Gradovitch, Bar-Ilan, & Beyth-Marom, 2013), creating the globally interconnected ubiquitous information and entertainment world of today.

Although libraries have been important since ancient times (Lerner, 2009), LIS formally entered higher education in the form of a School of Library Economy in the USA in 1884 which was part of a small international movement towards systematising library education at the time (White, 1976). The core ideas of information science were then developed within the Institute of Bibliography in Brussels from 1895, although not using modern terminology (Rayward, 1997). The term "library science" was apparently popularised much later by a widely influential book from India, *The Five Laws of Library Science* (Ranganathan, 1931), and the term "information science" was only coined in 1955 (Shapiro, 1995). In the USA, library science extended from a focus on libraries to a wider focus on information and this was reflected by the almost universal extension of school names to LIS, starting in 1964 (Galvin, 1977). This change occurred in parallel with a shift in focus from documents to the wider concept of information, which was at least partially driven by the emergence of new technologies (Borko, 1968; Buckland, 1996). The shift was also probably influenced by attempts to automate searching for documents (Kent, 1962), leading to the development of information retrieval as a specialism. This specialism was boosted in 1992 with US Department of Defense and National Institute of Standards and Technology sponsorship the Text REtrieval Conference (TREC) series. The importance of information was then further underlined by the US-centred information school (iSchool) organization from 2005,[1] often losing the term library altogether from school names. A number of previous studies have tracked influential topics within LIS using citations (Garfield, 2009) and co-citations (Åström, 2007), showing that it contains distinct subfields, each with their own history, and that it has important influences from other disciplines (Cronin, 2008; Tang, 2004).

Sustained LIS interest in computers probably started with the recognition that they could automate many of the core labour-intensive, information-based functions of libraries, such as those concerned with cataloguing and lending books (Rayward, 2002). Since LIS is often about organising information and helping users to find relevant information, any system that can efficiently store data in a searchable way is potentially useful for libraries and also for wider information science research. Electronic computers were first investigated for their potential uses in libraries as far back as the 1950s (Borgman, 1997; Kilgour, 1970), and related research directions, such as analysing the logs of search systems, started in the 1960s (Peters, 1993), if not before. Almost from the start, computers did not just automate the existing functions of libraries but also extended them (Rayward, 2002), potentially leading to sustained interest in research into computer-based innovations for libraries and for the wider information work of LIS professionals. As early as 1974, Rosenberg (1974) claimed that computers are so central to information science that they have become a core part of its "way of looking at the world" so that information scientists may think in computer processing terms even for actions taken by computers. This approach has been developed by Warner (2008), who suggests that information technology is influential on theoretical discourses of information science but is essentially seen as external rather than an integral part of them.

The importance of computing to some but not all LIS is suggested by various studies of the field. For example, some of the 11 coherent research topics of the 120 most prolific authors in terms of published information science research 1972–1995 were about computing technologies (experimental retrieval, online retrieval, general library systems, OPACs), some probably had computers as an important aspect (citation analysis, bibliometrics, science communication), but others did not (user theory, indexing theory, citation theory, communication theory). A later study of 2002–2004 covering four general LIS journals and the specialist journal Scientometrics (Janssens, Leta, Glänzel, & De Moor, 2006) found four out of five computing-related clusters [bibliometrics (2 clusters), webometrics, information retrieval, patent analysis] and one partially-related cluster (social issues, combining computing terms like internet with others like seek, behaviour, health, and social). This shift towards more computing-related research in LIS and a strong web influence (also in: Åström, 2007) was confirmed by results from 1996–2005, although the later study found 2 topics that do not seem to be directly related to computing out of the 12 analysed (user theory, structured abstracts; also to some extent children's information searching behaviour and users' judgements of relevance) (Zhao & Strotmann, 2008). The situation in 2006–2010 was similar, with only one out of 12 factors seeming to be unrelated to computers (knowledge management), although it could be argued that computing technology had started to become part of the background of, rather than core to, other topics found, including *research evaluation*, *information behaviour*, *bibliometrics*, *bibliometric distributions* and perhaps even *technology acceptance* (Table 3 in. Zhao & Strotmann, 2014). This latter issue highlights the problem that in research topics relying upon computers, such as most bibliometrics, there may be periods of time when new research is rarely driven by computing innovations.

3. Methods

The overall strategy was to analyse a large sample of titles, abstracts and keywords from LIS journal articles and to calculate the yearly percentage of articles containing computer-related terms in order to identify increases and decreases over time. Journal articles were chosen rather than the full range of scholarly outputs (e.g., conference papers, monographs, book chapters) in order to focus on a clearly defined type of output that seems to be the most important for a majority of the LIS discipline and is well-covered by available databases. Monographs and book chapters are probably important for areas of LIS with a humanities orientation but it does not seem possible to gain a large sample of these for the subject area in an unbiased way. The largest current source is probably Google Books (e.g., Chen, 2012) and it is possible to conduct bibliometric analyses with this database (Kousha, Thelwall, & Rezaie, 2011), but it contains no pre-classified set of LIS books to select from. The Book Citation Index in the Web of Science (WoS) is also a large source of books and book chapters as far back as 2005 (Torres-Salinas, Rodríguez-Sánchez, Robinson-Garcia, Fdez-Valdivia, & García, 2013), but this is not enough for the current study. Conference papers are also presumably important for areas of LIS that are close to computer

[1] http://ischools.org/about/.