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Research Methods in Library and Information Science

Aspasia Togia and Afrodite Malliari

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Abstract

Library and information science (LIS) is a very broad discipline, which uses a wide range of constantly evolving research strategies and techniques. The aim of this chapter is to provide an updated view of research issues in library and information science. A stratified random sample of 440 articles published in five prominent journals was analyzed and classified to identify (i) research approach, (ii) research methodology, and (iii) method of data analysis. For each variable, a coding scheme was developed, and the articles were coded accordingly. A total of 78% of the articles reported empirical research. The rest 22% were classified as non-empirical research papers. The five most popular topics were “information retrieval,” “information behaviour,” “information literacy,” “library services,” and “organization and management.” An overwhelming majority of the empirical research articles employed a quantitative approach. Although the survey emerged as the most frequently used research strategy, there is evidence that the number and variety of research methodologies have been increased. There is also evidence that qualitative approaches are gaining increasing importance and have a role to play in LIS, while mixed methods have not yet gained enough recognition in LIS research.

Keywords: library and information science, research methods, research strategies, data analysis techniques, research articles

1. Introduction

Library and information science (LIS), as its name indicates, is a merging of librarianship and information science that took place in the 1960s [1, 2]. LIS is a field of both professional practice and scientific inquiry. As a field of practice, it includes the profession of librarianship as well as a number of other information professions, all of which assume the interplay of the following:

- information content,
- the people who interact with the content, and
- the technology used to facilitate the creation, communication, storage, or transformation of the content [3].

The disciplinary foundation of LIS, which began in the 1920s, aimed at providing a theoretical foundation for the library profession. LIS has evolved in close relationship with other fields of research, especially computer science, communication studies, and cognitive sciences [4].

The connection of LIS with professional practice, on one hand, and other research fields on the other has influenced its research orientation and the development of methodological tools and theoretical perspectives [5]. Research problems are diverse, depending on the research direction, local trends, etc. Most of them relate to the professional practice although there are theoretical research statements as well. LIS research strives to address important information issues, such as these of “*information retrieval, information quality and authenticity, policy for access and preservation, the health and security applications of data mining*” (p. 3) [6]. The research is multidisciplinary in nature, and it has been heavily influenced by research designs developed in the social, behavioral, and management sciences and to a lesser extent by the theoretical inquiry adopted in the humanities [7]. Methods used in information retrieval research have been adapted from computer science. The emergence of evidence-based librarianship in the late 1990s brought a positivist approach to LIS research, since it incorporated many of the research designs and methods used in clinical medicine [7, 8]. In addition, LIS has developed its own methodological approaches, a prominent example of which is bibliometrics. Bibliometrics, which can be defined as “*the use of mathematical and statistical methods to study documents and patterns of publication*” (p. 38) [9], is a native research methodology, which has been extensively used outside the field, especially in science studies [10].

Library and information science research has been often criticized as being fragmentary, narrowly focused, and oriented to practical problems [11]. Many authors have noticed limited use of theory in published research and have advocated greater use of theory as a conceptual basis in LIS research [4, 11–14]. Feehan et al. [13] claimed that LIS literature has not evolved enough to support a rigid body of its own theoretical basis. Jarvelin and Vakkari [15] argued that LIS theories are usually vague and conceptually unclear, and that research in LIS has been dominated by a paradigm which “*has made little use of such traditional scientific approaches as foundations and conceptual analysis, or of scientific explanation and theory formulation*” (p. 415). This lack of theoretical contributions may be associated with the fact that LIS emanated from professional practice and is therefore closely linked to practical problems such as the processing and organization of library materials, documentation, and information retrieval [15, 16].

In this chapter, after briefly discussing the role of theory in LIS research, we provide an updated view of research issues in the field that will help scholars and students stay informed about topics related to research strategies and methods. To accomplish this, we describe and analyze patterns of LIS research activity as reflected in prominent library journals. The analysis of the articles highlights trends and recurring themes in LIS research regarding the use of multiple methods, the adoption of qualitative approaches, and the employment of advanced techniques for data analysis and interpretation [17].

2. The role of theory in LIS research

The presence of theory is an indication of research eminence and respectability [18], as well as a feature of discipline's maturity [19, 20]. Theory has been defined in many ways. "Any of the following have been used as the meaning of theory: a law, a hypothesis, group of hypotheses, proposition, supposition, explanation, model, assumption, conjecture, construct, edifice, structure, opinion, speculation, belief, principle, rule, point of view, generalization, scheme, or idea" (p. 309) [21]. A theory can be described as "a set of interrelated concepts, definitions, and propositions that explains or predicts events or situations by specifying relations among variables" [22]. According to Babbie [23], research is "a systematic explanation for the observed facts and laws that related to a particular aspect of life" (p. 49). It is "a multiple-level component of the research process, comprising a range of generalizations that move beyond a descriptive level to a more explanatory level" [24] (p. 319). The role of theory in social sciences is, among other things, to explain and predict behavior, be usable in practical applications, and guide research [25]. According to Smiraglia [26], theory does not exist in a vacuum but in a system that explains the domains of human actions, the phenomena found in these domains, and the ways in which they are affected. He maintains that theory is developed by systematically observing phenomena, either in the positivist empirical research paradigm or in the qualitative hermeneutic paradigm. Theory is used to formulate hypotheses in quantitative research and confirms observations in qualitative research.

Glazier and Grover [24] proposed a model for theory-building in LIS called "circuits of theory." The model includes taxonomy of theory, developed earlier by the authors [11], and the critical social and psychological factors that influence research. The purpose of the taxonomy was to demonstrate the relationships among the concepts of research, theory, paradigms, and phenomena. Phenomena are described as "events experienced in the empirical world" (p. 230) [11]. Researchers assign symbols (digital or iconic representations, usually words or pictures) to phenomena, and meaning to symbols, and then they conceptualize the relationships among phenomena and formulate hypotheses and research questions. "In the taxonomy, empirical research begins with the formation of research questions to be answered about the concepts or hypotheses for testing the concepts within a narrow set of predetermined parameters" (p. 323) [24]. Various levels of theories, with implications for research in library and information Science, are described. The first theory level, called *substantive theory*, is defined as "a set of propositions which furnish an explanation for an applied area of inquiry" (p. 233) [11]. In fact, it may not be viewed as a theory but rather be considered as a research hypothesis that has been tested or even a research finding [16]. The next level of theory, called *formal theory*, is defined as "a set of propositions which furnish an explanation for a formal or conceptual area of inquiry, that is, a discipline" (p. 234) [11]. Substantive and formal theories together are usually considered as "middle range" theory in the social sciences. Their difference lies in the ability to structure generalizations and the potential for explanation and prediction. The final level, *grand theory*, is "a set of theories or generalizations that transcend the borders of disciplines to explain relationships among phenomena" (p. 321) [24]. According to the authors, most research generates substantive level theory, or, alternatively, researchers borrow theory from the appropriate discipline, apply it to the problem under investigation, and reconstruct the theory at the substantive level. Next in the hierarchy of theoretical categories is the *paradigm*, which is described as "a framework of basic assumptions with which

perceptions are evaluated and relationships are delineated and applied to a discipline or profession" (p. 234) [11]. Finally, the most significant theoretical category is the *world view*, which is defined as *"an individual's accepted knowledge, including values and assumptions, which provide a 'filter' for perception of all phenomena"* (p. 235) [11]. All the previous categories contribute to shaping the individual's worldview. In the revised model, which places more emphasis on the impact of social environment on the research process, research and theory building is surrounded by a system of three basic contextual modules: the self, society, and knowledge, both discovered and undiscovered. The interactions and dialectical relationships of these three modules affect the research process and create a dynamic environment that fosters theory creation and development. The authors argue that their model will help researchers build theories that enable generalizations beyond the conclusions drawn from empirical data [24].

In an effort to propose a framework for a unified theory of librarianship, McGrath [27] reviewed research articles in the areas of publishing, acquisitions, classification and knowledge organization, storage, preservation and collection management, library collections, and circulations. In his study, he included articles that employed explanatory and predictive statistical methods to explore relationships between variables within and between the above subfields of LIS. For each paper reviewed, he identified the dependent variable, significant independent variables, and the units of analysis. The review displayed explanatory studies *"in nearly every level, with the possible exception of classification, while studies in circulation and use of the library were clearly dominant. A recapitulation showed that a variable at one level may be a unit of analysis at another, a property of explanatory research crucial to the development of theory, which has been either ignored or unrecognized in LIS literature"* (p. 368) [27]. The author concluded that *"explanatory and predictive relationships do exist and that they can be useful in constructing a comprehensive unified theory of librarianship"* (p. 368) [27].

Recent LIS literature provides several analyses of theory development and use in the field. In a longitudinal analysis of information needs and uses of literature, Julien and Duggan [28] investigated, among other things, to what extent LIS literature was grounded in theory. Articles *"based on a coherent and explicit framework of assumptions, definitions, and propositions that, taken together, have some explanatory power"* (p. 294) were classified as theoretical articles. Results showed that only 18.3% of the research studies identified in the sample of articles examined were theoretically grounded.

Pettigrew and McKechnie [29] analyzed 1160 journal articles published between 1993 and 1998 to determine the level of theory use in information science research. In the absence of a singular definition of theory that would cover all the different uses of the term in the sample of articles, they operationalized *"theory"* according to authors' use of the term. They found that 34.1% of the articles incorporated theory, with the largest percentage of theories drawn from the social sciences. Information science itself was the second most important source of theories. The authors argued that this significant increase in theory use in comparison to earlier studies could be explained by the research-oriented journals they selected for examination, the sample time, and the broad way in which they defined *"theory."* With regard to this last point, that is, their approach of identifying theories only if the author(s) describe them as such in the article, Pettigrew and McKechnie [29] observed significant differences in how information science researchers perceive theory:

Although it is possible that conceptual differences regarding the nature of theory may be due to the different disciplinary backgrounds of researchers in IS, other themes emerged from our data that suggest a general confusion exists about theory even within subfields. Numerous examples came to light during our analysis in which an author would simultaneously refer to something as a theory and a method, or as a theory and a model, or as a theory and a reported finding. In other words, it seems as though authors, themselves, are sometimes unsure about what constitutes theory. Questions even arose regarding whether the author to whom a theory was credited would him or herself consider his or her work as theory (p. 68).

Kim and Jeong [16] examined the state and characteristics of theoretical research in LIS journals between 1984 and 2003. They focused on the “theory incident,” which is described as “an event in which the author contributes to the development or the use of theory in his/her paper.” Their study adopted Glazier and Grover’s [24] model of “circuits of theory.” Substantive level theory was operationalized to a tested hypothesis or an observed relationship, while both formal and grand level theories were identified when they were named as “theory,” “model,” or “law” by authors other than those who had developed them. Results demonstrated that the application of theory was present in 41.4% of the articles examined, signifying a significant increase in the proportion of theoretical articles as compared to previous studies. Moreover, it was evident that both theory development and theory use had increased by the year. Information seeking and use, and information retrieval, were identified as the subfields with the most significant contribution to the development of the theoretical framework.

In a more in-depth analysis of theory use in Kumasi et al. [30] qualitatively analyzed the extent to which theory is meaningfully used in scholarly literature. For this purpose, they developed a *theory talk* coding scheme, which included six analytical categories, describing how theory is discussed in a study. The intensity of theory talk in the articles was described across a continuum from minimal (e.g., theory is discussed in literature review and not mentioned later) through moderate (e.g., multiple theories are introduced but without discussing their relevance to the study) to major (e.g., theory is employed throughout the study). Their findings seem to support the opinion that “LIS discipline has been focused on the application of specific theoretical frameworks rather than the generation of new theories” (p. 179) [30]. Another point the authors made was about the multiple terms used in the articles to describe theory. Words such as “framework,” “model,” or “theory” were used interchangeably by scholars.

It is evident from the above discussion that the treatment of theory in LIS research covers a spectrum of intensity, from marginal mentions to theory revising, expanding, or building. Recent analyses of the published scholarship indicate that the field has not been very successful in contributing to existing theory or producing new theory. In spite of this, one may still assert that LIS research employs theory, and, in fact, there are many theories that have been used or generated by LIS scholars. However, “calls for additional and novel theory development work in LIS continue, particularly for theories that might help to address the research practice gap” (p. 12) [31].

3. Research strategies in LIS

3.1. Surveys of research methods

LIS is a very broad discipline, which uses a wide range of constantly evolving research strategies and techniques [32]. Various classification schemes have been developed to analyze

methods employed in LIS research (e.g., [13, 15, 17, 33–35, 38]). Back in 1996, in the “research record” column of the *Journal of Education for Library and Information Science*, Kim [36] synthesized previous categories and definitions and introduced a list of research strategies, including data collection and analysis methods. The listing included four general research strategies: (i) theoretical/philosophical inquiry (development of conceptual models or frameworks), (ii) bibliographic research (descriptive studies of books and their properties as well as bibliographies of various kinds), (iii) R&D (development of storage and retrieval systems, software, interface, etc.), and (iv) action research, it aims at solving problems and bringing about change in organizations. Strategies are then divided into quantitative and qualitative driven. In the first category are included descriptive studies, predictive/explanatory studies, bibliometric studies, content analysis, and operation research studies. Qualitative-driven strategies are considered the following: case study, biographical method, historical method, grounded theory, ethnography, phenomenology, symbolic interactionism/semiotics, sociolinguistics/discourse analysis/ethnographic semantics/ethnography of communication, and hermeneutics/interpretive interactionism (p. 378–380) [36].

Systematic studies of research methods in LIS started in the 1980s and several reviews of the literature have been conducted over the past years to analyze the topics, methodologies, and quality of research. One of the earliest studies was done by Peritz [37] who carried out a bibliometric analysis of the articles published in 39 core LIS journals between 1950 and 1975. She examined the methodologies used, the type of library or organization investigated, the type of activity investigated, and the institutional affiliation of the authors. The most important findings were a clear orientation toward library and information service activities, a widespread use of the survey methodology, a considerable increase of research articles after 1960, and a significant increase in theoretical studies after 1965.

Nour [38] followed up on Peritz’s [37] work and studied research articles published in 41 selected journals during the year 1980. She found that survey and theoretical/analytic methodologies were the most popular, followed by bibliometrics. Comparing these findings to those made by Peritz [37], Nour [38] found that the amount of research continued to increase, but the proportion of research articles to all articles had been decreasing since 1975.

Feehan et al. [13] described how LIS research published during 1984 was distributed over various topics and what methods had been used to study these topics. Their analysis revealed a predominance of survey and historical methods and a notable percentage of articles using more than one research method. Following a different approach, Enger et al. (1989) focused on the statistical methods used by LIS researchers in articles published during 1985 [39]. They found that only one out of three of the articles reported any use of statistics. Of those, 21% used descriptive statistics and 11% inferential statistics. In addition, the authors found that researchers from disciplines other than LIS made the highest use of statistics and LIS faculty showed the highest use of inferential statistics.

An influential work, against which later studies have been compared, is that of Jarvelin and Vakkari [15] who studied LIS articles published in 1985 in order to determine how research was distributed over various subjects, what approaches had been taken by the authors, and what research strategies had been used. The authors replicated their study later to include

older research published between 1965 and 1985 [40]. The main finding of these studies was that the trends and characteristics of LIS research remained more or less the same over the aforementioned period of 20 years. The most common topics were information service activities and information storage and retrieval. Empirical research strategies were predominant, and of them, the most frequent was the survey. Kumpulainen [41], in an effort to provide a continuum with Jarvelin and Vakkari's [15] study, analyzed 632 articles sampled from 30 core LIS journals with respect to various characteristics, including topics, aspect of activity, research method, data selection method, and data analysis techniques. She used the same classification scheme, and she selected the journals based on a slightly modified version of Jarvelin and Vakkari's [15] list. Library services and information storage and retrieval emerged again as the most common subjects approached by the authors and survey was the most frequently used method.

More recent studies of this nature include those conducted by Koufogiannakis et al. [42], Hildreth and Aytac [43], Hider and Pymm [32], and Chu [17]. Koufogiannakis et al. [42] examined research articles published in 2001 and they found that the majority of them were questionnaire-based descriptive studies. Comparative, bibliometrics, content analysis, and program evaluation studies were also popular. Information storage and retrieval emerged as the predominant subject area, followed by library collections and management. Hildreth and Aytac [43] presented a review of the 2003–2005 published library research with special focus on methodology issues and the quality of published articles of both practitioners and academic scholars. They found that most research was descriptive and the most frequent method for data collection was the questionnaire, followed by content analysis and interviews. With regard to data analysis, more researchers used quantitative methods, considerably less used qualitative-only methods, whereas 61 out of 206 studies included some kind of qualitative analysis, raising the total percentage of qualitative methods to nearly 50%. With regard to the quality of published research, the authors argued that *"the majority of the reports are detailed, comprehensive, and well-organized"* (p. 254) [43]. Still, they noticed that the majority of reports did not mention the critical issues of research validity and reliability and neither did they indicate study limitations or future research recommendations. Hider and Pymm [32] described content analysis of LIS literature *"which aimed to identify the most common strategies and techniques employed by LIS researchers carrying out high-profile empirical research"* (p. 109). Their results suggested that while researchers employed a wide variety of strategies, they mostly used surveys and experiments. They also observed that although quantitative research accounted for more than 50% of the articles, there was an increase in the use of most sophisticated qualitative methods. Chu [17] analyzed the research articles published between 2001 and 2010 in three major journals and reported the following most frequent research methods: theoretical approach (e.g., conceptual analysis), content analysis, questionnaire, interview, experiment, and bibliometrics. Her study showed an increase in both the number and variety of research methods but lack of growth in the use of qualitative research or in the adoption of multiple research methods.

In summary, the literature shows a continued interest in the analysis of published LIS research. Approaches include focusing on particular publication years, geographic areas, journal titles, aspects of LIS, and specific characteristics, such as subjects, authorship, and

research methods. Despite the abundance of content analyses of LIS literature, the findings are not easily comparable due to differences in the number and titles of journals examined, in the types of the papers selected for analysis, in the periods covered, and in classification schemes developed by the authors to categorize article topics and research strategies. Despite the differences, some findings are consistent among all studies:

- Information seeking, information retrieval, and library and information service activities are among the most common subjects studied,
- Descriptive research methodologies based on surveys and questionnaires predominate,
- Over the years, there has been a considerable increase in the array of research approaches used to explore library issues, and
- Data analysis is usually limited to descriptive statistics, including frequencies, means, and standard deviations.

3.2. Data collection and analysis

Articles published between 2011 and 2016 were obtained from the following journals: Library and Information Science Research, College & Research Libraries, Journal of Documentation, Information Processing & Management, and Journal of Academic Librarianship (**Table 1**). These five titles were selected as data sources because they have the highest 5-year impact factor of the journals classified in Ulrich's Serials Directory under the "Library and Information Sciences" subject heading. From the journals selected, only full-length articles were collected. Editorials, book reviews, letters, interviews, commentaries, and news items were excluded from the analysis. This selection process yielded 1643 articles. A stratified random sample of 440 articles was chosen for in-depth analysis (**Table 2**). For the purpose of this study, five strata, corresponding to the five journals, were used. The sample size was determined using a margin of error, 4%, and confidence interval, 95%.

Each article was classified as either research or theoretical. Articles that employed specific research methodology and presented specific findings of original studies performed by the author(s) were considered research articles. The kind of study may vary (e.g., it could be an experiment, a survey, etc.), but in all cases, raw data had been collected and analyzed, and conclusions were drawn from the results of that analysis. Articles reporting research in system design or evaluation in the information systems field were also regarded as *research articles*. On the other hand, works that reviewed theories, theoretical concepts, or principles discussed topics of interest to researchers and professionals, or described research methodologies were regarded as theoretical articles [44] and were classified in the *no-empirical-research* category. In this category, were also included literature reviews and articles describing a project, a situation, a process, etc.

Each article was classified into a topical category according to its main subject. The articles classified as research were then further explored and analyzed to identify (i) research approach, (ii) research methodology, and (iii) method of data analysis. For each variable, a coding scheme was developed, and the articles were coded accordingly. The final list of the

	Libr & Inf Sci Res	Coll & Res Libr	J Doc	Inf Proc & Manag	J Acad Libr
Scope	The research process in library and information science as well as research findings and, where applicable, their practical applications and significance	All fields of interest and concern to academic and research libraries	Theories, concepts, models, frameworks, and philosophies related to documents and recorded knowledge	Theory, methods, or application in the field of information science	Problems and issues germane to college and university libraries
Publisher	Elsevier	ACRL	Emerald	Elsevier	Elsevier
Start year	1979	1939	1945	1963	1975
Frequency	Quarterly	Bi-monthly	Bi-monthly	Bi-monthly	Bi-monthly
5-year impact factor	1.981	1.617	1.480	1.468	1.181

Table 1. Profile of the journals.

Titles	Total number of articles	Articles selected
Libr & Inf Sci Res	214	57
Coll & Res Libr	233	62
J of Docum	304	81
Inf Proc & Manag	432	116
J Acad Libr	460	123
Total	1643	440

Table 2. Journal titles.

analysis codes was extracted inductively from the data itself, using as reference the taxonomies utilized in previous studies [15, 32, 43, 45]. Research approaches “are plans and procedures for research” (p. 3) [46]. Research approaches can generally be grouped as qualitative, quantitative, and mixed methods studies. Quantitative studies aim at the systematic empirical investigation of quantitative properties or phenomena and their relationships. Qualitative research can be broadly defined as “any kind of research that produces findings not arrived at by means of statistical procedures or other means of quantification” (p. 17) [47]. It is a way to gain insights through discovering meanings and explaining phenomena based on the attributes of the data. In mixed model research, quantitative and qualitative approaches are combined within or across the stages of the research process. It was beyond the scope of this study to identify in which stages of a study—data collection, data analysis, and data interpretation—the mixing was applied or to reveal the types of mixing. Therefore, studies using both quantitative and qualitative methods, irrespective of whether they describe if and how the methods were integrated, were coded as mixed methods studies.

Research methodologies, or strategies of inquiry, are types of research models “that provide specific direction for procedures in a research design” (p. 11) [46] and inform the decisions concerning data collection and analysis. A coding schema of research methodologies was developed by the authors based on the analysis of all research articles included in the sample. The methodology classification included 12 categories (**Table 3**). Each article was classified into one category for the variable *research methodology*. If more than one research strategy was mentioned (e.g., experiment and survey), the article was classified according to the main strategy.

Methods of data analysis refer to the techniques used by the researchers to explore the original data and answer their research problems or questions. Data analysis for quantitative researches involves statistical analysis and interpretation of figures and numbers. In qualitative studies, on the other hand, data analysis involves identifying common patterns within the data and making interpretations of the meanings of the data. The array of data analysis methods included the following categories:

- Descriptive statistics,
- Inferential statistics,
- Qualitative data analysis,
- Experimental evaluation, and
- Other methods,

Descriptive statistics are used to describe the basic features of the data in a study. Inferential statistics investigate questions, models, and hypotheses. Mathematical analysis refers to mathematic functions, etc. used mainly in bibliometric studies to answer research questions associated with citation data. Qualitative data analysis is the range of processes and procedures used for the exploration of qualitative data, from coding and descriptive analysis to identification of patterns and themes and the testing of emergent findings and hypotheses. It was used in this study as an overarching term encompassing various types of analysis, such as thematic analysis, discourse analysis, or grounded theory analysis. The class experimental evaluation was used for system and software analysis and design studies which assesses the newly developed algorithm, tool, method, etc. by performing experiments on selected datasets. In these cases, “experiments” differ from the experimental designs in social sciences. Methods that did not fall into one of these categories (e.g., mathematical analysis, visualization, or benchmarking) were classified as *other methods*. If both descriptive and inferential statistics were used in an article, only the inferential were recorded. In mixed methods studies, each method was recorded in the order in which it was reported in the article.

Ten percent of the articles were randomly selected and used to establish inter-rater reliability and provide basic validation of the coding schema. Cohen’s kappa was calculated for each coded variable. The average Cohen’s kappa value was $\kappa = 0.60$, $p < 0.000$ (the highest was 0.63 and lowest was 0.59). This indicates a substantial agreement [48]. The coding disparities across raters were discussed, and the final codes were determined via consensus.

Research methodology	Description
Action research	Systematic procedure for collecting information about and subsequently improving a particular situation in a setting where there is a problem needing a solution or change
Bibliometrics	"A series of techniques that seeks to quantify the process of written communication" (Ikpaahindi, 1985). The most common type of bibliometric research is citation analysis
Case study	In-depth exploration of an activity, an event, a program, etc., usually using a variety of data collection procedures
Content analysis	Analysis (qualitative or quantitative) of secondary text or visual material
Ethnography	Study of behavior, actions, etc. of a group in a natural setting
Experiment	Pre-experimental designs, quasi-experiments, and true experiments aiming at investigating relationships between variables establishing possible cause-and-effect relationships
Grounded theory	The development of a theory "of a process, action, or interaction grounded in the views of participants" (Creswell, 2014, p. 87)
Mathematical method	Studies employing mathematical analysis (e.g., integrals)
Phenomenological	The study of the lived experiences of individuals about a phenomenon (Creswell, 2009)
Secondary data analysis	Use of existing data (e.g., circulation statistics, institutional repository data, etc.) to answer the research question(s)
Survey	Descriptive research method used to "describe the characteristics of, and make predictions about, a population" ("LARKS: Librarian and Researcher Knowledge Space," 2017)
System and software analysis/design	Development and experimental evaluation of tools, techniques, systems, etc. related to information retrieval and related areas

Table 3. Coding schema for research methodologies.

3.3. Results

3.3.1. Topic

Table 4 presents the distribution of articles over the various topics, for each of which a detailed description is provided. The five most popular topics of the papers in the total sample of 440 articles were "information retrieval," "information behavior," "information literacy," "library services," and "organization and management." These areas cover over 60% of all topics studied in the papers. The least-studied topics (covered in less than eight papers) fall into the categories of "information and knowledge management," "library information systems," "LIS theory," and "infometrics."

Figure 1 shows how the top five topics are distributed across journals. As expected, the topic "information retrieval" has higher publication frequencies in Information Processing &

Topic	Description	%
Information retrieval	Theory, algorithms, and experiments in information retrieval, issues related to data mining, and knowledge discovery	21.6
Information behavior	Interaction of individuals with information sources. Topics such as information access, information needs, information seeking, and information use are included here	15.0
Information literacy	Issues related to information literacy and bibliographic instruction (methods, assessment, competences and skills, attitudes, etc.)	9.5
Library services	Issues related to different library services, such as circulation, reference services, ILL, digital services, etc., including innovative programs and services	9.3
Organization and management	Elements of library management and administration, such as staffing, budget, financing, etc. and issues related to the assessment of library services, standards, etc.	7.3
Scholarly communication	Issues related to different aspects of scholarly communication, such as publishing, open access, analysis of literature, methods, and techniques for the evaluation and impact of scientific research (e.g., journal rankings, bibliometric indices, etc.)	5.7
Digital libraries and metadata	Issues related to digital collections, digital libraries, institutional repositories, design and use of metadata, as well as data management and curation activities	4.3
Knowledge organization	Processes (e.g., cataloguing, subject analysis, indexing and classification) and knowledge and information organization systems (e.g., classification systems, lists of subject headings, thesauri, ontologies)	4.3
Library collections	Development and evaluation of all types of library collections, including special collections. Issues related to e-resources (e-books, e-journals, etc.), including their use, evaluation, management, etc.	3.9
Library personnel	Issues related to library personnel (qualifications, professional development, professional experiences, etc.)	3.6
Research in LIS	Issues related to research methods employed in LIS research as well as librarians' engagement in research activities	3.0
Social media	Issues related to social media (facebook, twitter, blogs, etc.) and their use by both libraries and library users	2.5
Spaces and facilities	Library buildings, library as place	2.0
Information/knowledge management	Issues related to the process of finding, selecting, organizing, disseminating, and transferring information and knowledge	1.6
Library information systems	Issues related to different aspects of information systems, such as OPAC, ILS, etc. Design, content, and usability of library websites	1.6

Topic	Description	%
LIS theory	Issues related to theoretical aspects of LIS and theoretical studies on the transmission, processing, utilization, and extraction of information	1.6
Infometrics	The use of mathematical and statistical methods in research related to information. Bibliometrics and webometrics are included here	1.1
Other	Topics that could not be classified anywhere else and were represented by minimal number of articles (e.g., information history, faculty-librarian cooperation)	2.0
Total		100

Table 4. Article topics.

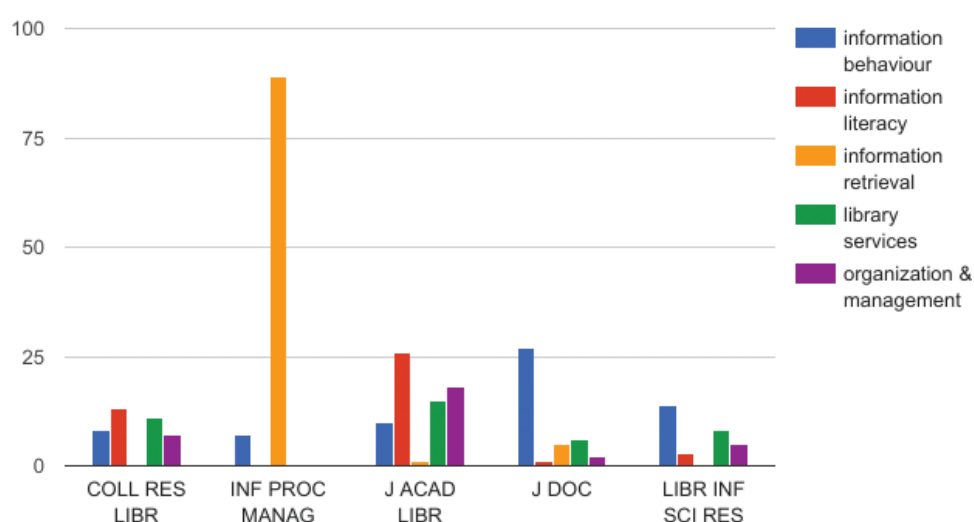


Figure 1. Distribution of topics across journals.

Management, a journal focusing on system design and issues related to the tools and techniques used in storage and retrieval of information. “Information literacy,” “information behavior,” “library services,” and “organization and management” appear to be distributed almost proportionately in College & Research Libraries. “Information literacy” seems to be a more preferred topic in the Journal of Academic Librarianship, while “information behavior” is more popular in the Journal of Documentation and Library & Information Science Research.

3.3.2. Research approach and methodology

Of all articles examined, 343 articles, which represent the 78% of the sample, reported empirical research. The rest 22% (N = 97) were classified as non-empirical research papers. Research articles were coded as quantitative, qualitative, or mixed methods studies. An overwhelming

majority (70%) of the empirical research articles employed a quantitative research approach. Qualitative and mixed methods research was reported in 21.6 and 8.5% of the articles, respectively (**Figure 2**).

Table 5 presents the distribution of research approaches over the five most famous topics. The quantitative approach clearly prevails in all topics, especially in information retrieval research. However, qualitative designs seem to gain acceptance in all topics (except information retrieval), while in information behavior research, quantitative and qualitative approaches are almost evenly distributed. Mixed methods were quite frequent in information literacy and information behavior studies and less popular in the other topics.

The most frequently used research strategy was survey, accounting for almost 37% of all research articles, followed by system and software analysis and design, a strategy used in this study specifically for research in information systems (Jarvelin & Vakkari, 1990). This result is influenced by the fact that Information Processing & Management addresses issues at the intersection between LIS and computer science, and the majority of its articles present the development of new tools, algorithms, methods and systems, and their experimental evaluation. The third- and fourth-ranking strategies were content analysis and bibliometrics. Case study, experiment, and secondary data analysis were represented by 15 articles each, while the rest of the techniques were underrepresented with considerably fewer articles (**Table 6**).

3.3.3. Methods of data analysis

Table 7 displays the frequencies for each type of data analysis.

Almost half of the empirical research papers examined reported any use of statistics. Descriptive statistics, such as frequencies, means, or standard deviations, were more frequently used compared to inferential statistics, such as ANOVA, regression, or factor analysis. Nearly one-third of the articles employed some type of qualitative data analysis either as the only method or—in mixed methods studies—in combination with quantitative techniques.

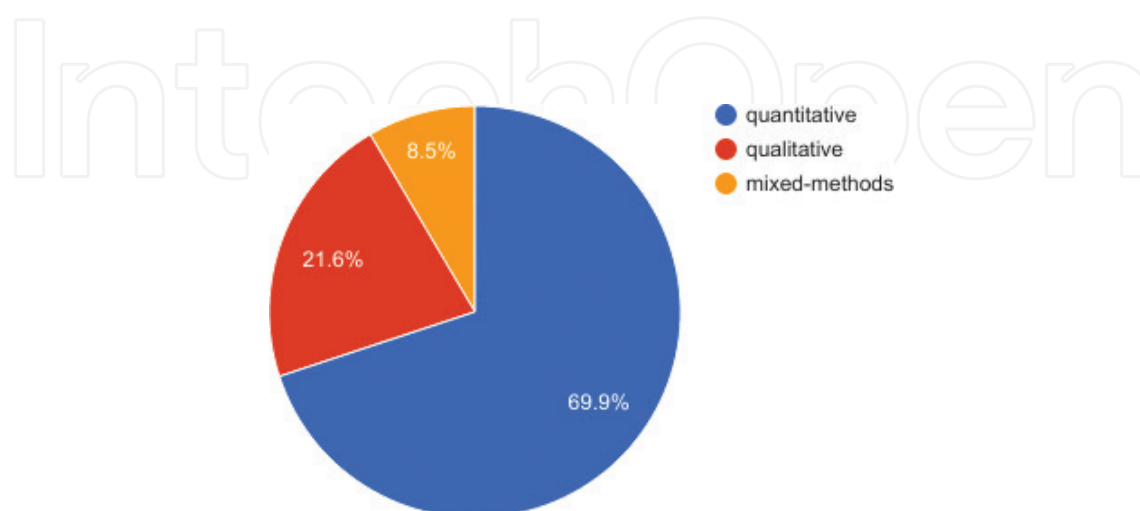


Figure 2. Research approach.

Topics	Mixed methods	Qualitative	Quantitative
Information behavior	14.0%	40.4%	45.6%
Information literacy	17.6%	26.5%	55.9%
Information retrieval	0.0%	0.0%	100.0%
Library services	3.6%	39.3%	57.1%
Organization and management	4.8%	23.8%	71.4%

Table 5. Topics across research approach.

Research methodology	%
Survey	37.0
System and software analysis/design	26.8
Content analysis	9.6
Bibliometrics	6.4
Case study	4.4
Experiment	4.4
Secondary data analysis	4.4
Grounded theory	2.6
Phenomenological	2.0
Ethnography	1.5
Action research	0.6
Mathematical method	0.3
Total	100.0

Table 6. Research methodologies.

Method	%
Descriptive statistics	28.4
Inferential statistics	18.5
Qualitative data analysis	27.1
Experimental evaluation	24.7
Other methods	1.3
Total	100

Table 7. Method of data analysis.

3.4. Discussions and conclusions

The patterns of LIS research activity as reflected in the articles published between 2011 and 2016 in five well-established, peer-reviewed journals were described and analyzed. LIS literature addresses many and diverse topics. Information retrieval, information behavior, and library services continue to attract the interest of researchers as they are core areas in library science. Information retrieval has been rated as one of the most famous areas of interest in research articles published between 1965 and 1985 [40]. According to Dimitroff [49], information retrieval was the second most popular topic in the articles published in the *Bulletin of the Medical Library Association*, while Cano [50] argued that LIS research produced in Spain from 1977 to 1994 was mostly centered on information retrieval and library and information services. In addition, Koufogiannakis et al. [42] found that information access and retrieval were the domain with the most research, and in Hildreth and Aytac's [43] study, most articles were dealing with issues related to users (needs, behavior, information seeking, etc.), services, and collections. The present study provides evidence that the amount of research in information literacy is increasing, presumably due to the growing importance of information literacy instruction in libraries. In recent years, there is an ongoing educational role for librarians, who are more and more actively engaging in the teaching and learning processes, a trend that is reflected in the research output.

With regard to research methodologies, the present study seems to confirm the well-documented predominance of survey in LIS research. According to Dimitroff [49], the percentage related to use of survey research methods reported in various studies varied between 20.3 and 41.5%. Powell [51], in a review of the research methods appearing in LIS literature, pointed out that survey had consistently been the most common type of study in both dissertations and journal articles. Survey reported the most widely used research design by Jarvelin and Vakkari [40], Crawford [52], Hildreth and Aytac [43], and Hider and Pymm [32]. The majority of articles examined by Koufogiannakis et al. [42] were descriptive studies using questionnaires/surveys. In addition, survey methods represented the largest proportion of methods used in information behavior articles analyzed by Julien et al. [53]. There is no doubt that survey has been used more than any other method in LIS research. As Jarvelin and Vakkari [15] put it, "it appears that the field is so survey-oriented that almost all problems are seen through a survey viewpoint" (p. 416). Much of survey's popularity can be ascribed to its being a well-known, understood, easily conducted, and inexpensive method, which is easy to analyze results [41, 42]. However, our findings suggest that while the survey ranks high, a variety of other methods have been also used in the research articles. Content analysis emerged as the third-most frequent strategy, a finding similar to those of previous studies [17, 32]. Although content analysis was not regarded by LIS researchers as a favored research method until recently, its popularity seems to be growing [17].

Quantitative approaches, which dominate, tend to rely on frequency counts, percentages, and descriptive statistics used to describe the basic features of the data in a study. Fewer studies used advanced statistical analysis techniques, such as t-tests, correlation, and regressions, while there were some examples of more sophisticated methods, such as factor analysis, ANOVA, MANOVA, and structural equation modeling. Researchers engaging in quantitative

research designs should take into consideration the use of inferential statistics, which enables the generalization from the sample being studied to the population of interest and, if used appropriately, are very useful for hypothesis testing. In addition, multivariate statistics are suitable for examining the relationships among variables, revealing patterns and understanding complex phenomena.

The findings also suggest that qualitative approaches are gaining increasing importance and have a role to play in LIS studies. These results are comparable to the findings of Hider and Pymm [32], who observed significant increases for qualitative research strategies in contemporary LIS literature. Qualitative analysis description varied widely, reflecting the diverse perspectives, analysis methods, and levels of depth of analysis. Commonly used terms in the articles included coding, content analysis, thematic analysis, thematic analytical approach, theme, or pattern identification. One could argue that the efforts made to encourage and promote qualitative methods in LIS research [54, 55] have made some impact. However, qualitative research methods do not seem to be adequately utilized by library researchers and practitioners, despite their potential to offer far more illuminating ways to study library-related issues [56]. LIS research has much to gain from the interpretive paradigm underpinning qualitative methods. This paradigm assumes that social reality is

the product of processes by which social actors together negotiate the meanings for actions and situations; it is a complex of socially constructed meanings. Human experience involves a process of interpretation rather than sensory, material apprehension of the external physical world and human behavior depends on how individuals interpret the conditions in which they find themselves. Social reality is not some 'thing' that may be interpreted in different ways, it is those interpretations (p. 96) [57].

As stated in the introduction of this chapter, library and information science focuses on the interaction between individuals and information. In every area of LIS research, the connection of factors that lead to and influence this interaction is increasingly complex. Qualitative research searches for “all aspects of that complexity on the grounds that they are essential to understanding the behavior of which they are a part” (p. 241) [59]. Qualitative research designs can offer a more in-depth analysis of library users, their needs, attitudes, and behaviors.

The use of mixed methods designs was found to be rather rare. While Hildreth and Aytac [43] found higher percentages of studies using combined methods in data analysis, our results are analogous to those shown by Fidel [60]. In fact, as in her study, only few of the articles analyzed referred to mixed methods research by name, a finding indicating that “the concept has not yet gained recognition in LIS research” (p. 268). Mixed methods research has become an established research approach in the social sciences as it minimizes the weaknesses of quantitative and qualitative research alone and allows researchers to investigate the phenomena more completely [58].

In conclusion, there is evidence that LIS researchers employ a large number and wide variety of research methodologies. Each research approach, strategy, and method has its advantages and limitations. If the aim of the study is to confirm hypotheses about phenomena or measure and analyze the causal relationships between variables, then quantitative methods might be used. If the research seeks to explore, understand, and explain phenomena then qualitative methods might be used. Researchers can consider the full range of possibilities and make their

selection based on the philosophical assumptions they bring to the study, the research problem being addressed, their personal experiences, and the intended audience for the study [46].

Taking into consideration the increasing use of qualitative methods in LIS studies, an in-depth analysis of papers using qualitative methods would be interesting. A future study in which the different research strategies and types of analysis used in qualitative methods will be presented and analyzed could help LIS practitioners understand the benefits of qualitative analysis.

Mixed methods used in LIS research papers could be analyzed in future studies in order to identify in which stages of a study, data collection, data analysis, and data interpretation, the mixing was applied and to reveal the types of mixing.

As far as it concerns the quantitative research methods, which predominate in LIS research, it would be interesting to identify systematic relations between more than two variables such as authors' affiliation, topic, research strategies, etc. and to create homogeneous groups using multivariate data analysis techniques.

Author details

Aspasia Togia^{1*} and Afrodite Malliari²

*Address all correspondence to: aspatogi@libd.teithe.gr

1 Department of Library Science & Information Systems, Technological Educational Institute (TEI) of Thessaloniki, Greece

2 DataScouting, Thessaloniki, Greece

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