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Disciplinary contributions to research topics and methodology in Library and Information Science—Leading to fragmentation?

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Abstract

The study analyses contributions to Library and Information Science (LIS) by researchers representing various disciplines. How are such contributions associated with the choice of research topics and methodology? The study employs a quantitative content analysis of articles published in 31 scholarly LIS journals in 2015. Each article is seen as a contribution to LIS by the authors' disciplines, which are inferred from their affiliations. The unit of analysis is the article-discipline pair. Of the contribution instances, the share of LIS is one third. Computer Science contributes one fifth and Business and Economics one sixth. The latter disciplines dominate the contributions in information retrieval, information seeking, and scientific communication indicating strong influences in LIS. Correspondence analysis reveals three clusters of research, one focusing on traditional LIS with contributions from LIS and Humanities and survey-type research; another on information retrieval with contributions from Computer Science and experimental research; and the third on scientific communication with contributions from Natural Sciences and Medicine and citation analytic research. The strong differentiation of scholarly contributions in LIS hints to the fragmentation of LIS as a discipline.

1 | INTRODUCTION

Scholarly disciplines develop through contributions and pressures based on internal and external factors. The latter include relations with other disciplines, and socioeconomic and technological factors. Each discipline's research community has social and cognitive norms which transform these factors into views on preferred research topics and methodology (Whitley, 1984). The present paper focuses on scholarly contributions to Library and Information Science (LIS). Scholarly contributions are conveyed through research publications, which often are created in collaboration between scholars of varying disciplinary backgrounds (Chang, 2018). We study journal articles in LIS to find out which disciplines contributed them and how this affects the research topics and methodology used.

Past research has analyzed research topics, viewpoints, and methodology in LIS (e.g., Åström, 2007; Järvelin & Vakkari, 2021; Tuomaala et al., 2014). However, it is not reported which disciplinary backgrounds these articles come from. On the other hand, studies focusing on affiliations of authors in scholarly LIS articles describe the general contribution of various disciplines to

LIS (e.g., Chang, 2018, 2019; Chang & Huang, 2012; Urbano & Ardanuy, 2020). However, these do not analyze in detail the topical or methodological contributions produced.

There are differing views about the notion of LIS. They vary from a coordinated discipline to multiple disciplines, which may form a loose collection of smaller fields without a solid focus or have large overlaps with a range of other disciplines (e.g., Bawden & Robinson, 2013; Saracevic, 1992). We take Vakkari's (1994) definition as our point of departure: the unifying characteristic of LIS is the study on the provision of access to desired information typically in the form of documents.

We observe the disciplinary contributions to various research topics of LIS. Based on content analysis of journal articles, Järvelin and Vakkari (1990) categorized LIS research into a hierarchy of research topics and subtopics. An updated version (Järvelin & Vakkari, 2021) lists the research topics as follows: LIS context, LIS studies, L&I services, information retrieval (IR), information seeking, scientific communication. This categorization is generic, representative and has become popular in empirical studies of LIS (e.g., Ma & Lund, 2021). Adapting this categorization, we divide LIS research into five *research topics*: LIS context (incl. LIS studies), L&I services, IR, information seeking, and scientific communication (Appendix B). Thus, we analyze the contributions of various disciplines to five research topics of LIS research.

We consider articles in scholarly LIS journals as contributions to LIS knowledge. We assume that authors' affiliations given in the article roughly indicate their disciplinary affiliations at the time of writing. Affiliations can be interpreted as social and cognitive. The former simply indicates the fact that a scholar belongs to an organization labeled with the name of some discipline. Cognitive affiliation assumes that scholars with a given disciplinary affiliation share similar cognitive values like domain of interest, metatheoretical assumptions and methodological ideas. Therefore, regarding indexing, for example, a psychologist and a statistician see different problems, pose different research questions, arrive at different findings, and report different contributions.

Each discipline tends to define research problems from its own perspective and select research methodology accordingly. Thus, the larger the contribution of a discipline to LIS, the more the discipline shapes the development of LIS. If this contribution is strong within research topics of LIS research, it may produce fragmentation in LIS. Now that LIS research has become dominated by non-LIS authors (Chang, 2018; Urbano & Ardanuy, 2020), the associations of their disciplines with their research topics and other characteristics of LIS research are worth comparing to those by LIS authors. For a relatively small discipline like LIS, associated and cooperating with bigger ones, the growing influence of the latter may be a question of growth or withering away. Our results show which disciplines drive research in the main subfields of LIS. This brings kindling in the discussion about the future of LIS as a discipline.

The main research question of the present paper is: How are LIS contributions from various disciplinary backgrounds associated with the choice of research topics and methodology? We tackle this question by classifying and analyzing authors' affiliations and their contributions' topical and methodological aspects. Our specific research questions are as follows:

- What is each *discipline's share of contribution* in each research *topic*?
- What is the *topical distribution* of contributions of each *discipline*?
- How are *research strategies* patterned by each *contributing discipline*?
- How do the contributing *disciplines* relate to *research strategies* and *viewpoints* applied in different *topics*? How do the *contributing disciplines* relate to *data collection methods* and *types of investigation* in different *topics*?

2 | LITERATURE REVIEW

As fields of study have become more interdisciplinary (Abramo et al., 2012; Chang & Huang, 2012; Porter & Rafols, 2009), research attention has shifted to determining which disciplines shape the development of a target discipline. Over time, research contributions to a discipline by scholars outside that discipline can gradually change its character. LIS is one such highly interdisciplinary field that is expected to change in research topics at a higher pace than other disciplines. Many studies have examined the evolution of LIS research topics (e.g., Armann-Keown & Patterson, 2020; Han, 2020; Liu & Yang, 2019; Song et al., 2021; Taşkın, 2021). Some studies have examined LIS research methodology (e.g., Chu, 2015; Hider & Pymm, 2008) and the interaction between methodology and topics (e.g., Ma & Lund, 2021; Tuomaala et al., 2014).

To identify LIS research topics, researchers have traditionally used content analysis (Armann-Keown & Patterson, 2020). Bibliometric methods (Ellegaard, 2018) and text mining (Thakur & Kumar, 2021) have also been applied to detect emerging research topics. Given that several characteristics of LIS research embedded in the content of articles are the research focus, this study used content analysis and only reviewed studies that also used content analysis.

Järvelin and Vakkari (1990) devised a classification scheme for characterizing articles by research topic, methods, viewpoints, and strategies. This classification scheme helped the authors characterize LIS articles published in 1965, 1975, 1985, 2005, and 2015 (Järvelin & Vakkari, 1990, 1993, 2021; Tuomaala et al., 2014). The scheme has been adopted in multiple studies to explore the characteristics of LIS research published in certain countries or specific years (Asubiaro & Badmus, 2020; Hider & Pymm, 2008; Lund & Wang, 2021; Ma & Lund, 2021). Although other classification schemes for identifying research topics have been proposed (e.g., Zins, 2007), the classification scheme established by Järvelin and Vakkari has the advantage of considering multiple aspects of LIS research, including research topics, methods, and viewpoints. This may explain the wide use of this classification scheme in studies on LIS.

Although content analysis has been widely used to elucidate LIS research topics (Aharony, 2012; Asubiaro & Badmus, 2020; Ma & Lund, 2021), research methods (Asubiaro & Badmus, 2020; Chu, 2015; Ma & Lund, 2021) and adopted theories (Kim & Jeong, 2006), few studies have examined the relationship between study characteristics and the disciplinary backgrounds of study authors.

Unexpectedly, recent studies have indicated that a high percentage of LIS research is contributed by authors coming from non-LIS disciplines. Chang and Huang (2012) reported that non-LIS authors accounted for close to half of all authors contributing articles to 10 LIS journals between 1978 and 2007. The non-LIS authors represented 24 disciplines, and the number of disciplines was shown to increase by year. Lund (2020) analyzed the disciplinary affiliations of authors who published in the 10 top Information science journals from 2015 to 2019. LIS authors accounted for only 34.6% of all authors. The major non-LIS authors represented 30 disciplines. Urbano and Ardanuy (2020) reported a similarly low percentage of LIS authors (30.3%) when studying LIS articles from four European countries published between 2010 and 2017. Because certain LIS journals cater to authors from certain backgrounds, journals differed in author disciplines. Chang (2019) expanded the number of LIS journals reviewed to 75. Although only articles published in 2015 were included, precluding observation of a trend in the proportion of non-LIS authorship over time, this study confirmed that non-LIS authors dominate most journals. The percentage of articles by LIS authors exceeded 50% in only 30.7% of the journals. This suggests that the number of non-LIS authors will continue to increase.

Prebor (2010) and Chang (2018) analyzed LIS topics favored by certain disciplines. Prebor (2010) focused on the difference in topic preference between LIS and non-LIS graduate students by examining theses and dissertations submitted between 2002 and 2006. Non-LIS graduate students spanned 18 disciplines. The four non-LIS fields most represented were Business-and-Management (22%), Computer Science (16%), Communication and Journalism (13%), and Education (13%). The research topics of dissertations and theses written by students from the other 14 disciplines were not examined. Chang (2018) examined articles published in 39 LIS journals over a 10-year period (2005–2014). Articles by non-LIS authors accounted for up to 72.1% of total articles in these journals. Authors affiliated with computer science schools constituted the largest group of non-LIS authors (38.8%), followed by those working in business and economics (18.8%). Scientometrics was the top topic studied by non-LIS authors. Moreover, non-LIS authors primarily collaborated with LIS authors. Although a coauthorship pattern is common in LIS, the topics of LIS/non-LIS coauthored articles were significantly different from those written by only non-LIS authors. The disciplinary breakdown of the research topics favored by non-LIS authors was not examined. Both Prebor (2010) and Chang (2018) observed a difference in research topic preference between LIS and non-LIS authors. If the increasing trend in the proportion of articles published by non-LIS authors continues, LIS authors may lose sway in LIS research. Therefore, paying attention to non-LIS authors who engage in LIS research is necessary to confirm the evolution of LIS research.

Due to differences in disciplinary cultures, the best strategy to adopt for external researchers entering other disciplines is collaboration with researchers in those disciplines. Abramo et al. (2012) analyzed publications from nine natural science disciplines by authors affiliated with Italian universities from 2004 to 2008. Researchers in each discipline engaged in interdisciplinary collaboration, but the degree of collaboration varied by discipline. Urbano and Ardanuy (2020) confirmed the phenomenon when exploring the interdisciplinary collaboration in LIS journal articles by authors from four European countries between 2010 and 2017. Findings indicated that only 7.7% of articles were collaboration between LIS and non-LIS authors. The authors claimed that this low figure represents a low degree of interdisciplinarity that contrasts with the image of LIS as a highly interdisciplinary field. However, the percentage of non-LIS authors was 69.7%, which is consistent with the studies reviewed above. This indicates that the rate of collaboration between LIS and non-LIS authors may not reflect the degree of LIS interdisciplinarity.

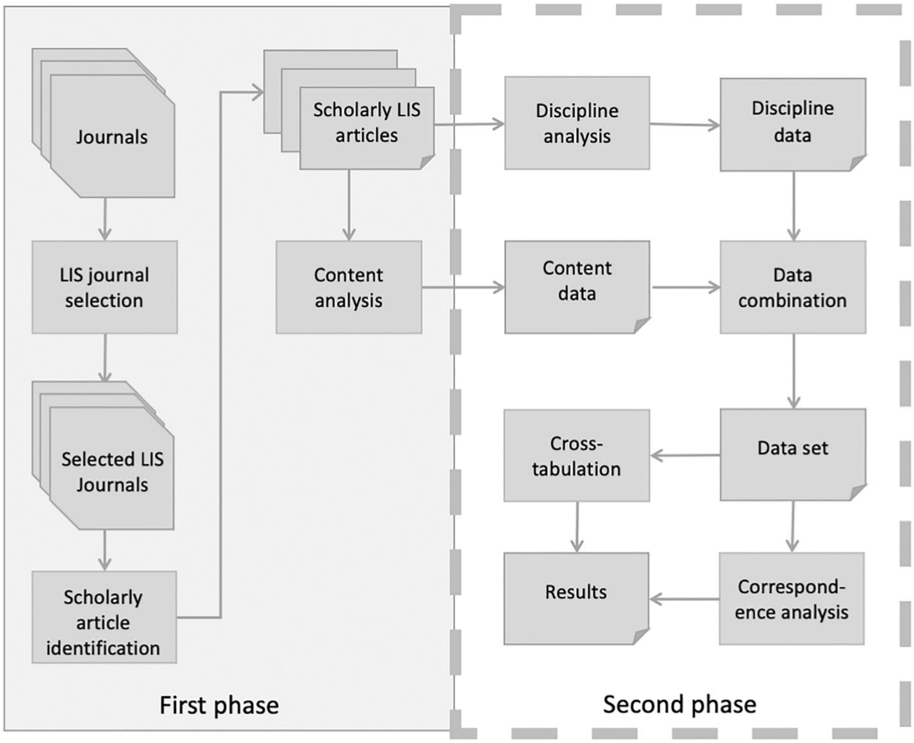

FIGURE 1 The data collection, preparation, and analysis process

3 | METHODOLOGY

The construction of the data set, the topical, methodological, and author discipline variables used in the analysis of the LIS articles, and the methods of analysis are explained in subsequent sections.

3.1 | Data collection

The data set was collected in two main phases, see Figure 1. An initial data set was produced in the first phase for content analysis and reused with extension in the second phase. The first phase involved selection of journals to represent LIS in 2015, identification of scholarly articles in the journals and performing a multidimensional content analysis of the articles. Issues in constructing the data set and the results of analysis were discussed in Järvelin and Vakkari (2021). Statistics on the data set are given in Table 1.

A total of 1,514 articles published in 31 LIS journals were collected initially—aiming at full articles, brief communications, and critical reviews—using digital versions of the journals. These three types of articles were taken as representing research. After exclusion of accidentally collected 112 non-scholarly articles, and 192 articles falling outside LIS, altogether 1,210 scholarly LIS articles published in 2015 formed the content-analytic sample articles. In the second phase, the bibliographic records of these LIS research articles were collected from the Scopus database for the author affiliation data. The affiliation data indicated 926 mono-disciplinary articles, and more

TABLE 1 Dimensions of data

Object	Attribute	Value
Journals	Volume	2015
	Unit of observation	A journal
	Total number of titles	31
Articles	Unit of observation	An article
	Total number	1,514
	No. excluding non-LIS	1,322
	No. excluding non-research	1,210
	No. content dimensions	6
	Classifiers, equal shares	2
Disciplinary contributions	Unit of observation	The pair (article, discipline)
	Total number	1,533
	No. content dimensions	3
	Classifiers	1

than one contributing discipline for 283 articles. The final number of units of observation grew to 1,533 article-discipline pairs.

TABLE 2 The variables of the data set

Content analytic variables	
Name	**Explanation**
LIS topic	The focus of an article, for example, information seeking, expressed as a main topic
Scholarliness	Indicates whether the article reports scholarly research or not
Viewpoint on information dissemination	Indicates whose interests are served in the article
Research strategy	Indicates the overall combination of data-collection and analysis methods of the study
Data-collection methods	The concrete data-collection methods in empirical research and otherwise "no method"
Type of investigation	Indicates empirical, theoretical, methodological, constructive, etc. research output
Discipline analytic variables	
Name	**Explanation**
Discipline	Gives each unique discipline name based on an article's coauthors' affiliation.
Collaboration type	Indicates LIS-internal, external, and mixed research
No. of disciplines	Indicates the number of unique disciplines contributing to an article

3.2 | Data processing

3.2.1 | Classifying the content of articles

Content analysis of each article was based on its title, abstract and keywords. If these were not available, the article title and first page were used instead. If the available information was insufficient for classification, the entire article was consulted. Each article was classified into one content class for each of six content dimensions by two of the authors, both broadly experienced with LIS. Table 2 lists the content variables and Appendix B their classes.

The classification of research *topics* is presented in Appendix B. We used the five research topics for analysis: *LIS context*, *L&I services*, *IR*, *information seeking*, and *scientific communication*. The research topic class *Non-LIS research* was coded but excluded from the analyses. Classification reliability was measured by Fleiss' *kappa* (Table 3).

For increasing the degrees of freedom in the analysis we merged classes of some variables. In the viewpoint to information dissemination, intermediary's and intermediary organizations' views were merged as intermediary's view; end-user's and end-user organization's views were merged as end-user's view; several viewpoints, producer's, seller's, LIS educator's and other viewpoints were collapsed as other viewpoints.

In research strategies historical, and evaluation strategies were merged with other empirical strategies as other empirical strategies; citation analysis was merged with other bibliometric strategy as citation analysis; verbal argumentation and concept analysis were merged as conceptual strategy; literature review and bibliographic

TABLE 3 Classification reliability (Fleiss' *kappa*)

Content analytic variables ($N = 31$)				
Name	***Kappa***	***p*-value**	**No. of raters**	**Level**
LIS topic	0.619	.000	2	Good
Scholarliness	0.631	.000	2	Good
Viewpoint on information dissemination	0.555	.000	2	Moderate
Research strategy	0.532	.000	2	Moderate
Data-collection methods	0.603	.000	2	Moderate
Type of investigation	0.601	.000	2	Moderate
Discipline analytic variables ($N = 40$)				
Name	***Kappa***	***p*-value**	**No. of raters**	**Level**
Discipline	0.71	.000	3	Good
Collaboration type	0.70	.000	3	Good
No. of disciplines	0.64	.000	3	Good

strategy were merged with other strategy as other strategy.

In data collection methods harvesting databases, observation, thinking aloud, text collection, historical source analysis, use of data collected earlier, and other methods were collapsed as other methods.

3.2.2 | Identifying authors' disciplines

The method by Chang (2018) was used to identify the disciplinary attributes of individual authors based on author affiliation information of articles. Authors who were affiliated with LIS-related institutions were coded as LIS authors. Most LIS-related institutions were departments and institutes that were affiliated with universities and offered LIS courses, followed by libraries and library associations. Authors who did not qualify as LIS authors were classified as authors in Business-and-Economics, Computer Science, Engineering, Humanities, Medicine, Natural Sciences, and Social Sciences (Appendix C). Regarding multi-affiliated authors, their disciplinary attributes were determined by their first affiliations. The share of such authors was negligible (only 6% based on a random sample of 32 articles and among them, the additional affiliations often led to the same discipline as the primary one). In addition to referring to reference sources related to LIS institutions mentioned in Chang (2018), the present study employed the Internet to identify some authors' expertise because of incomplete affiliation information in the analyzed articles.

After the disciplinary attribute of each author was assigned, each article could be described by one or more disciplines. The same discipline was coded once for each article, not for each author. For example, a three-author article written by two LIS authors and one Computer Science author was coded as LIS and Computer Science, indicating the contribution of two disciplines to the article. To investigate the contribution of a specific discipline to individual articles, each distinct pair of an article-id and a discipline formed one unit of observation. Each discipline was credited by one article for each article. Because some articles were contributed by two or more disciplines, the total number of units of observation in disciplinary analysis rose to 1,533 (Table 1). In addition, encoding the author discipline was conducted by one author of this study. To enhance the precision of determination of a discipline for each author, articles contributed by at least one non-LIS discipline were examined twice. Classification reliability was measured by Fleiss' *kappa* (Table 3). *Kappa* value ranges from −1 for complete disagreement, to ±0 for random choices, and to +1 for complete agreement. *Kappa* values 0.41–0.60 are moderate, 0.61–0.80 good, and 0.81–1.0 very good.

3.2.3 | 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.

In addition, we visualized the relationships between the disciplines, topics, and various characteristics of contributions by applying correspondence analysis (CA). CA is a dimension reduction technique for exploring the association between categories of variables (Hair et al., 2010). It resembles factor analysis and can be used with nominal data and nonlinear relationships. CA creates perceptual maps in a single step, where variables and objects are simultaneously plotted in the map based directly on the association of variables and objects. It estimates orthogonal dimensions upon which the categories can be placed to best account for the strength of association represented by the χ^2 distances. This technique uses the χ^2 value as the basis for deriving a similarity measure, which is then used to plot the categories as points on a map (Hair et al., 2010). Proximity indicates the level of association among row and column categories. Points with higher similarities are mapped closer to each other. The distance between points is used for interpreting relative position, rather than for making precise statements on exact point-to-point distance (Hair et al., 2010).

4 | FINDINGS

4.1 | Research topics

LIS scholars' share of contribution with 36% is the largest among disciplines followed by Computer Science (21%), Business and Economics (16%), and Social Sciences (10%) (Table 4). Thus, most of the contributions to LIS come from other disciplines. These four largest disciplines cover 83% of all contributions.

The share of contribution between disciplines varies significantly by research topics (χ^2, $df = 28$, 486.9, $p < .001$). LIS is responsible for the largest contribution share, in descending order, in L&I services (68%), LIS context (66%), information seeking (43%), and scientific communication (24%), while its share is second largest (22%) in IR. Other disciplines contribute essentially less to professionally related LIS topics.

TABLE 4 Disciplinary contribution by research topics (%)

Discipline	LIS context (%)	L&I services (%)	Information retrieval (%)	Information seeking (%)	Scientific commun (%)	Total (%)
Humanities	10	1	4	1	3	3
Social Sciences	9	10	8	7	13	10
Business and Economics	7	8	12	19	22	16
LIS	66	68	22	43	24	36
Computer Science	6	9	48	19	14	21
Engineering	0	1	3	4	7	4
Medicine	1	1	1	3	4	3
Natural Sciences	1	2	2	4	13	7
Total	100 ($n = 161$)	100 ($n = 209$)	100 ($n = 347$)	100 ($n = 216$)	100 ($n = 600$)	100 ($n = 1,533$)

TABLE 5 Topic distributions by disciplinary contributions (%)

Discipline	LIS context	L&I services	Information retrieval	Information seeking	Scientific communication	Total
Humanities (%)	33	4	24	4	35	100 ($n = 49$)
Social Sciences (%)	10	13	17	10	50	100 ($n = 155$)
Business and Econ (%)	5	7	17	17	54	100 ($n = 234$)
LIS (%)	19	25	13	17	26	100 ($n = 558$)
Computer Science (%)	3	5	52	13	27	100 ($n = 322$)
Engineering (%)	0	3	21	12	64	100 ($n = 66$)
Medicine (%)	2	7	13	15	63	100 ($n = 40$)
Natural Sciences (%)	2	5	6	9	78	100 ($n = 100$)
Total (%)	10	14	23	14	39	100 ($n = 1,533$)

In IR, Computer Science produces the largest share (48%) of contribution, followed by LIS (22%), and Business and Economics (12%). In information seeking, in addition to LIS (43%), Business and Economics (19%) and Computer Science (19%) have large contribution shares. In scientific communication, the distribution of contribution is the most even among research topics: LIS produces 24%, Business and Economics 22%, Computer Science 14%, and Social Sciences 13%.

In all, the share of contribution is differentiated between the disciplines in research topics. In professionally oriented topics—LIS context and L&I services—LIS alone covers about two thirds of contribution. In IR, the contribution of Computer Science is the dominating one with a share of almost one half. In information seeking, LIS is the dominating contributor followed by Business and Economics and Computer Science. In scientific communication, the contributions are relative evenly distributed between LIS, Business and Economics, Computer Science and Social Sciences.

The topic distributions of contributions between the disciplines differ significantly (χ^2, $df = 28$, 486.9, $p < .001$) (Table 5). The contribution profile of LIS is distributed relatively evenly among topics compared to other disciplines. Scientific communication (26%) and L&I services (25%) have drawn the largest contributions, while IR the smallest ones (13%) in articles authored by LIS scholars. The interest in LIS research topics by other disciplines is typically focused on one topic with a share of over 50%. Humanities is the only exception with its share of contribution about one third both in scientific communication and LIS context. Scientific communication also covers the major share of contribution, in ascending order, in Social Sciences (50%), Business and Economics (54%), Medicine (63%), Engineering (64%), and Natural Sciences (78%). Both IR and information seeking have a relative strong position in the profiles of these five disciplines. In the topic distribution of Computer Science, the emphasis is on IR (52%) and scientific communication (27%).

In all, LIS allocates its contribution relative evenly across all main research topics. External disciplines, except for Computer Science and Humanities, contribute to scientific communication; the more, the harder the science. Computer Science focuses on IR, while Humanities share its contributions between scientific communication and LIS context.

4.2 | Research strategies

The use of research strategies differs significantly between the disciplines observed (χ^2, $df = 70$, 450.3, $p < .001$). Survey is the most frequent strategy followed by conceptual research strategy in LIS and Humanities. In other disciplines, except for Computer Science, citation analysis is among the two most common research strategies combined with survey in Business and Economics and Social Sciences, and with case studies in Engineering, Medicine, and Natural Sciences. In Computer Science, mathematical strategy is the most applied strategy followed by experiment.

The applied research strategies vary across topics. Therefore, it is evident that the research strategies differ due to the variation in topical contributions between the disciplines (Table 6). LIS and Humanities were most interested in LIS context and L&I services, and consequently survey and conceptual strategy were the most used in contributions based on these disciplines. The frequent use of citation analysis by other external disciplines except for Computer Science is due to the top position of scientific communication in their topical research profile. Computer Science contributed mostly to IR, where mathematical or logical strategy and experiment were two major research strategies. Survey is a typical method in behavioral sciences, which would explain its common use in Social Sciences and in Business and Economics. The frequent use of case study strategy in Medicine, Engineering and Natural Sciences is due to its use in problems of scientific communication, which is a popular topic in the contributions by these disciplines. A closer look at the data did not produce essential differences in the use of research strategies in topics between LIS and other disciplines.

To find out the effect of collaboration between LIS and other disciplines on the use of research strategies over topics, we compared contributions by sole LIS scholars with contributions by LIS scholars collaborating with scholars from other disciplines. There were enough

TABLE 6 Research strategies by disciplinary contributions (%)

Research strategy	Huma (%)	Soc (%)	Busin (%)	LIS (%)	Comp (%)	Engin (%)	Med (%)	NatSci (%)	Total (%)
Survey	25	19	35	29	14	15	20	17	24
Qualitative	0	5	3	6	3	1	3	0	4
Case study	10	12	12	7	4	20	35	25	11
Content analysis	2	2	2	7	2	0	0	0	3
Citation analysis	10	26	23	13	11	27	20	35	18
Experiment	4	10	5	7	16	6	2	6	8
Other empirical	16	7	3	6	5	4	8	5	5
Conceptual	20	12	6	19	6	1	3	2	11
Mathematical	8	6	7	3	21	13	8	8	9
System analysis	4	2	5	1	14	8	3	2	5
Total	100 ($n = 49$)	100 ($n = 155$)	100 ($n = 242$)	100 ($n = 555$)	100 ($n = 317$)	100 ($n = 64$)	100 ($n = 40$)	100 ($n = 100$)	100 ($n = 1{,}522$)

Note: "Not applicable" ($n = 11$) removed from the table.

Abbreviations: Huma, Humanities; Soc, Social Sciences; Busin, Business and Economics; Engin, Engineering; Med, Medicine; NatSci, Natural Sciences.

cases for analysis only in IR, information seeking and scientific communication. The differences between the two groups of LIS scholars were not statistically significant in any research topic. However, there was a slight tendency that, compared to sole LIS contribution, collaboration led in IR to a more extensive use of mathematical strategy (7% vs. 14%) and experiment (30% vs. 38%) at the cost of conceptual strategy (28% vs. 0%). The major collaborating discipline was Computer Science with a share of 62%. In scientific communication, in the application of mathematical strategy the respective figures were 5% versus 12%. The major collaborating disciplines were Computer Science (31%) and Business and Economics (27%). Although the evidence is lean, it suggests that collaboration with other disciplines, with Computer Science and Business and Economics in particular, enriches the methodological arsenal in LIS at least in IR and scientific communication.

4.3 | Correspondence analysis

Next, we visualize the relationships between the disciplinary contributions, topics, and various characteristics of contributions by applying CA.

We divided the variables in CA into two groups to avoid the overload of information in the maps. We are mainly interested in how disciplines and topics relate to other research characteristics. First, we relate disciplines with research strategies and viewpoints applied in topics. The categories of these variables are plotted in a two-dimensional space. The discrimination values of variables suggest that research topic and research strategy as the best discriminators can be used for naming the dimensions. The horizontal dimension can be called research topics, and the vertical one research strategies (Figure 2).

There are three clusters on the CA map. In the upper center area, the topic IR is close to experimental (Experim), system analytic (System_A) and mathematical (Mathemat) research strategies, developer's viewpoint, and Computer Science. The associations suggest that contributions to IR typically come from scholars in Computer Science and are created from developer's viewpoint by applying experimental, mathematical and system analytic research strategies.

In the lower right area, the topics LIS Context, L&I services, and information seeking (Info seeking) are close to survey, content analytic (Content_A), qualitative, other empirical (Other_Emp) and conceptual research strategies. Also, intermediary's, end-user's and other viewpoints belong to the cluster, and LIS among disciplines. This cluster represents professionally oriented LIS topics and information seeking typically studied by LIS scholars. L&I services are explored from intermediary's viewpoint applying content analytic strategies, while problems of LIS context are typically conceptualized from

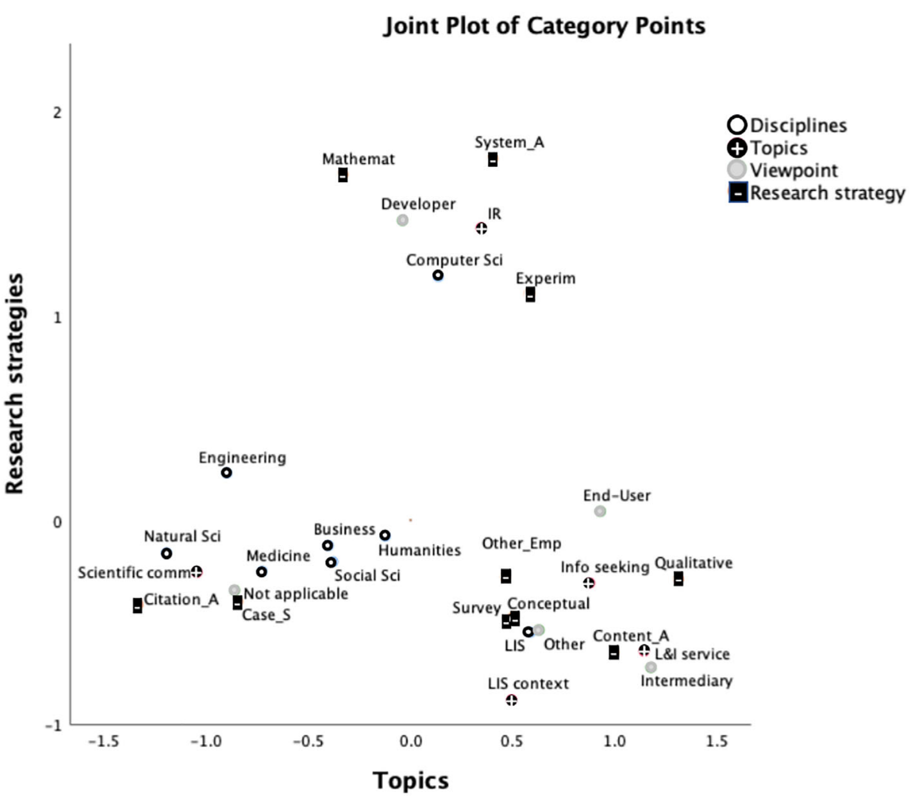

FIGURE 2 Correspondence map for research strategies and viewpoints applied in topics by contributing disciplines

other (e.g., producer, seller, or educator) viewpoint and analyzed by applying survey and conceptual research strategies. Information seeking is mainly analyzed from end-user's angle using survey, qualitative, other empirical or conceptual research strategies.

In the lower left area is the third cluster consisting of topic scientific communication, case study and citation analytic research strategies, not-applicable category of viewpoint, and disciplines Natural Sciences, Medicine, Engineering, Business and Economics, Social Sciences and Humanities. This cluster represents research in scientific communication (mostly consisting of scientometric studies) applying case study and citation analytic research strategies, which are mostly based on disciplinary contributions from Natural Sciences, Medicine, Engineering, Business and Economics, Social Sciences and Humanities from a neutral viewpoint. This strengthens the conception already visible in Table 6 that contributions from these disciplines are mainly empirical and meant for analyzing their discipline-specific problems in research assessment and science policy.

The second CA (Figure 3) relates disciplinary contributions with data collection methods and investigation types applied in topics. The discrimination values of variables suggest that the horizontal dimension can be called data collection methods and the vertical one research topics.

The map consists of three clusters. In the upper right area, IR is close to IR experiment as data collection method, system design and comparative investigations, and Computer Science. These associations suggest that IR is typically studied by scholars in Computer Science using IR experiment as data collection method and applying either system design or comparative investigations for answering research questions.

In the upper left area topics LIS context, L&I services and information seeking are close to the use of questionnaire, content analysis, several methods (Several), and other methods for data collection. In addition, conceptual, theoretical, and other types of investigations belong to this cluster. Explanatory and descriptive types of investigations are situated between this and the cluster in the lower middle area. Information seeking is nearest to the explanatory type of investigation. LIS and Humanities belong also to this cluster. The associations suggest that professionally oriented LIS topics—LIS context and L&I services - and information seeking are explored by scholars in LIS and Humanities collecting data with questionnaires and interviews, content analytic techniques and several other methods. The type of investigation typically applied to research questions is conceptual or theoretical. In information seeking also explanatory design is common.

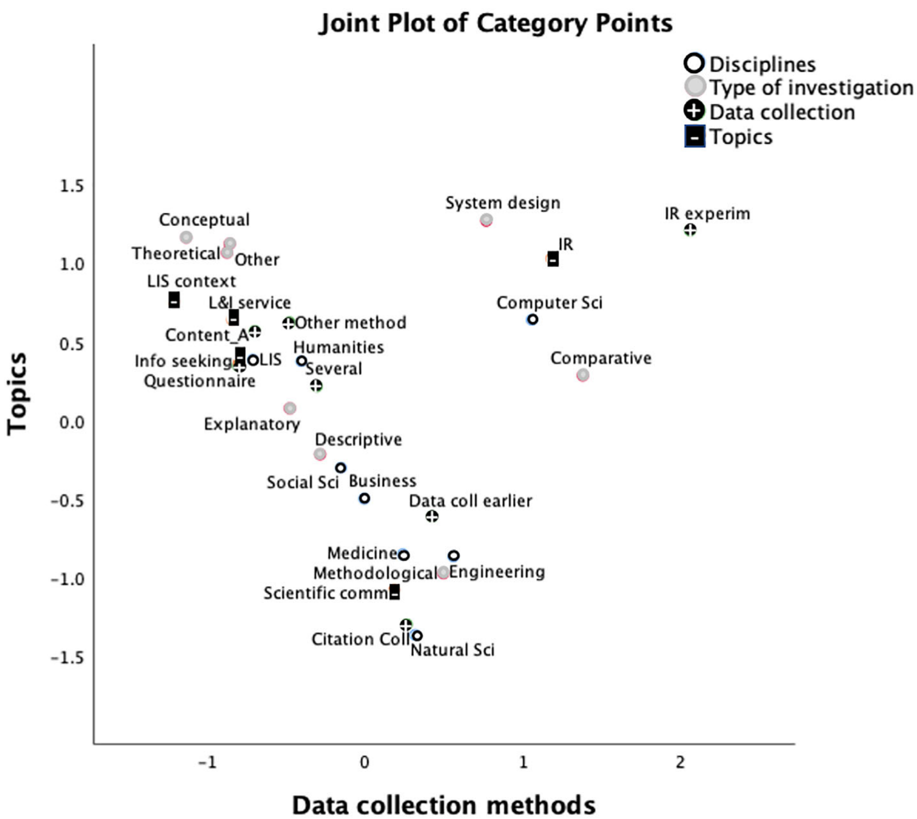

FIGURE 3 Correspondence map for data collection methods and investigation types applied in topics by disciplines

TABLE 7 Clusters resulting from correspondence analysis

Variable	LIS and information seeking	Information retrieval	Scientific communication
Topics	LIS context, L&I services, information seeking	Information retrieval	Scientific communication
Disciplines	LIS, humanities	Computer science	Natural sciences, medicine
Viewpoints on dissemination	Intermediary, end-user	Developer	
Research strategies	Survey, conceptual	System analysis and design, experiment	Citation analysis, case study
Data collection methods	Questionnaire, content analysis	IR experiment	Citation collection
Types of investigations	Theoretical, conceptual	System design	Methodological

The third cluster is in the lower mid area. It consists of scientific communication, citation collection and data collected earlier as data acquisition techniques, methodological and descriptive types of investigation, and disciplines Natural Sciences, Medicine, Engineering, Business and Economics, and Social Sciences. This cluster represents research in scientific communication (mainly including scientometric studies) cultivated by the disciplines mentioned using data collected earlier or citation collection for answering typically descriptive or methodological research questions.

Table 7 summarizes the findings of CA. The two CAs consistently identified three clusters of topics: professional LIS topics (LIS) and information seeking, IR, and scientific communication. The contributions in these topics were associated with certain disciplines and typical approaches and methodological solutions.

5 | DISCUSSION

Our study is the first to analyze the characteristics of research contributions to LIS by various disciplines. It elaborates earlier findings (e.g., Chang, 2018, 2019; Chang & Huang, 2012; Urbano & Ardanuy, 2020) which show that disciplines external to LIS are responsible for over half of the research articles contributing to LIS. The study at hand analyzed in detail topical and methodological contributions to LIS by various disciplines.

5.1 | Major findings

RQ1: How Do Various Disciplines Contribute to LIS Topics. The share of contributions by LIS in research articles was slightly over one third implying that other disciplines have a great influence on the LIS body of knowledge. This finding corresponds to the results of earlier studies (Chang, 2018, 2019; Chang & Huang, 2012; Urbano & Ardanuy, 2020) that other disciplines contribute more to LIS than LIS itself. Computer Science with a share of one fifth and Business and Economics with a share of one sixth are the major external disciplines contributing to LIS. Also, Chang (2018) has shown that Computer Science and Business and Economics provided between 2005 and 2014 the greatest number of external contributions to LIS.

In professionally oriented topics—LIS context and L&I services—LIS dominated the contributions by a share of two thirds, while in IR Computer Science was responsible for about one half of the contributions and LIS about one fifth. In scientific communication the share of contributions by external disciplines was three fourths, with Business and Economics, and Computer Science as the largest ones. In information seeking LIS was the dominant contributor with a share of two fifths followed by Business and Economics and Computer Science with a share of one fifth each. Thus, it seems that mainly LIS scholars reproduce research in professional LIS topics, while mainly scholars in other disciplines reproduce research in IR, information seeking, and scientific communication.

RQ2: Topical Distributions of Contributing Disciplines. The contribution profile of LIS is distributed relative evenly between research topics compared to other disciplines. The contributions of external disciplines are focused on one research topic with a share of over 50%. Computer Science focuses on IR (53%), while in the profile of other disciplines scientific communication is the major topic from a share of 50% in Social Sciences to a share of 78% in Natural Sciences. Humanities is an exception of this trend with its focus on scientific communication and LIS context.

This difference in the distribution of topical contributions between LIS and other disciplines is evidently due to the responsibility of LIS to cover in education and research the whole field, not only one or two of its topics. From the perspective of LIS, as reflected in the topic classification of the data set, external disciplines may focus on those topics in LIS, which are most interesting in their research agenda. They may have quite different views on the structure and relations of scholarly disciplines compared with LIS scholars and the latter have no privilege to enforce their view.

RQ3: Methodological Patterns of Contributing Disciplines. Our analysis showed also that the use of research methodology in LIS topics differed between disciplines. Each discipline tends to apply its own characteristic methodology for solving research problems in LIS topics of interest. Thus, other disciplines introduce in LIS topics methodology that is not typically applied by LIS scholars.

Research Strategies. LIS and Humanities were most interested in LIS context and L&I services, and consequently survey and conceptual strategies were the most used in their contributions. Computer Science contributed mostly to IR, mathematical strategy and experiment being the major research strategies. The survey strategy was associated with contributions by Social Sciences and Business and Economics. The popularity of case study strategy in contributions by Medicine, Engineering and Natural Sciences is associated with research on scientific communication, suggesting applicative use of its methods. For the same reasons, the citation analytic strategy was popular in contributions by other external disciplines, except for Computer Science. Data collection methods followed from research strategies.

RQ4: Correspondence Analysis of Contributing Disciplines, Viewpoints on Different Topics, and Methodological Aspects. The two CAs consistently identified three clusters of topics: professional LIS topics and information seeking, IR, and scientific communication. The contributions in these clusters were associated with certain disciplines and typical approaches and methodological solutions as shown in Table 7.

Limitations. One limitation of our study is our approach of not recognizing the unequal contributions of authorship based on the number and order of authors. However, there is no simple way for tackling this problem because: (a) the total contribution of an article is difficult to measure but varies from marginal to revolutionary, (b) there is no single pattern of contribution related to author positions, and (c) the contribution types vary from, for example, formulation of the research problem, to working with the problem, providing methodological consultation, and to supervision. Therefore, an author (a discipline) at the third position of one article may contribute more than the single author of another—and we only note the presence or absence of a disciplinary contribution.

The identification of authors' affiliations may somewhat limit the validity of the findings. The name of a research organization may in some cases be vague, not clearly indicating the disciplines the organization consists of. Some authors may have several affiliations, which also may produce challenges in identifying the most appropriate one. However, the latter one is a minor problem, because the proportion of articles with authors having several affiliations was about 6 % in our data. In addition, the parallel affiliations mostly referred to the same discipline. The relatively high reliability of our affiliation coding suggests that neither the former one undermines our findings significantly. An additional limitation is the classification of articles concerning research topics or methods into one class. The means to counteract the problem were the instruction to identify the primary class among alternatives, considering the data at the level of main classes, and offering a class for "multiple x's" for some variables. In addition, the classification of methods is multidimensional allowing categorizing an article into several dimensions like research strategy, data collection method, and type of investigation.

5.2 | Fragmentation of LIS?

The disciplinary contributions may affect LIS in manty ways. Many scholars note that IR is a part of Computer Science according to the ACM classification system. Therefore, many IR scholars do not think, nor would accept the view, that they would be contributing to LIS rather than Computer Science when working with IR problems. Likewise, during the last decades scientometric analyses have become major tools for evaluating research performance. Understandably, there is great interest in many disciplines in exploring their own research performance. Research funding agencies also expect value for money in their funding decisions. This explains the focus of many disciplinary contributions on problems of scientific communication.

Nolin and Åström (2010) claim, based on conceptual analysis, that LIS is a fragmented adhocracy. According to Whitley (1984) a fragmented adhocracy is characterized by a combination of high task uncertainty and low mutual dependence between scholars. Task uncertainty refers to the degree of uncertainty about intellectual priorities, the significance of research topics, and preferred ways of tackling them. Mutual dependence refers to scholars' dependence upon colleagues to make competent contributions to collective intellectual goals and acquire prestigious reputations (Whitley, 1984).

Our results indicate that traditional professional topics are cultivated mostly by LIS scholars, while disciplines external to LIS contributed most to IR, scientific communication, and information seeking. Research in LIS is fragmented across various disciplines. It is also likely that there is not much interaction between the five research topics. This suggests that LIS may be characterized as fragmented adhocracy. There are significant differences between the main research topics in disciplinary orientations, which also lead to essential differences in research strategies. This implies a low mutual dependence between scholars in different research topics, when they are uncertain about what contributions are competent in various topics. This disciplinary differentiation also leads to high task uncertainty when it is challenging to assess research goals and methodologies.

The external contributions may enrich LIS conceptually, theoretically, and methodologically. At the same time, they introduce and maintain, in LIS, conceptual frames and methodological approaches of their home disciplines which may be much bigger than LIS. With larger resources and associated research potential external disciplines may little by little erode and disintegrate LIS as a discipline. Fuchs (1993) suggests that fragmentation is the typical mode of scientific change in disciplines characterized as fragmented adhocracies like LIS. We conjecture that LIS is in a process of fragmentation, which disconnects IR and scientometrics from it. The dominant contributions of external disciplines in these topics indicate that clearly. These topics likely integrate strongly with external contributing disciplines.

Although the observed contributions occur within the social system of LIS—in LIS journals—cognitively they mostly belong to the external disciplines. In addition, established LIS journals have extended consciously their scope to include articles from interdisciplinary areas related to LIS like Computer Science, Communication, or Management (Castella et al., 2016). A few journals traditionally considered as representing LIS could currently be characterized as representing mainly other disciplines. Thus, also the communication system of LIS shows signs of erosion. It is also possible that the recent trend of merging LIS departments as parts of larger institutions at universities may impair the academic position of LIS. This may occur by reducing the social institutionalization of LIS, for example, by moving its academic posts into adjacent disciplines or merging its doctoral programs with other programs. In all, there are indications of changes in both cognitive and social institutionalization of LIS which likely lead to the decline and fragmentation of the discipline.

Our conjecture about the fragmentation of LIS is based on cross-sectional data. Longitudinal analysis would give a more reliable account on the change dynamics of various disciplinary contributions to LIS. It would also be interesting to know the level of cognitive and social integration within the topical domain of LIS. Is there integration of research foci and goals, or concepts and theories, or do the contributing disciplines play each with their own tools? Coauthorships across disciplines is not a confirmation of cognitive integration, only indicating the possibility. From where do the theoretical and methodological contributions come and where do they go? Is there a tendency toward some type of contributions being more important than others—we have assessed all contributions equal? Has the situation changed toward more or less integration over time? The current data set cannot answer these questions. Signals of (dis)integration could be seen in the cited literature—do the LIS journal articles of different origin but on the same topical area cite the same or distinct literatures?—and the citing literature—do the citing articles of different literatures cite the same or distinct articles of LIS journals?

6 | CONCLUSION

Our results indicate that traditional professional topics are cultivated mostly by LIS scholars, while IR, scientific communication and information seeking are mostly contributed by disciplines external to LIS. There are significant differences between the research topics of LIS research in disciplinary orientations, which also lead to essential differences in research strategies. The contributing disciplines form three topical and methodological clusters: one around traditional LIS and information seeking, another around IR, and the third around scientific communication. The strong differentiation of scholarly contributions in LIS hints to fragmentation of LIS as a discipline.

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APPENDIX A

JOURNAL TITLES IN THE DATA SET

Title	Volumes	No. of articles
ACM Transactions on Information Systems	33(1)–34(1)	27
Aslib Journal of Information Management	67	36
College and Research Libraries	76	57
Information & 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	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	54(3)–55(2)	12
Scientometrics	102–105	345
The Electronic Library	33	70
The Indexer	33	30
Total		1,514

APPENDIX B

CONTENT CLASSES

Research topics by main topic	
I. Research on LIS context	
010	The professions
020	Library history, history of L&I institutions
030	Publishing
100	Education in LIS studies
200	Methodology
300	Analysis of LIS discipline
800	Other aspects of LIS
II. Research on L&I services	
410	Document delivery
420	Collections
430	Information or reference service
440	User education or information literacy
450	L&I service buildings
460	Administration or planning
470	Automation or digital libraries
480	Other L&I services
490	Several interconnected activities
III. Research on information retrieval	
510	Metadata/cataloguing
520	Classification and indexing
531	Text retrieval
532	Retrieval methods in other media
533	Web retrieval methods
534	Social media retrieval

Research topics by main topic	
540	Digital information resources
550	Interactive (user-oriented) IR
560	Other aspects of IR)
IV. Research on information seeking	
610	Information dissemination
620	Use/users of channels/ sources of inform
630	Use of L&I services
641	Task-based information seeking
642	Other type of information seeking
650	Information use
660	Information management
V. Research on scientific and professional comm	
710	Scientific/professional publishing
720	Citation patterns and structures
730	Web-metrics
740	Other aspects of sci/prof communication
[900 study in another discipline—excluded]	
Scholarliness	
0	Not research
1	Research
Viewpoint on dissemination	
10	Several interconnected phases
11	Producer's
12	Seller's (marketer's)
13	Intermediary's
14	Intermediary organization's
15	End-user's
16	End-user organization's
17	Service developer's
18	LIS educator's
19	Other viewpoint
00	No viewpoint on dissemination

Research strategy	
Empirical	
11	Historical
12	Survey
13	Qualitative
14	Evaluation
15	Case study or action research
16	Content or protocol analysis
17	Citation analysis
18	Other bibliometric
21	Secondary analysis
22	Experiment
29	Other empirical strategy
Conceptual	
31	Verbal argumentation
32	Concept analysis
Other nonempirical	
40	Mathematical or logical
50	System analysis and design
60	Literature review
80	Bibliographic
90	Other strategy
00	Not applicable
Data collection method	
10	Questionnaire, interview
15	Harvesting databases
20	Observation
30	Thinking aloud
40	Text/item collection
50	Citation data collection
60	Historical source analysis
70	Several methods of collecting
80	Use of data collected earlier
85	IR experiment
90	Other method
00	Not applicable
Type of investigation	
Empirical	
11	Descriptive
12	Comparative
13	Explanatory
Nonempirical	
20	Conceptual

(Continues)

Type of investigation	
30	Theoretical
40	Methodological
50	System design
Other contributions	
90	Other type
00	Not applicable

APPENDIX C

AFFILIATION-BASED DISCIPLINE CLASSES

Mainclasses and sample subclasses (Chang, 2018)
Business and Economics
Business
Economics
Management
Computer Sciences
Computer Science and Engineering
Information Systems and HCI
Engineering
Engineering
Architecture
Energy
Humanities
Humanities
Literature
Arts
Anthropology
Linguistics
Philosophy and Religion
History
Library and Information Science (LIS)
Documentation
information Science
Library Science
Medicine
Medicine
Nursing
Health Science
Natural Sciences
General Science
Physics
Mathematics
Biology
Agriculture
Chemistry
Zoology
Botany
Social Sciences
Education
General Social Science
Communication
Law
Psychology
Sociology
Political Science
Tourism
Other
Any other non-fitting or unknown discipline