Main Research Methods in Library and Information Science: Understanding, Selecting, and Using Post-prints

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Abstract

[Purpose/Significance] Research methods play a crucial role in academic research. This study identifies the main research methods in the field of library and information science and provides an understanding of them, thereby enabling their reasonable selection and flexible application in research to ensure research quality. [Method/Process] Content analysis was conducted on nearly 2,000 research articles in the field of library and information science and related research method papers. On this basis, the classification and naming of research methods, the identification of main research methods in the library and information science community, their characteristics, and usage considerations are introduced and discussed. [Results/Conclusion] Research methods should be named based on data collection methods rather than data analysis methods. Commonly used research methods in the field of library and information science include the experimental method, questionnaire method, theoretical discussion method, content analysis method, interview method, and bibliometric method, each with its own characteristics. Therefore, when selecting and using them, one should consider not only the specific research topic and the characteristics of the research method, but also the usage considerations, and strive to adopt two or more methods in the same study to leverage strengths and avoid weaknesses, thereby conducting research more effectively.

Full Text

Major Research Methods in Library and Information Science: Understanding, Selection, and Use

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Abstract:
[Purpose/significance] Research methods play a critical role in any scholarly research. It is important to identify major research methods utilized in library and information science (LIS) research, and to become familiar with them so that researchers can choose and employ them properly in their investigations. [Method/process] Based on a content analysis of close to 2000 scholarly documents in LIS as well as related publications on research methods, this study explores the naming of research methods and identification of major LIS research methods with a focus on how to understand, select, and use them in scholarly endeavors. [Result/conclusion] Research methods should be named after data collection techniques instead of data analysis techniques. Major research methods used in LIS include experiment, questionnaire, theoretical approach, content analysis, interview, and bibliometrics. Each method has its own features. Thus, the selection and use of methods in LIS research should be done not only by research questions and method characteristics but also by taking into consideration the dos and don' ts associated with each research method. For the same reason, more than one method generally should be selected and utilized in a single study in order to cancel out the limitations of each chosen method and ultimately ensure the quality of research.

Keywords: information management; research method naming; research method selection; research method utilization; research quality evaluation

1. Basic Composition, Classification, and Overview of Research Methods

Any scientific research must employ certain methods to collect and analyze data, and library and information science research is no exception. Research methods consist of data collection and data analysis techniques, both of which can be further subdivided. Data collection methods typically include questionnaires, interviews, experiments, content analysis, and bibliometrics, among others. Data analysis methods can first be divided into quantitative and qualitative categories, with each category further subdivided in greater detail. Quantitative data analysis is synonymous with statistics and includes numerous analytical techniques (such as frequency, variance, and regression analysis). In contrast, qualitative data analysis methods (such as annotation-coding, comparison, induction, and abstraction) are relatively few in number. Because an extended discussion of data analysis methods falls beyond the scope of this paper, we will only note that quantitative analysis is used for analyzing numerical data (such as age and library collection size), while qualitative analysis is used for analyzing textual data (such as suggestions for improving information services).

Since research methods include both data collection and data analysis components, how should they be classified and named? Based on observation and research [1-2], research methods should be named according to data collection techniques rather than according to quantitative or qualitative categories of data analysis techniques. This is because: First, "quantitative" or "qualita-

tive" refers only to the type of data collected, whereas the same data collection method, while having certain tendencies in the type of data it collects, can often be used to collect both quantitative numerical data and qualitative textual data. For example, as a data collection method, questionnaires are primarily used to collect numerical data but can also collect textual data through open-ended questions. Similarly, interviews are mainly used to collect qualitative data but can also obtain quantitative data through appropriate interview questions. Therefore, inappropriately labeling a questionnaire as a quantitative research method overlooks its capability to collect qualitative data. Second, any research project first collects data and then decides on the appropriate analysis method based on the collected data type, which suggests that naming research methods after data collection techniques is more logical. Third, compared to the three top-level categories of data analysis methods (quantitative, qualitative, and integrated), data collection method names are more direct and clear. Naming research methods as quantitative or qualitative is evidently insufficiently explicit, while naming them after specific data analysis techniques (such as variance analysis or factor analysis) would result in too many categories with inevitable overlaps. Incidentally, while the academic community commonly uses "mixed" rather than "integrated" to refer to the third type that employs both quantitative and qualitative methods in data analysis, I argue that data analysis methods, like data collection methods, should be carefully selected rather than simply mixing certain methods together. Finally, naming research methods after data collection techniques helps determine whether a particular approach qualifies as a research method: if a method (such as experiment) can be used to collect data, it is a research method; otherwise, it is not. For example, is case study a research method? Case study only indicates that the sample size is one or a few cases and does not specify which method is used to collect data. In other words, any case study must employ some method to collect data; therefore, it is not a research method itself.

Table 1 presents an overview of research methods named according to data collection techniques, showing the results of analysis, synthesis, and organization of relevant studies and nearly 2000 LIS research papers [2]. In Table 1, except for the last category "other methods," the research methods are arranged in alphabetical order by their English names.

2. Major Research Methods in Library and Information Science

Foreign researchers have examined the research methods employed in LIS over the past 30 years. Table 2 summarizes representative findings from relevant studies.

As shown in Table 2, questionnaires have consistently been the most commonly used research method in LIS over the last three decades, followed by interviews and experiments. Bibliometrics has also been increasingly adopted in the field. Additionally, H. Chu [1] and H. Chu & Q. Ke [2] conducted a content analysis

of 1,981 research articles published between 2001 and 2010 in *Journal of Documentation* (JDoc), *Journal of the American Society for Information Science & Technology* (JASIS&T; the American Society for Information Science and Technology was renamed the Association for Information Science and Technology in 2012), and *Library & Information Science Research* (LISR), identifying the five most frequently used research methods in each journal, as shown in Table 3 .

Clearly, the most commonly used research methods vary across these journals. However, four methods appear in the "top five"list for every journal: experiment, questionnaire, content analysis, and theoretical approach. Bibliometrics ranks second only in JASIS&T, while interview appears as the third and fifth most common method in LISR and JDoc, respectively. It must be noted that because an increasing number of researchers employ two or more data collection methods in a single study, and H. Chu [1] and H. Chu & Q. Ke [2] counted each method separately, the percentage totals in Table 3 may exceed 100.

Combining the results from Tables 2 and 3 reveals that the commonly used research methods in LIS are essentially experiment, questionnaire, theoretical approach, content analysis, interview, and bibliometrics. Historical research has gradually become an uncommon method in LIS over time.

3. Characteristics of Major Research Methods in Library and Information Science

Having identified the major research methods in LIS, we can examine their respective characteristics to inform researchers' method selection.

3.1 Characteristics of the Experimental Method

The experimental method is primarily used in information science, such as for evaluating information systems, new technologies, or processes. It includes two major types: (1) Classical experimental design, which comprises elements such as random sampling and assignment of subjects, comparison between experimental and control groups, pre-testing, introduction of independent variables, and post-testing; and (2) Non-classical experimental design, which includes only some of these elements. Quasi-experiments contain at least one experimental element, while pre-experiments contain at most one such element.

Experiments can be conducted in laboratories or in the field, though laboratory experiments, mostly non-classical, predominate in our field. Compared to other methods (such as questionnaires), experiments are relatively costly to implement, even for laboratory-based non-classical designs. Experiments often employ questionnaires or interviews for pre- and post-testing and use observation and think-aloud methods to collect data. Data collected through experiments can be analyzed using both quantitative and qualitative methods.

3.2 Characteristics of the Questionnaire Method

The questionnaire method requires using a prepared questionnaire to collect data. Researchers can either develop their own questionnaire or adapt one created for other research purposes. The former approach is time-consuming but necessary when no existing questionnaire is available, while the latter is more efficient provided the adopted questionnaire is similar to one' s research topic, permission is obtained from the original author, and appropriate acknowledgment is made in the final report.

Question items constitute the main part of any questionnaire, typically consisting primarily of closed-ended questions with occasional open-ended questions. Because questionnaires mainly collect data through closed-ended questions, quantitative analysis methods are predominantly used. If multiple open-ended questions are needed, researchers should consider using interviews instead, as respondents often do not provide detailed answers to open-ended questions in questionnaires.

The greatest advantage of the questionnaire method is its ability to reach large numbers of respondents regardless of time and location constraints. The emergence of dedicated questionnaire websites (such as Wenjuanxing) has significantly reduced the cost and time required for distribution and collection. However, compared to interviews, questionnaires have limitations including poorer targeting, low response rates, inability to obtain in-depth data, and lack of real-time interaction with respondents. These issues warrant attention and should be addressed through measures such as designing concise and clear questionnaires and providing respondents with appropriate material or spiritual incentives to encourage completion.

Additionally, questionnaires are often used together with interviews to comprehensively collect quantitative and qualitative data about a research problem. Questionnaires can also be used for pre- and post-testing in experiments and are indispensable data collection tools for the Delphi method.

3.3 Characteristics of the Theoretical Approach

The theoretical approach focuses on abstract analysis and discussion of concepts and theories, model construction, or theory development. It employs reasoning, induction, comparison, and deduction to achieve research purposes without involving extensive empirical data collection. It shares some similarities with latent content analysis (mentioned below), but its emphasis is on analyzing, exploring, or proposing concepts, theories, or models. A conceptual discussion of the pros and cons of open access serves as an example. Additionally, models developed through analysis and synthesis of others' research (such as information-seeking behavior models) also fall under the theoretical approach.

Unlike other research methods, the theoretical approach has no fixed procedure; each study determines its specific implementation steps according to the research

problem, though qualitative methods are typically used to analyze corresponding textual data. Precisely because of this, there is no specialized literature on the theoretical approach for novice researchers to study, nor are there widely accepted evaluation criteria for its appropriate use. Despite the lack of consistent naming in academia, we should not confuse the theoretical approach with literature reviews, as theoretical approach research must propose and explore research questions, whereas reviews only summarize and evaluate relevant research without presenting their own research questions. Influenced by research traditions on theoretical topics and issues, LIS scholars in China and European countries employ the theoretical approach more frequently than researchers in other countries.

3.4 Characteristics of Content Analysis

Content analysis collects data through systematic and objective analysis of textual content (such as comparison, abstraction, and induction), making it an integrated research method where data collection and analysis are inseparable. Specifically, it can be divided into manifest content analysis (such as article authors) and latent content analysis (such as article topics). The former is straightforward and easy to implement, while the latter is more difficult to use, prone to incorporating subjective bias.

The units of analysis in content analysis are typically textual information such as words, sentences, paragraphs, and chapters, with analytical techniques primarily consisting of qualitative methods like open coding supplemented by quantitative analysis (such as frequency and percentage). Given the nature of content analysis, its procedural steps have no fixed pattern, and the analytical process generally needs to be repeated one or more times to obtain high-quality data and results. Furthermore, content analysis must consider inter-coder consistency, which refers to both consistency by the same researcher at different times and consistency among different coders.

In recent years, an increasing number of LIS researchers have adopted content analysis. As mentioned earlier, content analysis can also be used independently as a data analysis method, as in the analysis of interview transcripts and observational content.

3.5 Characteristics of the Interview Method

The interview method collects data through question-and-answer sessions with research subjects. Based on the degree of preparation of interview questions, interviews can be classified as structured, semi-structured, or unstructured. Structured interviews involve completely prepared questions with predetermined sequencing, making them similar to questionnaires except that question-and-answer occurs orally. Unstructured interviews involve no specific question preparation; researchers only think broadly about potential topics based on familiarity with the research problem and pose specific questions in

real-time during the interview. Semi-structured interviews fall between these two extremes, allowing researchers to prepare some questions while also posing follow-up questions as needed during the interview to obtain richer and more targeted data. Among these three types, semi-structured interviews are most commonly used in LIS.

Unlike questionnaires, interview questions are mostly open-ended and can incorporate follow-up questions to target detailed, in-depth qualitative data about the research topic. Additionally, interviews can collect body language data or gather information from subjects who cannot write (such as children or illiterate individuals). However, interviews are relatively costly, thus limiting the number of participants. Interview quality is affected by both the researcher' s interviewing skills and experience and by subjects' potential unnaturalness induced by the interview situation.

As a research method, interviews are frequently used together with questionnaires to leverage their respective strengths and compensate for weaknesses. Interviews are sometimes also used in experiments and field studies. Generally, few studies in LIS use interviews as the sole data collection method.

3.6 Characteristics of Bibliometrics

Bibliometrics achieves research purposes through analysis of bibliographic data (i.e., citation and publication data), primarily focusing on citation data with publication data as supplementary. This method must rely on citation databases (such as CSCI-China Science Citation Index, CSSCI-Chinese Social Sciences Citation Index, Scopus, and Web of Science) to collect data, though these databases have inevitable limitations in coverage and scope.

Compared to questionnaires and interviews, citation data are generated during the process of academic writing, offering objectivity and avoiding human factors (such as deliberate presentation during interviews) that may affect other data collection methods—a feature much appreciated by researchers. Data collected through bibliometrics can be used for in-depth quantitative analysis and some qualitative analysis. However, the uncertain purposes of citations and over-interpretation of citation data can affect research validity.

In the past decade, domestic LIS researchers have employed bibliometrics with extreme frequency. Bibliometrics can be used independently but also in combination with other methods (such as questionnaires and interviews).

4. Selection of Research Methods in Library and Information Science

The main bases for selecting research methods are threefold: the research problem, characteristics of the methods, and reference to methods used in related studies. These three selection criteria are broadly applicable to LIS and other research fields. Since research methods refer to data collection and analysis

methods, when selecting methods for our research, we must first consider what data can answer the proposed research questions. For example, if a study aims to explore various factors affecting information behavior, data should be collected about information behavior (such as information source selection, information searching, and evaluation of retrieved results) and related factors (such as age, gender, and information accessibility).

Additionally, we can reference data collection methods used in other related studies. Given the relevance of research topics, there should be referential value in their methods. If after consideration, a method used in previous research seems appropriate, we can adopt the same method in our own study. If related studies provide corresponding data collection instruments (such as questionnaires or interview questions, observation guidelines), with the researchers' permission and after appropriate modification and supplementation, we can use them for our own purposes. This saves the cost of developing new data collection instruments and ensures their validity since they have been validated in other studies.

Because each individual research method has its limitations, we should select two or more methods according to our needs to comprehensively collect data while enabling the chosen methods to compensate for each other' s weaknesses. Then, based on the collected data, we determine the appropriate data analysis methods. Generally, numerical data are analyzed using quantitative methods, and textual data using qualitative methods. The selection of specific data analysis methods falls beyond the scope of this discussion.

5. Using Research Methods in Library and Information Science

5.1 Preparations for Using Research Methods

5.1.1 Familiarizing Yourself with Selected Research Methods In most cases, researchers are already in the workplace when conducting research. Moreover, even if they have the opportunity to take research methods courses, they cannot learn about their chosen methods in detail due to course focus and scope limitations. Therefore, a strategy of self-study supplemented by formal education (such as attending specialized lectures) is more appropriate for familiarizing oneself with selected research methods. Simultaneously, we should read relevant research reports to understand their experiences and lessons in using certain methods, thereby learning about precautions in method use and avoiding repeating others' mistakes.

5.1.2 Selecting and Determining Data Sources Some research methods must collect data through subjects, such as questionnaires and interviews. Other methods may not involve people and can obtain data directly from other sources. Among commonly used LIS methods, content analysis and bibliometrics fall into this category. Content sources for content analysis can be formal publications (such as academic literature) or other information resources (such as social me-

dia), with researchers selecting appropriate data sources and units according to their needs. Using academic literature as an example, data units can be full texts, titles, chapter headings, or theories mentioned and research methods used in the literature (such as in H. Chu & Q. Ke [2]). Data sources for bibliometrics are relatively determined, with domestic citation databases including CSCI and CSSCI, and international databases including Scopus and Web of Science. Additionally, Baidu Scholar, Google Scholar, and some specialized databases also provide citation data, though these are slightly inferior to dedicated citation databases in terms of authority and comprehensiveness.

5.1.3 Sampling and Selecting Research Subjects Research subjects here refer both to participants (subjects) and data sources such as literature, citations, and social media information. Considering time and economic factors, we often need to sample research subjects. Although there are many specific sampling methods, they can be broadly divided into two categories: random and non-random sampling. While we will not discuss specific sampling methods here, we must remember that when conditions permit, random sampling should be used as much as possible to allow research results to be generalized to the population from which the sample was drawn—that is, to ensure external validity. Otherwise, research results cannot be generalized or lack external validity.

5.1.4 Preparing Required Data Collection Instruments Among LIS research methods, questionnaires for the questionnaire method, experimental designs for the experimental method, coding schemes for content analysis, and interview questions for the interview method all require preparation as data collection instruments. If data collection instruments are self-developed rather than adopted from other studies, they should be pre-tested after preparation to ensure they can collect the data planned in the research design. Pre-testing generally involves inviting 2-3 qualified subjects to complete the instrument, then revising and improving it based on their feedback.

Although the above preparations are presented in sequence, in actual research, the order of completing these steps can be adjusted as needed.

5.2 Precautions in Using Research Methods

The previous subsection discussed some common points about using research methods when addressing preparations. Additionally, for all methods involving human subjects (such as questionnaires and interviews), participants should be given appropriate material or spiritual encouragement (such as providing academic participants with summaries of research findings), and promises must be fulfilled to ensure research integrity. This subsection discusses specific precautions for commonly used methods in LIS. Given that the theoretical approach has no fixed procedures, it will not be discussed here.

5.2.1 Precautions for Using the Experimental Method As previously mentioned, experiments are divided into classical and non-classical designs. When possible, researchers should adopt classical experimental design. If classical design is not feasible, they should incorporate as many experimental elements as possible to ensure experimental rigor. They should also maintain authenticity and naturalness in the experimental environment and use multiple methods to collect various data generated during the experiment, including pre-test and post-test results. Simultaneously, they should control factors affecting internal validity (such as history, maturation, testing, instrumentation, and sampling bias) and external validity (such as reactivity, Matthew effect, and interactions among multiple factors). They must avoid any bias in experimental design itself and prevent external interference during the experimental process.

5.2.2 Precautions for Using the Questionnaire Method The questionnaire method consists primarily of questionnaire items. Before the questions, a sincere and clear introduction or cover letter should be prepared to explain the research purpose, invite participation, guarantee that collected data will be used only for research purposes, and ensure anonymity and confidentiality. Questionnaires should be prepared in language that matches respondents' habits and levels. Questions should be arranged with logical coherence, ensuring clarity, accuracy, and consistency. For questions that are not immediately clear, instructions on how to answer should be provided. Additionally, researchers should avoid question skipping, overly complex wording, leading or intimidating questions, double-barreled questions, and questions requiring recall or memory (such as "How many times did you visit the library in the past year?"). Appropriate font size and spacing should be used. After distribution, follow-up is necessary to determine whether redistribution is needed to ensure adequate response rates. Generally, response rates are 20% for humanities and social sciences and 50% for natural sciences.

5.2.3 Precautions for Using Content Analysis Implementation of content analysis must be based on familiarity with the content to be analyzed and selection or development of a content analysis coding scheme. Then, according to research needs, conduct analysis of corresponding content types (such as words, co-words, sentences, paragraphs, and chapters). If developing a coding scheme, it should be refined during the content analysis process. Whether conducting manifest or latent content analysis, appropriate analytical methods (such as comparison, abstraction, and induction) should be flexibly selected, with corresponding measures taken to ensure quality and consistency.

Common measures include: (1) Ensuring thoroughness and persistence in content analysis to achieve comprehensive, exhaustive analysis and obtain all necessary data; (2) Exchanging content analysis results with peers to solicit suggestions for improvement; (3) Using exclusion methods to remove impurities and noise from data sources, eliminating content unrelated to research needs; (4) Employing split-half methods by dividing analysis content into two parts, ana-

lyzing each separately, comparing results, and improving quality; (5) Frequently comparing and revising content analysis results during the process to maintain quality.

Additionally, at the beginning of data collection, 20-30 samples should be extracted from the data source, divided into two parts, and analyzed separately. A simple percentage method can then compare consistency between the same researcher' s analyses. If two or more researchers conduct content analysis, the same method can assess inter-coder consistency. According to K. A. Neuendorf [11], content analysis results with consistency above 80% are acceptable to most researchers, while those above 90% are acceptable to all researchers. In other words, when assessing content analysis consistency, we should aim for at least 80% consistency, preferably 90%. If consistency falls below 80%, researchers must improve their content analysis procedures before continuing data collection.

5.2.4 Precautions for Using the Interview Method Since interviews collect data through direct, real-time conversation with subjects, researchers must make adequate preparations beforehand, such as selecting a natural and comfortable location (like the interviewee' s office) and preparing audio/video recording equipment. Appropriate attire, demeanor, and communication style are also important.

Before formal interviews, researchers should briefly introduce the interview purpose and duration, guarantee that collected data will be used only for research, and ensure anonymity and confidentiality. During interviews, researchers should take advantage of real-time interaction to collect data including body language, pose follow-up questions based on responses to gather relevant data, and remain focused, attentive, and patient—avoiding checking watches or looking out windows to ensure subjects answer questions seriously and candidly. Interview language should be conversational, discussions should stay on topic, and body language (such as nodding) should be used to affirm and encourage subjects to speak freely. Finally, interviews should be completed within a predetermined time (such as 30 minutes), as overly long interviews only fatigue subjects without yielding better data.

5.2.5 Precautions for Using Bibliometrics The quality of bibliometric data depends heavily on the quality of citation data itself. Therefore, reliable and comprehensive specialized citation databases (such as CSCI and CSSCI) should be selected, supplemented by other platforms containing partial citation data (such as Baidu Scholar). Citation data are generally voluminous, so random sampling should be considered to collect representative and moderate amounts of data. Simultaneously, collected citation data should span a certain time period and maintain adequate volume.

When analyzing citation data, context and other relevant data must be considered—citation data should never be used in isolation. Attention should be

paid to self-citation rates, avoiding use of only first authors and striving to consider all authors of each publication. Additionally, citation frequency should be treated as only a rough indicator of literature quality rather than the sole metric, avoiding over-interpretation of citation data or treating all citations as equal.

6. Evaluating Research Method Use

To ensure research quality, research method selection and use must also be evaluated, with reasonableness of method selection and replicability of method use serving as primary evaluation indicators. Reasonableness of method selection depends on two factors: (1) whether the selected method is appropriate for collecting needed data, and (2) whether the collected data can answer the research question. Affirmative answers to both questions indicate reasonable method selection. The second point precisely defines internal validity. External validity, in contrast, is relatively straightforward: any study using random sampling produces results with external validity, meaning findings apply not only to the sample but also to the population from which it was drawn.

Replicability of method use measures research reliability. If others conducting research on the same topic using identical procedures obtain similar results, this confirms the study' s reliability. Therefore, based on ensuring reasonableness of method selection, research reports should accurately and thoroughly describe method procedures (including data collection instruments and specific data analysis methods) to enable others to replicate the study and ensure reliability.

Clearly, research methods play a crucial role in scholarly research. Comprehensively understanding and becoming familiar with commonly used methods in LIS is a prerequisite and guarantee for conducting research smoothly and effectively. We should select appropriate methods based on research problems and method characteristics, consider using two or more methods in the same study to leverage their respective strengths, and pay attention to relevant considerations in method design and implementation to ensure research validity and reliability.

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Note: Figure translations are in progress. See original paper for figures.