



Applications of meta-analysis to library and information science research: Content analysis



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ABSTRACT

Content analysis was conducted to provide a framework for studying the current state of and problems in the application of meta-analysis in the field of library and information science (LIS). The content of 35 meta-analysis application articles published in LIS-oriented journals was analyzed for their bibliometric information, reasons for conducting a meta-analysis, literature searches, criteria for selecting studies, meta-analysis procedures, quality control mechanisms, and results. Although meta-analysis appears to be underappreciated in the LIS domain, the findings demonstrate that meta-analysis holds strong prospects as an LIS research method. However, there are a number of problems that must be solved, one being the misunderstanding of meta-analysis as compared with other similar systematic review methods. Suggestions are offered for developing meta-analysis. An informed understanding of the role of the meta-analysis method in LIS will be helpful for future research and practice.

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1. Introduction

The science of research synthesis is rapidly evolving, and the methods employed for integrating research and the evaluation of data, such as meta-analysis, narrative review, meta-synthesis, systematic review, and Cochrane review, have been evolving over time. Meta-analysis is considered to be a useful technique to review a pool of scientific findings on the same topic. In *Medical Subject Headings*, the [National Library of Medicine \(NLM\) \(2014\)](#) defines meta-analysis as a quantitative method of combining the results of independent studies (usually drawn from the published literature) and synthesizing summaries and conclusions; this method can be used to evaluate therapeutic effectiveness, plan new studies, and achieve other appropriate goals. In the social sciences, [Glass \(1976\)](#) was the first author to coin the term meta-analysis, saying that

meta-analysis refers to the statistical analysis of a large collection of analysis results from individual studies for the purpose of integrating the findings. It connotes a rigorous alternative to the casual, narrative discussions of research studies, which typify our attempts to make sense of the rapidly expanding research literature. (p. 3).

At about the same time, [Rosenthal \(1976\)](#) independently engaged in a similar discussion on this methodology. Both of their publications are widely cited in the meta-analysis literature now.

Narrative review, by contrast, is a qualitative technique. [Hunter and Schmidt \(1990\)](#) discussed the limitations of narrative review (such as the absence of a rigorous technique). [Glass, McGaw, and Smith \(1981\)](#)

presented some narrative review examples in which multiple reviewers had reached different conclusions with the same set of primary studies. The superiority of the meta-analysis method over narrative review is that more valid inferences can be drawn from meta-analysis ([Hunter & Schmidt, 1990](#)). Meta-synthesis of qualitative research is a parallel technique to meta-analysis of quantitative research but has important differences ([Walsh & Downe, 2005](#)). [Urquhart \(2011\)](#) thought that in the social sciences, synthesis was a better descriptor for the process as applied in qualitative research and the term meta-synthesis is used to distinguish this from quantitative meta-analysis. Meta-synthesis may also be used to integrate the findings from quantitative and qualitative studies.

Although many people use the term meta-analysis interchangeably with systematic review, strictly speaking, a meta-analysis is an optional component of a systematic review ([Green, 2005](#)). As [McGowan and Sampson \(2005\)](#) explain, systematic review is a review that uses systematic and explicit methods to identify, select and critically appraise relevant research and to collect and analyze data from the studies that are included in the review. The *Cochrane Handbook for Systematic Reviews of Interventions* ([Higgins & Green, 2011](#)), which provides advice to authors for the preparation of Cochrane reviews, includes a guide on meta-analysis. The *Handbook* states that meta-analysis can provide more precise estimates of the effects of health care than those derived from the individual studies included within a review. Meta-analysis also facilitates investigations of the consistency of evidence across studies and the exploration of differences across studies.

The main focus of this study is the application of meta-analysis to library and information science (LIS) research, in which, in fact, few studies have been reported. In a literature search on the Scopus database for publications with the title terms “meta analy*” or “meta-analy*” from all

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of the years through 2013, 1744 articles were retrieved under the social science category, and the top five subjects within the social science category were psychology (551), medicine (462), health professions (157), arts and humanities (128) and nursing (105). Clearly, meta-analysis is undervalued in LIS.

2. Problem statement

On the one hand, meta-analysis has been used to study a wide range of topics and has been supported by many scientific communities and scholars in the social sciences. On the other hand, LIS researchers appear to be hesitant to import this useful method into their studies.

Progress in the sciences and social sciences is cumulative and is made based on multiple previous investigations. If the meta-analysis method can be widely applied in LIS, it will potentially increase the impact of multiple individuals' past work and provide impetus for the development of the discipline and applications of LIS research. Scholars may wonder whether this method is suitable for LIS research applications because it is still not widely used in this domain. The identification of the current status and problems of the application of meta-analysis in LIS can help scholars to perceive the benefits of the method. In addition, the present study investigates the reasons for using meta-analysis among those scholars who have applied it in LIS, and describes the results and benefits.

The following questions guide this study:

- (1) What is the current state of the application of meta-analysis in the field of LIS?
- (2) What are the main problems with the application of meta-analysis in LIS?
- (3) How might LIS scholars be encouraged to perform meta-analysis studies?

3. Literature review

3.1. General aims and objectives of meta-analysis

Many factors may motivate researchers to undertake a meta-analysis. The *Cochrane Handbook* (Higgins & Green, 2011) summarizes five overarching aims of Cochrane review: to resolve conflicting evidence, to address questions where clinical practice is uncertain, to explore variations in practice, to confirm the appropriateness of current practice, or to highlight a need for future research. Though the *Handbook* focuses on health intervention, it describes the general aims and objectives of conducting a meta-analysis.

Scholars have discussed the advantages or benefits of performing meta-analysis in LIS research. Ankem (2005) summarizes two advantages: to allow more precise results and to increase power. Saxton (1997) explains that the benefit of meta-analysis is to obtain a greater understanding by comparing a large body of research. McGowan and Sampson (2005) consider that meta-analysis can help practitioners and decision makers keep abreast of the literature because the method summarizes large bodies of evidence and helps to explain apparently different results among studies addressing the same question. Bornmann, Mutz, Hug, and Daniel (2011) claim five advantages:

Firstly, it allows generalized statements on the strength of the effects (here: correlations), regardless of the specificity of individual studies. Secondly, it presents findings of the original studies in a manner that are more sophisticated than the usual literature reviews that heavily rely on qualitative summarizing with no respect, for instance, to sample sizes of the primary studies. Thirdly, it is capable of revealing relationships that are obscured in traditional summarizing reviews. Fourthly, it provides a systematic way of getting information from a large number of study findings. Fifthly, it is a widely accepted method

to systematically summarize information of primary studies, especially in social sciences and medicine ("evidence based medicine"). (p. 347).

3.2. Methods used for meta-analysis

The general method for meta-analysis in the *Cochrane Handbook* (Higgins & Green, 2011) is made up of the following eight steps: defining the review question and developing criteria for including studies, searching for studies, selecting studies and collecting data, assessing risk of bias in included studies, analyzing data and undertaking meta-analysis, addressing reporting biases, presenting results and "summary of findings" tables, and interpreting results and drawing conclusions. Similar methods are described in the LIS literature for conducting meta-analysis. Trahan (1993) summarizes the common elements: a research question of interest, on which a large quantity of experimental data has accumulated, is identified; an exhaustive literature search is performed to locate the experimental studies on the topic; the studies are analyzed and coded for their various methodological features; effect sizes are computed from the reported numerical results of the studies and these findings are combined to produce an overall result; and finally the results are then analyzed on the basis of the coded study features to determine whether any of these features had a consistent effect on the study outcomes. Saxton (1997) identified the process for quantitative synthesis across the studies as requiring three steps: homogeneity testing, calculating and combining the findings, and significance testing. The calculation and combining process is the central core of conducting the meta-analysis. Ankem (2005) described the following process for conducting meta-analysis: location of relevant studies through computer and manual searches; data abstraction, described as "the most tedious part... Not only is it required that the same variables are measured across studies but the variables must be measured consistently in comparable units for meaningful amalgamation to take place in the meta-analysis (p. 11); entering the statistics that were gathered across the studies that represent each relationship into the analysis to test the respective aggregate relationship; and finally, conducting homogeneity tests to explore any effect size heterogeneity."

In these different descriptions of meta-analysis, some common steps are emphasized. These include the identification of the studies, the calculation of the effect size, and homogeneity testing. McGowan and Sampson (2005) give a systematic review of the methods, skills, and knowledge of expert searchers working on systematic review teams, which is very relevant to the searching and identification of the studies in meta-analysis studies. Some of the literature on meta-analysis focuses on the effect size calculation. Three approaches to calculate the meta-analysis effect size were compared by Ankem (2005): the Hedges and Olkin approach, Rosenthal and Rubin approach, and Hunter and Schmidt approach. These are the most cited meta-analysis calculation approaches in the recent literature. Lyons (1998) suggests that there are two methods: one is the combination of probability values or z scores, while the second is the combination of the effect size, such as Cohen's *d* and correlation coefficients. Hameed, Counsell, and Swift (2012) state that the procedure involves accumulating the effect size across studies, combining and evaluating them to obtain an average effect size. In general, it can be said that LIS authors follow the basic guideline of conducting a meta-analysis that is provided by Glass (1976) and Rosenthal (1976).

3.3. Difficulties in meta-analysis and possible measures

Some common methodological difficulties are also reinforced by LIS scholars, including publication bias (He & King, 2008; Hjørland, 2001; Saxton, 2006), inconsistent reporting findings (Ankem, 2005; Saxton, 1997), different operational definitions or measures (Saxton, 1997, 2006), heterogeneity of effect sizes (Ankem, 2005), and small sample sizes (Ankem, 2005).

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