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Largest contribution to LIS by external disciplines as measured by the characteristics of research articles

Pertti Vakkari[1] · **Yu-Wei Chang**[2] · **Kalervo Järvelin**[1]

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Abstract
The paper analyses Library and Information Science (LIS) articles published in leading international LIS journals based on their authors' disciplinary backgrounds. The study combines content analysis of articles with authors' affiliation analysis. The main research question is: Are authors' disciplinary backgrounds associated with choice of research topics and methods in LIS articles? The study employs a quantitative content analysis of articles published in 30 + scholarly LIS journals in 2015, focusing on research topics and methods. The articles are also assigned to three disciplinary categories based on authors' affiliations: External (no authors from LIS institutions), Internal (all authors from LIS institutions), and Mixed (some authors from LIS institutions, some from outside). The association of articles' disciplinary categories with article research topics and methods is analysed quantitatively. Most research contributions to LIS come from external articles (57%). However, LIS scholars have a clear majority in research on L&I services and institutions (68%), while external scholars dominate the contributions in Information retrieval (73%) and Scientific communication (Scientometrics, 69%). Internal articles tend to have an intermediary's (29%) or end-user's (22%) viewpoint on information dissemination while the external ones have developer's viewpoint (27%) or no dissemination viewpoint (49%). Among research strategies, survey (29%) and concept analysis (23%) dominate internal articles, survey (28%) and citation analysis (19%) dominate mixed articles, and survey (20%) and citation analysis (19%) dominate external articles. The application profiles of research strategies varied somewhat between disciplinary categories and main topics. Consequently, the development of LIS in the areas of Information retrieval, Information seeking, and Scientific communication seems highly dependent on the contribution of other disciplines. As a small discipline, LIS may have difficulties in responding to the challenges of other disciplines interested in research questions in these three areas.

Keywords Library and information science · Content analysis · Journal articles · Research chracteristics · Contributing disciplines

✉ Pertti Vakkari
pertti.vakkari@tuni.fi

Extended author information available on the last page of the article

Introduction

The development of information technology and its applications drive evolution of (Library and) Information Science (LIS). One indication for this is topical and methodological reorientation in LIS (e.g., Han, 2020; Ma & Lund, 2021). In research, the comprehensiveness of the change calls for contributions based on diverse knowledge and collaboration between researchers. In the present paper we study the nature of this collaboration and find out where the contributions come from. Each scholarly article, published in a LIS journal, is here taken as a contribution to LIS. The main research question is: Are authors' disciplinary backgrounds associated with choice of research topics and methods in LIS articles?

Past literature has analysed research topics, viewpoints, and methods in LIS (e.g., Åström, 2007; Tuomaala et al., 2014; Järvelin & Vakkari, 2021). However, they give no indication on where the contributions come from–from what kind of disciplinary background as mediated by the authors. On the other hand, studies focusing on the affiliation of authors in LIS articles indicate the general contribution of various disciplines to LIS, but do not analyse in detail the topical or methodological characteristics this contribution entails (Chang & Huang, 2012; Chang, 2018a, 2019; Urbano & Ardanuy, 2020). In the present paper, we aim to find out the differences in the characteristics of topical and methodological contributions made by scholars in LIS, external to LIS, and those by LIS and non-LIS scholars in collaboration. For this we reuse the data set by Järvelin and Vakkari (2021) providing a content analysis of LIS articles published in 2015. This dataset describes topical and methodological aspects of more than 1500 articles. We extend this dataset by data on the article authors' disciplinary background using the method developed by Chang (2018a). In this method, each article is classified as "an article by only one or more external authors" (category *External*), or "an article by only one or more internal authors" (category *Internal*), or "an article by at least one external and one internal author" (category *Mixed*). We apply in the present paper the same three disciplinary categories: internal, external, and mixed regarding LIS.

The extended data set allows us to answer the overall research question and the following specific research questions:

- How are articles distributed in *disciplinary categories by main topics*?
- Which viewpoints on information dissemination do the *disciplinary categories* employ?
- Which *research strategies and data collection methods* do the *disciplinary categories* employ?
- How are the *types of investigstion* associated with the *disciplinary categories* of the contributions? The type informs about the result, e,g., empirical-descriptive, theoretical, methodological, constructive.

The variables (in italics above) and the construction of the data set are explained in subsequent sections.

The overall research question is important because the answers help develop the discipline's self-understanding; development of educational/research programs; forming alliances in campaigns for resources, etc. The key is the analysis of the sources of contributions to LIS knowledge. Typical analyses of research in a discipline focus on the analysis of what the articles inform about (the development or status of) research topics. In the present

paper we observe, additionally, the affiliations of the authors and register what these inform about the disciplines contributing to the published articles.

The methods used in the present paper are general while LIS is its sample application domain. The 6-dimensional content classification and encoding the authors' affiliations require intellectual effort in construction and application. This drawback is rewarded by the analytic power in revealing connections between variables describing the flow of ideas in a discipline. Current topic modelling methods are efficient in processing masses of data at low cost (e.g. Han, 2020; Miyata et al., 2020). However, currently they do not provide the analytic power of a reliable faceted classification e.g. for distinguishing topics and methods.

Literature review

The highly interdisciplinary nature of LIS field has been highlighted by numerous studies (Chang & Huang, 2012; Chang, 2018b; Sugimoto et al., 2011); thus, the observation of changes in the characteristics of LIS during a given decade is highly likely. Consequently, researchers continue to monitor the characteristics of LIS research. Some researchers have focused on specific content-related characteristic of LIS articles, such as research topics (Chang et al., 2015; Liu & Yang, 2019), adopted theories (Kim & Jeong, 2006), and research methods (Armann-Keown & Patterson, 2020; Chu, 2015). In particular, studies have examined the topics of LIS research by using diverse methods, including content analysis (e.g., Aharony, 2012; Chang, 2018a), bibliometric analysis (e.g., Chang et al., 2015), and topic modeling (e.g., Han, 2020; Miyata et al., 2020). To obtain a superior understanding of LIS research, researchers have explored multiple aspects of the content of LIS research by using content analysis (Järvelin & Vakkari, 1990; Ma & Lund, 2021; Tuomaala et al., 2014) or combining content analysis with other methods (Chang, 2016, 2018a). Only studies that used content analysis, which was adopted in the current study, are reviewed below.

Content analyses. Content analysis has been widely used to identify the characteristics of LIS publications by referring to existing classification schemes or developing a classification scheme during data processing. Aharony (2012) analyzed 417 research articles that were published in 10 LIS journals during 2007–2008. Three main topics of LIS research were identified: information technology, methodology, and social information science. To obtain a comprehensive understanding of LIS literature, an increasing number of studies have analyzed multiple characteristics, rather than a single characteristic, of LIS research. The scheme devised by Järvelin and Vakkari (1990, 1993) for classifying the articles of 30 LIS journals (published in 1965, 1975, and 1985) according to the research topic, research method, and research strategies has been adopted by other researchers. For example, Rochester (1995) used this scheme to classify the research topics and research strategies used in studies published in two Australian LIS journals between 1985 and 1994. Tuomaala et al. (2014) used the aforementioned scheme for classifying LIS articles published in 2005. This classification enabled them to compare the differences in various characteristics of LIS-related articles published in 1965 and 1985 that were analyzed by Järvelin and Vakkari (1990, 1993). Ma and Lund (2021) compared the changes in research topics and data collection methods of LIS-related studies published in 2006, 2012, and 2018. These studies suggest that the content characteristics of LIS research are continually analyzed over time.

Analyses of author characteristics. In addition to examining the content characteristics of LIS research, studies have considered the characteristics of authors contributing to LIS articles. Authorship affiliation analysis is an effective method for identifying the contribution of authors from outside a certain discipline. The considerable and increasing proportions of LIS-related articles published by non-LIS authors (Chang, 2018a, 2019; Chang & Huang, 2012) imply that LIS research topics intersect with the interests and expertise of non-LIS authors. Chang and Huang (2012) and Chang (2019) only focused on the disciplinary attributes of authors. Chang and Huang (2012) reported that only half of the authors of LIS-related papers are LIS authors (50.3%) and that the proportion of LIS authors per year was decreasing. Chang (2019) identified articles published in 75 LIS journals in 2015 by authors affiliated with LIS-related institutions. Chang found that over half of the LIS-related articles in most journals were external. The aforementioned studies highlight the considerable influence of non-LIS authors on the development of LIS.

Analysing external LIS contributions. With the growth (in number) of non-LIS authors and the collaboration of LIS and non-LIS authors in the publication of LIS studies (Chang, 2018a, 2019), the characteristics of external LIS-related articles merit further examination. Few studies have examined the LIS research topic preferences of non-LIS authors. Prebor (2010) analyzed masters theses and doctoral dissertations assigned with at least one of two subject categories, namely "information science" and "library science," and submitted between 2002 and 2006 by graduate students from LIS and non-LIS departments. Prebor (2010) compared the differences in the main research topics between LIS and non-LIS departments. Graduate students affiliated with LIS departments favored topics related to information users, whereas graduate students affiliated with non-LIS departments exhibited a higher interest in topics related to information technology.

Chang (2018a) investigated the external contributors of LIS articles published between 2005 and 2014 in 39 LIS journals by scrutinizing the author affiliation information. Chang reported that up to 46.5% of the analyzed LIS articles were external. Topics related to scientometrics were preferred by non-LIS authors and in collaborations between LIS and non-LIS authors. The percentage of external articles was only 7.0% lower than that of internal articles. An increase in the proportion of external articles was observed. Moreover, over half of the external articles were about three topics: scientometrics, knowledge management and information retrieval, and information technology. A significant difference was observed in the preference of research topics between external articles and mixed articles. This finding indicates that tracking the LIS research contributed by authors from outside LIS institutions is crucial.

In addition to research topics, other characteristics of LIS research contributed by non-LIS authors merit attention. Therefore, this study focused on multiple characteristics of external LIS articles. Differences in various characteristics of external, internal, and mixed LIS articles were explored.

Methodology

In the multidiscplinary research environment of LIS, each contributing discipline contributes its own views on not only relevant research topics but also on proper methodologies to study them. This motivates our main research question on associations between contributing disciplines, inferred from authors' affiliations, and the choice of research topics and methods in LIS articles. There is no ready dataset to study this research question.

Fortunately, the content analysis of LIS by Järvelin and Vakkari (2021) made available a dataset on research topics and methodology. This dataset can be extended in the present study by a discipline analysis of authors' affiliations (see Fig. 1). In Järvelin and Vakkari (2021), the content analysis consists of eight content dimensions among which six were utilized here: LIS topic and Viewpoint to dissemination process represent the topical content, scholarliness indicates research articles, and research strategy, data-collection method, and type of investigation the methodological aspect of a study (Järvelin & Vakkari, 2021). These dimensions represent essential characteristics of research design and are discussed below and defined in Appendix 2.

Data

Dataset construction and analysis process (Fig. 1) for this study is consistent with the approach used in Järvelin and Vakkari (2021), and their other past studies (e.g., 1990; 1993), which discuss thoroughly the issues in constructing a dataset for content analysis of the LIS research area. Since we reuse their latest dataset for 2015, see Phase One in Fig. 1, we only summarize the issues and their solutions below. For the present study, we extend the dataset by discipline analysis in Phase Two (see Fig. 1).

Scope of LIS. One must define LIS to identify its publications among all other publications. The dataset is based on the assumption that the unifying characteristic of LIS is the study on the provision of access to desired information (Vakkari, 1994). This characterization is operationalized through the classification of LIS topics (Appendix 2). In particular, a publication's "LISness" is determined topically, not through the authors' disciplinary backgrounds.

Selection of journals. The dataset is based on articles published in core scholarly journals in LIS. This causes some bias as Sugimoto (2011) has noted. However, journal articles have been the main source of data in recent studies of LIS research. The set of 30+ source journals is in Appendix 1. All are in English, have good reputation, and have been used in earlier analyses of LIS. Keeping the set of journals as stable as possible for comparability with earlier studies has been a major criterion for inclusion of particular journals into the dataset.

Collection of articles. The year 2015 volumes were the sources of research articles. Only full articles, brief communications, and critical reviews were collected. The basis of

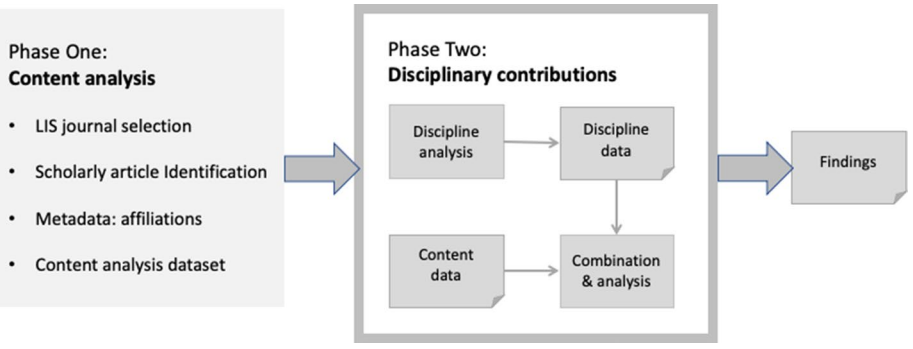

Fig. 1 Dataset construction and analysis

content analysis of each article has preferably been its metadata, i.e., title, abstract and keywords, or in lack of these, its title and first page.

Statistics on the data set are given in Table 1. The total number of articles in the data for 2015 is 1514. We excluded from the analysis articles which were classified as non-LIS studies (topic class A = 900) (n = 192) and non-scholarly articles (n = 112). The number of articles in the main analysis is thus 1210. We use six content dimensions of the eight available in the dataset.

Content classification

The articles are classified according to six dimensions (see Appendix 2). We introduce them briefly below.

LIS topic. Articles' topics were classified using the classification LIS topic. This classification system has been used widely (e.g., Hider & Pymm, 2008; Järvelin & Vakkari, 1990; 2021; Ma & Lund, 2021). For the presenr analysis we combined the topical classes 010–300 and 800 as LIS context, 410–490 as L&I service activities, 510–560 as Information retrieval, 610–660 as Information seeking, 710–740 as Scientific communication, and 900 as Non-LIS research.

Scholarliness indicates whether an article reports scholarly research or not. If not, we excluded the article from further analysis. The dataset criterion for research has been by Peritz (1980) that the article reports on at least somewhat systematic approach to construct new concepts, knowledge and ideas.

Classification of the viewpoint on information dissemination was based on traditionally recognized actors in the process of information dissemination (author, intermediary, end user, etc.) and their organizations. For the present analysis we combined viewpoint classes

Table 1 Dimensions of data

Journal property	Value
Volume	2015
Unit of observation	A journal
Total number of titles	31
Article property	Value
Unit of observation	An article
Total number	1514
No. excluding non-LIS	1322
No. excluding non-research	1210
No. content dimensions	6
Classifiers, equal shares	2
Contribution property	Value
Unit of observation	The pair (article, discipline)
Total number	1533
No. content dimensions	3
Classifiers	1

13–14 as Intermediary, 15–16 as End-user, 11–12, 18–19 as Other viewpoints. In addition, we used Developer's viewpoint (17) and No viewpoint (00).

The methodological aspect of a study consists of research strategy, data-collection method, and type of investigation (Järvelin & Vakkari, 2021). Research strategy in the dataset means an overall approach to the study within which, for example, the decisions on data collection and the type of analysis are made. We collapsed in this variable the following classes 17–18 as Citation analysis, 14 and 22 as Experiment/evaluation, 21 and 29 as Other empirical method, 31–32, 60 and 80 as Conceptual research strategy, 00 and 90 as Not applicable, other method.

In empirical research the data are collected through various data-collection methods. These are listed in the classification Data-collection method. In this variable we collapsed the dataset classes 15, 20, 30, 80 and 90 as Other method of collecting data.

Collapsing of classes was due to the small number of cases per class. In this way we sought to keep the degrees of freedom large enough for analysis.

Reliability. Each article was classified under one content class for each content variable. The problem with alternative competing classes was counteracted through instruction to identify the primary class among alternatives, considering the data at the level of main classes, and offering a class for "multiple items" for some variables. In addition, the classification of methods is multi-dimensional allowing categorizing an article into several dimensions like research strategy, data collection method, and type of investigation. Reliability was measured by Fleiss' Kappa, the value of which ranges from -1 for complete disagreement, to ± 0 for random choices, and to $+1$ for complete agreement. Table 2 reports the classification reliability (the content analytic part by Järvelin & Vakkari, 2021). The reliability of the classifications can be considered as sufficient for the analysis.

Encoding of authors' disciplines

The method of Chang (2018a) for identifying LIS authors was used to compare the characteristics of LIS-related articles written by only LIS authors (i.e., *Internal)*, only non-LIS authors (*External*), and both LIS and non-LIS authors (*Mixed*), as defined above. Various

Table 2 Classification reliability (Fleiss' *Kappa*)

Name	Kappa	*p* value	No of Raters	Level
Content analytic variables ($N=31$)				
LIS topic	0.619	0.000	2	good
Scholarliness	0.631	0.000	2	good
Viewpoint on dissemination	0.555	0.000	2	moderate
Research strategy	0.532	0.000	2	moderate
Data-collection methods	0.603	0.000	2	moderate
Type of investigation	0.601	0.000	2	moderate
Discipline analytic variables ($N=40$)				
Discipline	0.71	0.000	3	good
Collaboration type	0.70	0.000	3	good
No. of disciplines	0.64	0.000	3	good

LIS-related departments and institutes that were affiliated with universities and offered LIS courses and programs were classified as LIS institutions. Authors who did not qualify as LIS authors were classified as non-LIS authors. The disciplinary attributes of authors were based on the units subordinate to institutions (e.g., departments and institutes in universities). The keyword present in the names of departments and institutes usually revealed the disciplinary attribute. We referred to LIS directories and official websites of universities due to the variation of names of LIS departments and institutes. We also searched some authors on the Internet to identify their expertise if no departments and institutes were listed in their affiliation in the analyzed articles. After the disciplinary attribute of each author was examined, each article was given the disciplinary category internal, external, or mixed. The reliability of affiliation classification, measured by Fleiss' Kappa, was high, $k = 0.71$ (Table 2).

Data analysis

The final data matrix for analysis was constructed by combining the encoding of the authors' disciplines with the content analysis data. We used SPSS for statistical processing and report cross tabulations, and χ^2 significance test results. The χ^2 test is used to determine whether there is a statistically significant difference between the expected frequencies and the observed frequencies in one or more categories of a contingency table.

Findings

Topics

Of LIS research articles 34% were written by LIS scholars, 12% in collaboration by scholars from LIS and other disciplines, and 54% by other than LIS scholars (Table 3). Thus, the influence of other disciplines to LIS research is essential.

Articles published in LIS journals, but not belonging to LIS were mostly authored by scholars from disciplines external to LIS. Only in 17% of those articles was a LIS scholar as an author. In the following, we focus on articles belonging to LIS.

The proportion of research articles in main topics is significantly associated with authors' disciplinary background ($\chi^2 = 255.1$; $df = 8$, $p < 0.001$) (Table 3). Internal articles cover in LIS context 62% and in L&I services 68% of the whole article production,

Table 3 Articles in disciplinary categories by main topics (%)

Main topics	Internal	Mixed	External	Total
LIS context	62	13	25	100 (n = 142)
L&I service activities	68	15	17	100 (n = 170)
Information retrieval	19	8	73	100 (n = 277)
Information seeking	44	11	45	100 (n = 168)
Scientific communication	18	13	69	100 (n = 452)
Non-LIS	13	4	83	100 (n = 167)
Total	32	11	57	100 (n = 1376)
Total without non-LIS	34	12	54	100 (n = 1210)

while the share of the two other disciplinary categories is significantly smaller. External articles cover of the whole article production 73% in information retrieval and 69% in scientific communication. The share of internal or mixed articles in these topics is significantly smaller. In information seeking internal and external articles cover about equally large shares (44% vs. 45%).

A closer look at the contribution of disciplinary categories within sub-classes of main topics reveals some deviations in the major trends. Within information retrieval scholars external to LIS produced 98% of articles on text retrieval methods, 86% of articles on social media retrieval methods, and 82% of articles on other aspects of retrieval methods. LIS scholars were productive in studying metadata and cataloguing (47%) and also in interactive information retrieval (28%), although in the latter sub-topic other than LIS scholars published the most (53%).

In information seeking external articles contributed less than average on studies on the use of information channels (30%) and on the use of L&I services (29%), and more than average on studies on information management (64%). Correspondingly, the shares of contribution of internal and mixed articles were the opposite.

In all, it seems that the contribution of internal articles focused mainly on professionally oriented, LIS context and service topics, while external ones contributed most to information retrieval and scientific communication, and understandably to non-LIS topics. There is an equal interest among both groups in the problems of information seeking. When LIS scholars devote more attention to some sub-topics than their average share in information seeking, they focus on established professional themes like the use of L&I services or the use of information channels. This is consistent with their large article production in professionally oriented main topics of LIS. An astonishingly small proportion of research articles is authored by LIS scholars in information retrieval and scientific communication.

The topical profiles of articles published by the three disciplinary categories differ significantly ($\chi^2 = 255.1$; df = 8, $p < 0.001$) (Table 4). In the topical profile of internal articles L&I services is the foremost topic (28%), followed by, with about even proportions, LIS context (21%), scientific communication (20%) and information seeking (18%). Information retrieval stimulates least interest among LIS scholars (13%). External articles contribute most to scientific communication (48%) and information retrieval (31%) leaving LIS topics (6% and 4%) aside. Mixed articles contribute in scientific communication (42%), and relative evenly in L&I services (18%), information retrieval (15%) and information seeking (13%). The profile of mixed articles mediates between the profiles of internal articles heavily emphasizing professional LIS topics and of external ones notably oriented towards scientific communication and information retrieval.

Table 4 Articles in main topics by disciplinary categories (%)

Main topics	Internal (n = 416)	Mixed (n = 142)	External (n = 652)	Total (n = 1210)
LIS context	21	12	6	12
L&I service activities	28	18	4	14
Information retrieval	13	15	31	23
Information seeking	18	13	11	14
Scientific communication	20	42	48	37
Total	100	100	100	100

Viewpoint on information dissemination

The viewpoint on information dissemination in articles was significantly associated with authors' disciplinary background ($\chi^2 = 228.6$; df = 10, $p < 0.001$) (Table 5). It was not possible to identify a viewpoint on information dissemination in most articles. This is likely due to active technological development foci in information interaction and process-neutrality of many scientometric studies. This neutrality was most frequent in external articles (49%), and less frequent in internal articles (28%). In external articles developer's viewpoint was the dominating one (27%), followed by end-user's angle (13%), while in internal articles intermediary's (29%) angle was the dominating one, followed by end-user's viewpoint (22%). Developer's angle was rare (7%) in these articles. Mixed articles represented an intermediate profile between the two other disciplinary groups. End-user's angle was most frequent (21%), followed by developer's (15%) and intermediary's (14%) perspectives.

The differences in perspectives to dissemination in LIS between the disciplinary categories were notable. These differences are even greater when analyzed by viewpoints. For example, internal articles cover 74% of intermediary's viewpoint, while external articles cover 78% of developer's angle and 65% of cases where viewpoint was not possible to identify.

In all, in articles LIS scholars mostly represented intermediary's and end-user's perspectives on research problems, while scholars external to LIS represented mostly developer's viewpoint. Research problems in mixed articles represented both end-user' and developer's perspectives. It may be that LIS collaboration with other disciplines imports the idea of analyzing research questions from developer's angle to LIS as a discipline. On the other hand, it may export the idea of exploring research problems from end-user's perspective to collaborating disciplines.

Research strategies

The research strategies applied in studies differ significantly between the disciplinary categories ($\chi^2 = 196.0$; df = 22, $p < 0.001$) (Table 6). Survey was the most popular empirical strategy in each group, followed by citation analysis. The first one was equally popular in internal (29%) and mixed articles (28%), while somewhat less popular in external articles (20%). Citation analysis was as popular in external and mixed articles (19%). The third most popular empirical strategy in these two categories was case study (11% and 14%),

Table 5 Viewpoint on information dissemination by disciplinary categories (%)

Viewpoint	Internal (n = 416)	Mixed (n = 142)	External (n = 652)	Total (n = 1210)
Intermediary	29	14	4	13
End-user	22	21	13	17
Developer	7	15	27	19
Other	7	5	3	5
Several	7	5	4	5
Not applicable	28	40	49	41
Total	100	100	100	100

Table 6 Research strategies by disciplinary categories (%)

Research strategy	Internal (n = 416)	Mixed (n = 142)	External (n = 652)	Total (n = 1210)
Empirical				
Historical	2	1	1	2
Survey	29	28	20	23
Qualitative	7	3	3	4
Case study	6	14	11	10
Content analysis	8	4	2	4
Citation analysis	11	19	19	16
Experiment/evaluation	6	9	10	9
Other empirical method	4	6	3	4
Conceptual	23	6	8	13
Mathematical	2	7	14	9
System/software analysis	1	2	8	5
Not applicable, other	1	1	1	1
Total	100	100	100	100

while content analysis (8%) came third in internal articles. Experiment or evaluation strategy was the fourth most applied strategy in disciplinary categories except for qualitative strategy in internal articles. Of non-empirical strategies, the conceptual one was widely applied in internal articles (23%), while the Mathematical (14%) and System/software analysis (8%) strategies were frequently in use in external articles.

LIS scholars favoured in particular survey and conceptual strategy, but citation analysis, content analysis and qualitative strategy were also rather popular. The profiles of scholars from other disciplines and of collaborating LIS scholars resembled each other in part of most used empirical strategies—survey, citation analysis, case studies and experiment/evaluation. Their profiles differed in the use of non-empirical strategies, of which mathematical strategy and system/ software analysis were popular in external articles. Thus, other disciplines import to LIS as discipline methodological knowledge about case studies, citation analysis and mathematical strategy and system/software analysis. The absolute volume of methodological knowledge transferred from other disciplines to LIS as a field of research is naturally larger than the share in their profile due to the larger volume of research articles published. For example, when the proportion of mathematical strategy in the strategy profile of external articles is 14%, this disciplinary category covers 82% of the total use of mathematical strategy. In the use of system/software analysis the respective figures are 8% vs. 85%. Thus, the absolute influence of other disciplines to the methodological arsenal of LIS is much larger than what the figures in relative profile indicate. An interesting finding is also, that likely the collaboration of LIS scholars with representants of other disciplines enriches methodological expertise in LIS in case studies and in citation analysis.

The profile of research strategies applied in the main topics varied somewhat between the disciplinary categories (Table 7). In articles on LIS context, all disciplinary categories favoured conceptual strategy and survey. Within L&I services, survey was notably the most preferred strategy in all disciplinary categories followed by conceptual strategy in internal and external articles, and case study in mixed articles. Content analysis was

Table 7 The three most popular research strategies for topics in disciplinary categories (%)

Main topics	Internal (n = 416)		Mixed (n = 142)		External (n = 652)		χ^2
LIS context	Conceptual	42	Conceptual	29	Conceptual	31	df = 20
	Survey	29	Survey	24	Historical	25	26.6
	…		…		Survey	19	p = 0.147
L&I service activities	Survey	37	Survey	39	Survey	32	df = 18
	Conceptual	22	Case study	23	Conceptual	18	40.4
	Content anal	12	…		System/software	18	p = 0.002
Information retrieval	Experiment/eval	30	Experiment/eval	38	Mathematical	30	df = 20
	Conceptual	28	…		Experiment/eval	24	75.1
	…		…		System/software	22	p = 0.000
Information seeking	Survey	43	Survey	63	Survey	45	df = 20,
	Qualitative	16	…		Qualitative	20	14.5
	Conceptual	14	…		…		p = 0.806
Scientific communic	Citation anal	49	Citation anal	44	Citation anal	41	df = 20
	Survey	21	Survey	19	Case study	20	26.8
	Case study	14	Case study	17	Survey	20	p = 0.139

…indicates n < 10

the third most popular in internal articles, whereas system/software analysis was the third in the external ones. It seems that when analysing L&I services other disciplines introduce methodological expertise in system/software analysis, which differs from the mainstream strategies of conceptual strategy and survey. A closer look at the data indicated that system/software analysis was applied most in various automated library systems.

In Information retrieval, the research strategies applied by the disciplinary categories varied significantly. Experiment/evaluation was unifying strategy, but other strategies differed significantly. It was most popular in internal and mixed articles (30 vs. 38%), and second most popular in external ones (24%). In external articles, mathematical strategy was the dominant one with system/software analysis in the third place. In the second place in internal articles was conceptual strategy, and in mixed ones it was survey. Conceptual strategy was applied in internal articles mostly in problems of classification and indexing. In external articles, mathematical strategy was most applied in classification and indexing, in text retrieval methods and in web retrieval methods, while experiment/evaluation was in focus in retrieval methods in other media and in interactive IR.

In information seeking, survey was in all disciplinary categories the dominant strategy. Qualitative strategy was in the second place in internal and external articles.

Citation analysis, survey and case study were dominating strategies in articles on scientific communication, in this order, except in the external category where case study was more popular than survey.

In all, the most popular research strategies did not differ so much between the disciplinary categories when applied in LIS context, information seeking and scientific communication, while there were significant differences in L&I services and information retrieval. The research strategies applied in external articles—mathematical strategy and system/software analysis in particular—seemed to differ from the two LIS categories' methodological solutions for solving problems in L&I services and in information retrieval.

Data collection methods

Data collection methods differ significantly between the disciplinary categories ($\chi^2 = 204.5$; df = 14, $p < 0.001$) (Table 8). In internal articles the dominant data collection method was questionnaire or interview (27%), followed by several methods of collecting data (14%), citation collection (12%), and content analysis (11%). Citation collection was the most frequent method in mixed (30%) and external articles (35%). In the former category questionnaire or interview was the second frequent method (21%) followed by several methods of collecting data (20%). In the latter category the second most popular data collection method was IR experiment (18%) and the third one questionnaire or interview (12%). The large share of articles where data collection method could not be identified (i.e. not applicable) is due to other than empirical strategy applied in articles, e.g. conceptual research strategy.

The distribution of data collection methods within disciplinary categories reflects the distribution of research strategies in them. Survey and citation analysis were popular strategies in each category implying that questionnaire and interview or citation collection were also popular in these categories. In internal articles both LIS context and L&I services were dominant main topics. In these topics, survey and conceptual research strategy were prevailing strategies. Consequently, questionnaire and interview were the most popular data collection method in internal articles. The popularity of studies in which empirical data collection methods were not possible to identify were for the same reason frequent in this category. Information retrieval was a popular topic in external articles. In this topic, experiment or evaluation was the most applied research strategy, and as a consequence IR experiment was common as data collection method. The extensive use of mathematical strategy and system/software analysis in information retrieval in the same category implies the frequent number of articles where data collection method was not possible to indicate.

Type of investigation

The type of investigation was significantly associated with disciplinary background ($\chi^2 = 102.1$; df = 12, $p < 0.001$) (Table 9). Descriptive investigation was dominant in all disciplinary categories, least applied in external articles (49%) and most in mixed articles (65%). Comparative and explanatory investigations were more popular in external articles

Table 8 Data collection methods by disciplinary categories (%)

Data collection method	Internal (n = 416)	Mixed (n = 142)	External (n = 652)	Total (n = 1210)
Questionnaire, interview	27	21	12	18
Content analysis	11	6	3	6
Citation collection	12	30	35	27
Historical analysis	2	1	2	2
Several methods	14	20	9	12
IR experiment	3	4	18	11
Other method	11	12	11	11
Not applicable	20	6	10	13
Total	100	100	100	100

Table 9 Type of investigation by disciplinary categories (%)

Type of investigation	Internal (n = 416)	Mixed (n = 142)	External (n = 652)	Total (n = 1210)
Descriptive	60	65	49	55
Comparative	8	15	22	16
Explanatory	5	6	10	8
Conceptual/theoretical	15	5	5	8
Methodological	4	5	8	6
System description	1	3	3	3
Other	7	2	3	4
Total	100	100	100	100

compared to the two other categories. However, comparative studies were notably more common in mixed articles compared to internal ones. While comparative investigations were second most popular in two other categories, conceptual and theoretical investigations were second most common type of investigation in internal articles.

The emphasis on comparative and explanatory investigations in external articles was due to their greater interest in studies on information retrieval. In information retrieval, evaluation research designs apply experiment and they are essentially comparative in nature. Mathematical research strategy was most common in studies on information retrieval in this disciplinary category, which likely explains the popularity of comparative and explanatory designs, too. A closer look at the data revealed that in information retrieval, scholars external to LIS applied comparative design in 45% of the articles. This category also applied explanatory design in one third of articles on Information retrieval.

Discussion and Conclusions

Compared to earlier studies, our findings provide a more detailed account of research topics, methods and approaches cultivated by LIS and non-LIS scholars. We analyse to what extent the topical and methodological characteristics of LIS research articles vary between LIS and non-LIS authors in articles published in LIS journals in 2015. We categorized the articles based on author's affiliations as internal (all authors having a LIS affiliation), external (none of the authors having a LIS affiliation), and mixed (some authors having a LIS affiliation, some not), We found out that over half of research articles in LIS journals were external. There is also a structural differentiation in research topics and methods between the article categories.

Major findings

Studies have shown that almost half of the research articles published in LIS journals are authored by scholars affiliated with institutions representing other disciplines than LIS (Chang, 2018a, 2019; Chang & Huang, 2012). Urbano & Ardanuy (2020) found out that of research articles published in LIS serials even about 70% were authored by scholars not affiliated with LIS in four European countries. Our results show that of all articles 54% were external, 34% internal, and 12% mixed. Our findings support the findings in Chang

(2018a) that the share of external LIS articles is increasing. She showed that from 2005 to 2014 the share of external articles increased from about 30% to 40%. Thus, scholars from other disciplines dominate the research contribution to LIS as a discipline. It seems that scholars affiliated with other than LIS institutions set the agenda for LIS research defining important research areas and questions as well as appropriate research methodologies for answering those questions. Next, we discuss in more detail to what extent these suppositions hold in the major research areas in LIS.

Authors' disciplinary background differentiates essentially to which major topics each group contributes. About two thirds of articles in topical areas LIS context and L&I services were internal, while in information retrieval and scientific communication around 70% of articles were external. Information seeking was a mediating topic: internal and external articles both forms about 45% of articles in this topic. The share of mixed articles was relative evenly distributed across major topics. These findings are in line with those by Chang (2018a) stating that compared to internal articles, external articles contribute in particular to scientometrics, knowledge organization and information retrieval, and information technology.

Our findings suggest that LIS scholars focus heavily on professionally oriented LIS topics like L&I services or problems associated with L&I institutions. When LIS scholars focus on information retrieval or information seeking, their approach typically reflects their orientation towards professional problem formulations. In the former, problems of metadata and cataloguing were most popular, in the latter studies on information channels, and the use of L&I services aroused most interest. Scholars external to LIS focused within Information retrieval on various retrieval methods and within Information seeking on Information management.

The methodological approaches selected reflected the structural differences in research topics. LIS scholars typically represented intermediary's and end-user's perspectives on research problems, while scholars from other disciplines mostly represented developer's viewpoint. Research problems in mixed articles reflected both end-user's and developer's perspectives. LIS scholars conceptualized from intermediary's angle problems of L&I services, in particular, while scholars from other disciplines most often applied developer's angle to problems of information retrieval.

There were significant differences between disciplinary categories in the application of research strategies in L&I services and information retrieval. External articles differed from the other two categories in the frequent application of system/software analysis and mathematical research strategy in the problems of L&I services, and information retrieval, in particular.

The distribution of data collection methods between disciplinary categories reflected the distribution of research strategies in these categories. Among internal articles, LIS context and L&I services were dominant research topics. Survey and conceptual research strategy were prevailing strategies in these topics and, consequently, questionnaire and interview were the most popular data collection methods. Analogously, within external articles, information retrieval was a popular topic and thus, experiment or evaluation the dominant research strategy and IR experiment the most common data collection method.

Differences in research topics and associated research strategies between the disciplinary categories also emerged in the type of investigation of articles. Descriptive studies were most common in all disciplinary categories, although they were most used among internal and mixed articles. External ones applied significantly more comparative and explanatory research designs. This is mostly due to interest in problems of Information retrieval, where both designs were common.

External scholars dominate research contributions in information retrieval and scientific communication and to some extent in information seeking. Consequently, they introduce to LIS research problems reflecting strategic views of their home disciplines. Disciplines tend to have a more or less shared understanding of their strategic research problems and ways to conceptualize and solve them (Whitley, 1984). What are the most appropriate research designs and approaches to solve problems vary by discipline. Thus, the export of research themes and methods to LIS is in line with the strategic views and ideals of those disciplines. This influence likely broadens the scope of research problems and methods in LIS, because LIS scholars tend to focus on established professionally oriented research problems, e.g., in information retrieval or information seeking. It seems that external articles also introduce new research methods to L&I services, which is the largest research topic among internal articles.

Factors explaining the influence of other disciplines

Which factors would explain the increasing influence of other disciplines to LIS as a discipline? First, LIS is a small discipline with a limited number of academic institutions and scholars worldwide. It is shown that scholars in computer science contribute 38.8% and in business and economics 18.8% of all external articles in LIS (Chang, 2018a). It is evident that the number of academic institutions and scholars in these disciplines is much larger compared to LIS. For example, Wang and colleagues (2021) have shown that the number of journals in SSCI/SCIE belonging to LIS is 89, while the respective number in computer science is 683. The number of articles published in computer science compared to LIS in 2014 was 12.5 fold, and in 2019 already 18.9 fold. This hints that the research community in computer science is progressively much larger than that in LIS. It may be that the competition and pressure to publish in computer science—and likely in other large disciplines interested in problems related to LIS – steers scholars affiliated with it to look for publication channels in relevant proximal disciplines like LIS. This implies an increasing influence of other disciplines to LIS as a discipline. This may *mutatis mutandis* be applied to other small disciplines as well.

Second, there is evidence that LIS research journals have consciously extended their scope to include interdisciplinary areas related to LIS. Many editors of LIS research journals indexed in Scopus or Web of Knowledge expressed an interest to include articles in their journal coming especially from communication, management, and computer science (Castella et al., 2016). Thus, there is not only push from other disciplines to publish in LIS journals, but also pull by these journals.

Third, LIS includes research areas information retrieval and scientific communication (scientometrics) which have grown in importance during the last decades. It seems evident that as a small discipline oriented mostly towards problems of L&I institutions LIS has not been able to respond to the challenges produced by the growing application of information technology in information retrieval or the increasing research evaluation of academic institutions in scientific communication. Large search engine enterprises and similar companies have invested enormously to research that would develop better tools and algorithms for accessing various types of information and things. Public organizations steering nationally, or locally academic institutions have been increasingly interested in the effectiveness of those institutions, which has led to a growing demand of research evaluations and tools for the assessment. Although scholars in LIS favour practical research problems of LIS institution, their financial and intellectual resources have been too small to respond

larger practical demands. From its establishment in 2005 the iSchool movement has sought to steer study programs and research in LIS more towards the problems of information retrieval and information technologies (Wu et al., 2012), but it seems that this effort has been launched too late and with resources too limited for properly competing with research institutions in computer science.

Fourth, information retrieval is also considered as a part of computer science (ACM classification system). Thus, it is natural that institutions and scholars in computer science also explore problems of information retrieval. A small fraction of scholars in a large scientific community like computer science interested in problems of information retrieval is still likely much larger than all scholars in LIS focusing on that topic. In addition, it is evident that the spectrum of research competence in the former is much extensive compared to the latter providing better skills to solve the varying problems of information retrieval. In scientific communication it is likely that many disciplines are interested in evaluating their own research performance. This would in part explain the high proportion of external articles in scientific communication.

It seems that there is insufficient intellectual interaction between the major research areas in LIS (Ingwersen, 1996; Ingwersen & Järvelin, 2005). Each cultivates its own field without much interest to others. An exception may be information seeking, which has some links with L&I services as our findings suggest, and recently also information retrieval with CHIIR conference as an example. Among other goals the conference seeks to integrate studies on information seeking and information retrieval. If our claim is valid, there is not much cross-fertilization of ideas between major research topics. This means that LIS scholars cultivate research focusing on LIS context and services and information seeking, and to a limited extent on information retrieval and scientific communication. Scholars affiliated with other disciplines dominate research on information retrieval and scientific communication, and information seeking, and to a lesser extent problems of L&I services and context. According to our results, collaboration between LIS and other scholars may broaden the topical and methodological arsenal of LIS and is therefore important. In addition, collaboration introduces research methods to LIS, like case studies, citation analysis or mathematical methods, which are more common in research produced by external scholars. It would also be of interest to compare the profiles of LIS practitioner-researchers (working in libraries) and educator-researchers (working in LIS schools) like Chang (2016). However, we have not encoded these researcher groups separately, and therefore cannot reflect on the point.

If we define LIS as a discipline as what LIS scholars investigate, compared to cognitive version of LIS indicated by our classification scheme, this social version of LIS is much narrower consisting mainly of research areas LIS context, L&I services and information seeking from traditional channels and sources including L&I institutions, and some minor sub-areas of information retrieval and scientific communication. It seems that scholars not affiliated with LIS maintain research in two major areas of LIS, information retrieval and scientific communication. Without their contribution, LIS would be much narrower and oriented more towards problems of L&I institutions.

When most of the contributions to information retrieval and scientific communication come from other disciplines than LIS, is it still appropriate to categorize these as LIS topics? This is mostly a conceptual problem, because we do not have a clear criterion how much a discipline should contribute to a topic for the latter to be considered as belonging to this discipline. We neither have longitudinal data to conclude about development trends. Traditionally, information retrieval and scientific communication have been considered as parts of LIS as, e.g., yearly chapters concerning these topics in the Annual Review of

Information Science and Technology indicate. An informed guess would be that these two topics seem to be about differentiating from LIS.

Limitations and further research questions

The identification of author affiliations may to some extent limit the validity of the results. The name of an academic department or faculty may not always clearly indicate which disciplines belong to the scope of the institution. There may be more disciplinary variation than the title suggests. The strong international trend in recent years to merge disciplinary departments of universities into larger units may blur the visibility of separate disciplines and thus, makes their identification a challenging enterprise. The extent of our knowledge of LIS related departments and institutes also affects the analysis. However, our author affiliation analysis is careful by examining the websites of institutions and likely reflects validly the distribution of disciplines contributing to LIS. This view is strengthened through understanding that, if the encoding would have low validity, it would not yield the systematic and interpretable data distributions over other variables reported in the tables. In other words, sensible outcomes add trust to the process.

We hypothesized that LIS mainly consists of loosely connected main topics with little exchange of research ideas, methods, and approaches. This conjecture is based on the notable differentiation of research topics and methodologies between the three disciplinary categories observed. This claim leans, however, just on weak evidence and needs to be validated. Therefore, it would be important to explore the exchange of research ideas and methods between the main fields of LIS, and to and from external disciplines, through citation analysis, for example. There may be interesting differences between the types of contribution that collaborations with various disciplinens create. For example, from the viewpoint of LIS, does some collaboration typically lead to export of empirical facts while another leads to import of methods? In addition, our results show that there is an essential difference in topics and methods in LIS research between internal LIS articles, external articles, and mixed authorship articles. However, it would be interesting to know how research characteristics vary if we divide the external scholars' disciplinary backgrounds into more specific disciplines like computer science, management, or communication science. That would reveal how these particular disciplines as such and in collaboration contribute to LIS.

Conclusion

The current situation of LIS may be summarized as follows: First, LIS is a small academic discipline, which has grown from professional practice. Second, it forms a loose collection of research areas, some of which raise interest in other, much larger disciplines. There is no shared research program (there is cognitive *dis*organisation). Third, a large share of contributions in LIS is created by external-to-LIS scholars, who tend to bring their home disciplines' ideas and strategies to LIS research (fostering cognitive subsumption). Fourth, therefore the scholars also keep and strengthen their relations within their home disciplines (causing social disorganization and subsumption). For LIS as a discipline this situation offers risks and opportunities: There is a call for a coordinated research program in the context of rapidly changing information technology and ways of doing research. There is

also the risk of being subsumed by the larger disciplines having closely related interests and bigger resources.

While providing empirical results on how author categories differently contribute to LIS knowledge base, this paper concurrently represents the methodology for similar studies in other fields of research. One needs a representative collection of publications, classification schemes for content-analytic variables and authors, the content analysis and author classification. Its weakness is the labour-intensive human content analysis, but this will be rewarded by the superior analytic power thus obtained. It becomes possible to systematically analyse and explain connections between semantically well-defined variables. Such is not available (today) in purely statistical approaches to text analysis, such as topic modelling, which are efficient in processing masses of text automatically, but have difficulty in analysing the cognitive differences human content analysis provides.

Appendix 1

Journal name 2015	Vols	No of arts
ACM transactions on information systems	33(1)-34(1)	27
Aslib journal of information management (formerly: aslib proc.)	67	36
College and research libraries	76	57
Information & culture (formerly: libraries & culture)	50	24
Information processing and management	51	65
Information research	20	46
Information retrieval	18	21
Information services & use	35	27
Information technology and libraries	34	19
International information & library review	47	10
International journal of information management	35	71
Journal of documentation	71	64
Journal of education for library and information science	56	23
Journal of information science	41	57
Journal of librarianship and information science	47	28
Journal of library administration	55	22
Journal of the association for information science & tech	66	185
Library & information history (formerly: library history)	31	11
Library and information science research	37	40
Library collections, acquisitions, and technical services	39	11
Library quarterly	85	24
Library resources and technical services	59	15
Library trends	63	47
Libri	65	24
New review of information networking	20	27
Online information review	39	52
Program	49	24
Reference & user services quarterly (formerly: reference quart.)	54(3)-55(2)	12
Scientometrics	102–105	345

Journal name 2015	Vols	No of arts
The electronic library	33	70
The indexer	33	30
Total	1514	

Appendix 2: The classification scheme

Only numeric codes in bold face were used in coding.

LIS TOPIC: A

010–030 Research on LIS context

010 the professions (of librarians, intermediaries)

020 history of L&I institutions

030 publishing (analyses of, incl. history)

100–300 Research on LIS studies

100 study on **education in LIS Studies** (studies on LIS itself, see 300)

200 methodology (study of research methods; for work task performance, see 400 … 600)

300 analysis of LIS discipline (also LIS subareas).

400 Research on LIS service activities

410 study on **document delivery** (incl. circulat-ion, interlibrary loans of docs in any forms)

420 collections study (of any media, e.g., ebooks).

430 study on information or reference service.

440 study on user education or information literacy education (incl. info skills)

450 study on L&I service **buildings** and facilities.

460 study on **administration or planning** (incl. L&I service visions and policies)

470 study on **automation or digital libraries** (if no L&I service context, consider 540)

480 study on **other L&I services** (incl. school libraries; library's public)

490 study on **several interconnected activities**

500 Research in information storage and retrieval

510 study on **metadata / cataloguing** (metadata for any type of docs)

520 study on **classification and indexing** (content of any media objects; using any intellectual & automatic means)

530 study on information search & retrieval

(clustering, filtering, recommendation, query formulation, retrieval models, QA, searching, summarization – in live or test collections, without user participation)

531 study on **text retrieval** methods (in live or test collections; incl. CLIR)

532 study on **retrieval methods in other media** (image, video, music, …, multi & hypermedia; if focus on WWW, then 533)

533 study on **web retrieval** methods.

534 study on **social media retrieval** methods.

540 study on **digital information resources** (e.g. various types of databases (incl. data journals; repositories – focus on general props & use)

550 study on **interactive (user-oriented) IR.**

560 study on **other aspects of IR** (incl., QA, archival IR system design; spoken queries)

600 Research on information seeking

610 study on **information dissemination** (pro-fesssional, work and everyday life contexts;)

620 study on the **use or users of channels or sources of information** (focus on channels or sources; manual or digital)

630 study on the **use of L&I services** (no other channels considered)

640 study on Information seeking behavior (focus.on persons).

641 study on **task-based information seeking** (tasks or interests as points of departure; incl. everyday-life tasks and info practices)

642 other type of information seeking study (ex: presence in social media sites; serendipity)

650 study on **information use** (whether and how).

660 study on **information management** (incl. IRM, knowledge management and sharing)

700 Research on scientific and professional comm

710 study on **scientific / professional** publishing (incl. reviewing)

720 study on **citation patterns and structures.**

730 study on **web-metrics** (incl. alt-metrics).

740 study on **other aspects** of scientific or professional communication

800 study on **other aspects of LIS** (e.g. task analysis, overview of library scene)

900 study in **another discipline** on LIS forum (may be relevant but focus is outside LIS)

SCHOLARLINESS—R

0 not research.

1 research.

VIEWPOINT ON DISSEMINATION – P

10 study on **several** interconnected phases of dissemination

11 information **producer's** viewpoint.

12 information **seller's** (marketer's) viewpoint.

13 intermediary's viewpoint.

14 intermediary organization's viewpoint.

15 end-user's viewpoint.

16 end-user organization's viewpoint.

17 viewpoint of the **developer** of the process or a service

18 LIS **educator's** viewpoint.

19 other viewpoint.

00 no viewpoint on information dissemination.

RESEARCH STRATEGY – M

10 empirical research strategy

11 historical strategy.

12 survey strategy (typically quant analysis, but may include qual studies)

13 qualitative strategy (prefer M = 14 – 16).

14 evaluation strategy.

15 case or **action research** strategy (incl. critical incident)
16 content or **protocol analysis** (both qual & quant; incl. discourse analysis)
17 citation analysis.
18 other bibliometric strategy (incl. co-authorship anal)
21 secondary analysis.
22 experiment (incl. field experiment).
29 other empirical method (catch-all for any other qual or quant strategy)
30 conceptual research strategy (non-empirical)
31 verbal **argumentation**, criticism.
32 concept analysis (incl. terminology analysis).
40–90 strategies for other non-empirical studies
40 mathematical or logical strategy (focus in formal definition)
50 system and software **analysis and design** (constructive)
60 literature **review** (research if analytical).
80 bibliographic strategy.
90 other strategy (incl. devel. of a method).
00 not applicable, no strategy.
DATA COLLECTION METHOD – C
10 questionnaire, interview (incl. structured and semi-structured)
15 harvesting databases or their log files (incl. social media sites)
20 observation (incl. eye-tracking, screen capture, wearable recorders)
30 thinking aloud
40 text/item collection for content analysis.
50 citation data collection (e.g. co-authorship and co-citation data, altmetric data)
60 historical **source analysis.**
70 several methods of collecting.
80 use of data collected earlier.
85 IR **experiment.**
90 other method of collecting (diary; crowdsourcing; other *test*)
00 not applicable (if study is not empirical).

TYPE OF INVESTIGATION – I

10 empirical
11 descriptive (incl. historical).
12 comparative
13 explanatory (building / testing theory).
20–50 non-empirical contribution
20 conceptual (incl. terminological).
30 theoretical (without direct data collection).
40 methodological
50 system design (constructive).
90–00 for other empirical, non-empirical and no contributions
90 other type (examples: review; plan/design).
00 not applicable, not a research arti.

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Authors and Affiliations

Pertti Vakkari[1] · Yu-Wei Chang[2] · Kalervo Järvelin[1]

Yu-Wei Chang
yuweichang2013@ntu.edu.tw

Kalervo Järvelin
kalervo.jarvelin@tuni.fi

[1] Faculty of Information Technology and Communication Sciences, Communication Sciences, Tampere University, 330114 Tampere, Finland

[2] Department of Library and Information Science, National Taiwan University, No.1, Sec.4, Roosevelt Road, Taipei 10617, Taiwan