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State of the art review

Mixed methods research in library and information science: A methodological review

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ABSTRACT

Mixed methods research is gaining prominence in the library and information science (LIS) discipline. However, according to previous analyses, few LIS studies utilized mixed methods research, and the researchers did not recognize or describe them as such. The present methodological review assesses the current state of mixed methods research in LIS. Eighty-four articles published between 2017 and 2018 and indexed in two core LIS databases, match the common definition of mixed methods. Out of those, 65 articles self-identified as mixed methods were analyzed focusing on reporting and conduct, specifically, the integration of quantitative and qualitative components. Review results suggest that more efforts are needed to raise awareness about using and reporting mixed methods research in LIS. This review provides guidance for future work and contributes to the discussion on how we can further improve methodological rigor, research training, and reproducibility in LIS.

1. Introduction

Qualitative and quantitative research methodologies and methods are often contrasted and presented as two opposite entities. However, many researchers have been interested in combining qualitative and quantitative methods to enhance the breadth and depth of understanding of a phenomenon and the corroboration of knowledge (Johnson, Onwuegbuzie, & Turner, 2007). The integration of qualitative and quantitative methods refers to mixed methods research, which has seen prominent expansion since the early 2000s, though its history can be traced back to the 1950s (Creswell & Plano Clark, 2018; Pluye, 2012). Mixed methods research is defined as a "type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches" (Johnson et al., 2007, p. 123). Today, mixed methods research has become popular in several disciplines such as health (Creswell, Klassen, Plano Clark, & Smith, 2011) and social sciences (Tashakkori & Teddlie, 2010).

Mixed methods research has evolved considerably in the last decade, with a growing and active community of researchers and practitioners interested in this approach. For example, the Mixed Methods International Research Association (MMIRA) was officially launched in 2013 and has been organizing annual regional and biannual global conferences since then. The number of empirical and methodological articles, as well as textbooks is also on the rise (Creswell & Plano Clark, 2018).

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The methodologies and methods used in library and information science (LIS) have evolved as well (Chu, 2015; Ullah & Ameen, 2018). Although mixed methods research is seen as potentially useful, the discussion of mixed methods in LIS remains limited (Ma, 2012). Fidel (2008) said that "mixed methods research - which integrates qualitative and quantitative methods in one study to improve the study's quality - is not common in LIS and has not been discussed in its literature" (p. 265). Mixed methods were not mentioned in methodological textbooks in LIS until recently (Fidel, 2008; Ma, 2012). In the 2013 edition of Research Methods in Information, Pickard stated: "although none of the reviews of the first edition of this text mentioned the omission of mixed methods, I feel it is probably useful now to include some discussion here to ensure new researchers are exposed to all possible approaches" (Pickard, 2013, p. 18). More than ten years have passed since the publication of Fidel's (2008) seminal analysis of mixed methods research in LIS. The present methodological review aims to extend the work of Fidel (2008) and describe how mixed methods research has been applied and reported in LIS more recently.

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2. Problem statement

In this methodological review, the analysis focused on how recent mixed methods research studies in LIS are conducted and reported in journal articles. The specific research questions are: (a) How many articles described as using quantitative and qualitative methods, indexed in two core LIS databases, match the most common definition of mixed methods? In articles self-identified as mixed methods, (b) what terminology is used to designate mixed methods research? (c) what methodological works on mixed methods are referenced? (d) what mixed methods designs are used? (e) how are the mixed methods reported? (f) what integration strategies are used?

The justification for the present review is two-fold. First, more than ten years ago Fidel asked, "Are we there yet?" It is thus valuable to ask, "Where are we now?" especially, considering the growing interest in mixed methods research across academic fields. For example, is the use and discussion of mixed methods in LIS research still limited? Second, there is new 'general' knowledge on mixed methods research (i.e., not field specific), such as reporting guidelines (O'Cathain, Murphy, & Nicholl, 2008) and a typology of integration strategies (Pluye, Garcia Bengoechea, Granikov, Kaur, & Tang, 2018). This methodological review is the first to bring reporting guidelines and a typology of integration strategies to the field of LIS by applying them in analysis of mixed methods articles. Ultimately, the goal of the present review is to examine the current state of mixed methods research in LIS and to continue the conversation, encouraging LIS researchers, practitioners, and students to conduct rigorous mixed methods studies and report them in an explicit and transparent manner, which will facilitate scientific peer-review and reproducibility.

3. Mixed method research

When conducting and reporting mixed methods research, three key elements need to be considered (Creswell & Plano Clark, 2018). First, a mixed methods study should have at least two methodological components, one qualitative and one quantitative. Each component refers to at least a specific research question/objective, a research design, and techniques for collecting and analyzing data (Pluye & Hong, 2014).

Second, it is recommended to use a mixed methods study design to plan and organize the procedures (Creswell & Plano Clark, 2018). Several mixed methods designs have been developed. Creswell and Plano Clark (2018) suggest that mixed methods have developed differently across disciplines, influencing the popularity of different mixed methods research designs. Creswell and Plano Clark (2018) propose three core mixed methods designs (convergent, sequential explanatory, and sequential exploratory), which differ based on their intent, sequencing, and point of interface.

On one hand, a convergent design usually aims to enhance understanding of a phenomenon (often represented as 'QUAN+QUAL'). To achieve this aim, the data collection and analysis of both components are usually (but not necessarily) performed concomitantly and are usually (but not necessarily) independent from each other. The point of interface occurs during or after the data collection and analysis of both components.

On the other hand, sequential designs are usually used to explain or explore a phenomenon. These designs include at least two phases, while the order of the phases can vary. In the sequential explanatory design, the quantitative phase is performed first, and its results inform the qualitative phase (QUAN \rightarrow QUAL). In the sequential exploratory design, the quantitative phase builds on the results of the qualitative phase (QUAL \rightarrow QUAN). The point of interface in sequential designs occurs between and after the phases; the results of one phase inform the data collection and analysis of a second phase (Creswell & Plano Clark, 2018).

Third, the integration of the qualitative and quantitative components is crucial in mixed methods research. Several strategies have been developed to help researchers carry out integration in mixed methods research (Fetters & Freshwater, 2015; Guetterman, Fetters, & Creswell, 2015). Building upon the literature on integration (Greene, 2007; O'Cathain, Murphy, & Nicholl, 2010; Tashakkori & Teddlie, 2003, 2010; Teddlie & Tashakkori, 2009), Pluye et al. (2018) developed a conceptual framework of integration strategies and tested it using 93 health-related mixed methods studies published in 2015. This framework suggests three main types of integration: (a) connection of phases, (b) comparison of results, and (c) assimilation of data.

For each type, three specific strategies were found. In the first integration type, the connection of phases occurs either between the results of a qualitative phase and the subsequent data collection of a quantitative phase, or between the results of a quantitative phase and the subsequent data collection of a qualitative phase. A special case of connection of phases occurs when the results of one phase inform the reanalysis of data from the other phase (a strategy called 'follow a thread'). The second type of integration strategy consists in comparing results obtained either from separate or interdependent data collection and analysis. Comparison can also occur when there are divergences between quantitative and qualitative results. In the third integration type, the data are assimilated either by transforming qualitative data into quantitative data (quantitizing) or quantitative into qualitative (qualitizing), or by merging both types of data together (case by case).

How research studies are reported is fundamental to assessing their quality and allowing reproducibility. Based on a documentary analysis of 75 mixed methods studies in health services research and methodological publications on the quality of the reporting of mixed methods studies, O'Cathain et al. (2008) proposed six recommendations in the 'Good Reporting of a Mixed Methods Study' (GRAMMS) guidelines. GRAMMS recommends to describe: (a) the justification for using mixed methods to answer the research question; (b) the research design, including the purpose, priority and order of methods; (c) each method, including the sampling technique, data collection and analysis; (d) the integration of methods, including when, where, and how it occurred: (e) the limitations of using one method associated to the presence of the other method; and (f) insights gained and value added by the integration of methods (O'Cathain et al., 2008). While GRAMMS was developed and frequently used in the context of health research (Brown, Elliott, Leatherdale, & Robertson-Wilson, 2015; Kaur, Vedel, El Sherif, & Pluye, 2019), these reporting guidelines are not field-specific and have been successfully applied in other fields, such as business (Cameron, Dwyer, Richardson, Ahmed, & Sukumaran, 2013) and education (Choudhary & Jesiek, 2016).

4. Mixed methods research in library and information science

This project is situated in the tradition of analysis of published literature in LIS, important for advancement of the discipline (Chu, 2015; Julien, Pecoskie, & Reed, 2011; Ullah & Ameen, 2018). Several authors reviewed empirical studies in LIS to identify those that use mixed methods research (Fidel, 2008; Ngulube, 2010; Ngulube, Mokwatlo, & Ndwandwe, 2009). These reviews focused on the prevalence of mixed methods research and briefly described the actual conduct (i.e., the how-to) and the reporting of mixed methods research. In other words, the findings of both Fidel and Ngulube et al. suggest that there is room for improvement in how mixed methods are used and reported in LIS.

In 2008, Fidel published a key article investigating the use of mixed methods research in LIS. Fidel analyzed 465 empirical research articles published in four major LIS journals between 2005 and 2006 (*Information Processing and Management, Journal of Documentation, Journal of the American Society for Information Science and Technology, Library and Information Science Research*). She found 22 articles (4.7%) that used mixed methods. In contrast to Fidel's 'global' analysis, Ngulube et al. explored the prevalence and use of mixed methods research in LIS studies published in South Africa (Ngulube et al., 2009) and in Sub-Sahara Africa (Ngulube, 2010). In South African peer-reviewed LIS journals, 32 out of 613 research articles (5.2%) published

between 2002 and 2008 used mixed methods research (Ngulube et al., 2009). In Sub-Sahara, 48 out of 685 reviewed articles (7.0%) used mixed methods research (Ngulube, 2010). It was concluded that this type of research was limited, while "there is no significant discourse around the use of mixed method research (MMR) in the LIS research discourse" (Ngulube, 2010, p. 253).

In addition to the low use of mixed methods research, a common finding across these three reviews is that LIS researchers do not systematically use the term 'mixed methods' to describe their work (Fidel, 2008; Ngulube, 2010; Ngulube et al., 2009). For example, researchers did not explicitly refer to their methodology as mixed methods but described it as the "use of combined qualitative and quantitative approaches" (Ngulube, 2010, p. 258). Fidel explained this as a potential lack of awareness and recognition of mixed methods research (Fidel, 2008).

Moreover, all three reviews mentioned potential problems related to the description of mixed methods research in LIS journals. In fact, even identifying mixed methods studies was often difficult due to "poor or incomplete reporting of research methods" (Fidel, 2008, p. 270). For example, Fidel observed that researchers may not describe if and how the quantitative and qualitative methods were integrated. In some articles, researchers presented both types of methods, but reported the results of only one type of analysis (Fidel, 2008). In addition, results were often reported without specifying which method and instrument provided them (Fidel, 2008). Similarly, Ngulube found that the quantitative and qualitative results were presented separately (without integration) in 40 out of 48 mixed methods studies (83.3%), reflecting a "quantitative/qualitative divide" (2010, p. 259).

Another observed problem is the lack of description of the rationale for using mixed methods research, its value added, and the encountered challenges (Ngulube, 2010; Ngulube et al., 2009). Such descriptions would be invaluable to peers, especially novice researchers who may want to reproduce the methods or the study (Ngulube, 2010). As stated by Fidel, "addressing these and similar issues would not only help to determine if the article is [truly] reporting on mixed methods research but would help all readers to understand better the study described and its contribution" (2008, p. 270).

Building on earlier analyses of published LIS studies using mixed methods research, a methodological review was carried out to investigate in depth what can be said about the conduct and reporting of mixed methods ten years after the publications by Fidel (2008) and Ngulube (2009, 2010). Specifically, it is assumed that LIS researchers are more aware of mixed methods research, are more likely to name them explicitly, and justify their use. It was also anticipated that researchers are more likely to provide clear and detailed descriptions of their mixed methods design, data collection and analysis techniques. Ultimately, this review aims to advance the discussion, visibility, and quality of mixed methods research in LIS.

5. Methodology and methods

A methodological review of mixed methods articles published in journals indexed in two core LIS databases was conducted. This review of included articles focused primarily on how mixed methods research is conducted and reported. To increase the reliability of results and limit personal bias, two independent reviewers carried out the screening of titles/abstracts, selection of full text articles, and data extraction. Inspired by the steps of systematic reviews, the present review includes well-defined research questions and a detailed description of methods from the search strategy to data extraction steps, thus, contributing to transparency and reproducibility (Pope, Mays, & Popay, 2007; Porta, Greenland, Hernán, dos Santos Silva, & Last, 2014; Ullah & Ameen, 2018).

5.1. Eligibility criteria

Eligibility criteria were as follows. To be included, a record had to represent a primary mixed methods research study written in English or French. Primary research was defined as empirical studies involving the analysis of original (raw or primary) data that are specifically collected to address research question(s) or objective(s). In line with O'Cathain et al. (2010) and Pluye et al. (2018), included mixed methods studies were required to report at least one qualitative and one quantitative research method, and describe how the methods are combined (either the integration of qualitative and quantitative phases, results, or data).

Conversely, the following types of studies were not considered mixed methods research and were excluded: (a) a quantitative method with a collection and analysis of qualitative information, as it does not refer to a qualitative research method (e.g., optional free-text responses to open-ended questions at the end of a self-administered structured questionnaire); (b) a qualitative method with a collection and analysis of quantitative information, as it does not refer to a quantitative research method (e.g., responses to few closed-ended demographic and socio-economic questions describing participants after an open-ended interview); (c) a combination of only quantitative methods; (d) a combination of only qualitative methods; and (e) the collection/analysis of qualitative and quantitative data conducted and reported separately (i.e., without integration).

Literature reviews were excluded, given that they synthesize secondary data extracted from included primary research studies. Bibliometric studies were also excluded, being analyses of existing publications. Finally, research protocols were excluded as they do not report research findings, making it difficult to evaluate if and how the integration of qualitative and quantitative methods occurred at the levels of data analysis or interpretation of results.

5.2. Literature search

A bibliographic search was conducted on May 10, 2018 in two core LIS databases: Library and Information Science Abstracts (LISA) and Library, Information Science and Technology Abstracts (LISTA). The bibliographic search was conducted in two core LIS databases, rather than in core LIS journals. This decision was made in order to cast the nets wider and remain open to valuable emerging journals in the field. Moreover, the decision was supported by a pilot analysis of articles that used the term "mixed methods" in the title, published between 2015 and 2016, and indexed in the LISTA database. Out of 45 records identified in this pilot analysis, only 18 articles (40%) satisfied the definition of mixed methods. Nine out of 18 were published in the Journal of Medical Internet Research (JMIR), which was not considered to be a core LIS journal in Fidel's study. Moreover, instead of looking at all studies to identify the ones that are empirical and then the ones that use mixed methods, as done by Fidel (2008), this review focused on studies that described use of mixed methods or that described a combination of quantitative and qualitative methods.

The same search strategy based on keywords in title and abstract was used in both databases: AB,TI(("mixed method*" OR "mixed stud*" OR "mixed research" OR "mixed knowledge" OR "multi-method*" OR multimethod* OR "multiple method*") OR AB,TI(quantitative AND qualitative)). The search strategy was limited to retrieve abstracts of articles published between January 1, 2017 and May 10, 2018 in scholarly journals (a search filter available both in LISA and LISTA databases). The combination of keywords (quantitative AND qualitative) was included in the search string, based on findings from previous methodological reviews indicating that LIS authors may not be using the term 'mixed methods'.

5.3. Selection

All bibliographic records including author names, title, source, year, abstract, and keywords were imported into an EndNote X7 library, where duplicates were removed using the Bramer method (Bramer, Giustini, de Jonge, Holland, & Bekhuis, 2016). The final set of unique records was uploaded to Rayyan QCRI (https://rayyan.gcri.org), a web

Table 1

Coding scheme for included mixed methods studies.

Questions	Response options
What mixed methods design is referenced in the article?	Sequential explanatory
	Convergent
	• Other (comment)
	None mentioned
Is there a bibliographic reference for mixed methods research?	• Yes (comment)
	• No
What term is used for mixed methods research?	• Mixed methods
	• Multiple methods
	• Two approaches
	• Other (comment)
	• No reference
Is the overall mixed methods design discussed in terms of the priority of methods, the	• Yes (comment)
purpose of combining methods, the sequence of methods, and the stage when integration occurred? (If not clear, then "No")	• No
Are the qualitative and quantitative methods described? (including sampling, data	• Yes (comment)
collection and analysis for BOTH)	• No
Is there a description of the justification for using a mixed methods approach to answer	• Yes (comment)
the research question (i.e., pre-study, why mixed methods were chosen)?	• No
Is there a description of any insights gained from mixing/integrating methods (i.e., post-	• Yes (comment)
study, based on findings)?	• No • Vec (comment)
is there a description of any minitation of one method associated with of due to the	• Yes (comment)
What is the type and strategy of integration in the study (if not named explicitly based on	• Cannot tell
interpretation)?	• Connection of phases: Qualitative to quantitative
	• Connection of phases: Quantitative to qualitative
	• Connection of phases: Following a thread
	• Comparison of results: Qualitative and quantitative results obtained SEPARATELY
	• Comparison of results: Qualitative and quantitative results obtained in an
	INTERDEPENDENT manner
	 Comparison of results: Divergence of qualitative and quantitative results
	 Assimilation of data: Qualitative into quantitative
	 Assimilation of data: Quantitative into qualitative
	 Assimilation of data: Merging of qualitative and quantitative
	• Other / new strategy
is the research paradigm/worldview(s) mentioned in the article?	• Yes (comment)
Other comments	• NU
Other comments	(comment)

application used for systematic screening of records.

Using eligibility criteria, each record was screened by two reviewers, who independently assigned eligibility codes. When the reviewers agreed on potentially relevant records, the corresponding fulltext publications were sought. Records were excluded when both reviewers agreed that they were not relevant. When the reviewers could not come to an agreement after discussion, the records were included for full-text screening. Based on titles/abstracts only, it was often difficult to tell how integration of methods was done, which resulted in many records passing to the stage of full text screening.

For full text screening, the bibliographic records selected for inclusion, together with corresponding full text versions, were uploaded to DistillerSR (<u>https://v2dis-prod.evidencepartners.com</u>). Two independent reviewers screened all full text articles. Discrepancies between reviewers' responses were resolved by discussion and referred to a third party when no agreement could be reached (Higgins & Green, 2011).

After full text screening, only articles that satisfied the eligibility criteria were included for the next steps. Since the description of the integration of qualitative and quantitative methods was not always detailed, articles that mentioned a specific mixed methods design, or keywords usually associated with mixed methods integration strategies (such as "triangulated" or "integrated" or "compared"), or a figure or table illustrating the design, were also included. The sample of included articles consisted of articles that self-identified as mixed methods and those that did not. This decision was also justified by the findings of earlier reviews, like that of Fidel (2008), demonstrating that LIS authors may not identify their studies as mixed methods research even when they match the common definition.

5.4. Data extraction and coding of results

To answer the first research question, all included articles were analyzed in terms of their characteristics (e.g., journal name, country of primary affiliation). To answer the following research questions, the articles that self-identified as mixed methods were distinguished from those that did not. Articles were coded as "self-identified mixed methods" when at least one of the following conditions was met: (1) the authors explicitly used the terms mixed or multiple methods, and/or (2) a methodological mixed methods text was referenced by the authors (e.g., Creswell), and/or (3) a specific mixed methods research design is cited (e.g., sequential explanatory design). The articles not self-identified as mixed methods were excluded from subsequent data extraction and analysis, in order to not apply specific mixed methods guidelines and frameworks when the authors did not claim or acknowledge using mixed methods. However, considering existing knowledge, it was deemed valuable to identify how many of recently published LIS articles satisfy the common definition of mixed methods without selfidentifying as such.

For self-identified mixed methods articles, a data extraction form was created in DistillerSR software, consisting of 15 questions (Table 1). The data extraction form was based mainly on a definition of mixed methods design (Creswell & Plano Clark, 2018), 'Good Reporting of A Mixed Methods Study' (GRAMMS) recommendations (O'Cathain et al., 2008), and types of integration strategies (Pluye et al., 2018). GRAMMS and the integration strategies framework are standard tools for mixed methods studies and are not field-specific. Using standard tools enables comparison across fields. Moreover, adapting the two frameworks to



Fig. 1. Flow diagram.

Table 2

Distribution of included mixed methods articles by journal.

Journal title	Number of mixed methods articles
Journal of Medical Internet Research	15
Journal of Librarianship and Information Science	5
Behaviour and Information Technology	4
Journal of the Association for Information Science	4
and Technology (JASIST)	
Information Development	3
Telematics and Informatics	3
The Electronic Library	3
European Journal of Information Systems	2
Information Research	2
International Journal of Libraries & Information	2
Services	
Journal of Academic Librarianship	2
New Technology, Work & Employment	2

Legend: This list presents only journals that published at least two mixed methods research articles included in the present review (n = 47).

LIS was beyond the scope of the present review.

While coding for the types of integration strategies, for each included study, one or more than one code (i.e., strategy) could be assigned. In fact, the strategies are often combined in mixed methods research and are therefore necessarily not mutually exclusive. This highlights an advantage of mixed methods, where quantitative and qualitative methods could be integrated in more than one way in the same study.

Two independent reviewers carried out the data extraction and coding of all included articles. They read, collected, and coded the following data for self-identified mixed methods articles using the data extraction form: type of referenced mixed methods design, bibliographic reference for mixed methods, the term used for mixed methods, discussion of mixed methods design, description of each method used, description of justification for using mixed methods and insights gained from the use, limitations, and integration strategies. As in Selection, disagreements were solved through discussion or arbitrage by a third party. Fifteen articles were used as a testing sample for the data extraction form, leading to its revision and the refinement of the coding manual.

Data extraction was followed by a descriptive analysis. All extracted data were organized in Excel spreadsheets (available upon request). The first author calculated frequencies as well as percentages (e.g., components of GRAMMS), and synthesized the characteristics of studies and mixed methods related data in order to describe the present patterns.

6. Results

6.1. Description of studies matching the definition of mixed methods

A total of 386 unique records were retrieved and screened, out of which 84 (21.8%) met the eligibility criteria of being empirical mixed methods studies (i.e., involving quantitative and qualitative methods as well as their integration) (See Fig. 1). Most commonly, articles were excluded for having no integration of quantitative or qualitative components (i.e., no explicit description or enough information to infer that integration occurred) or for not using quantitative and qualitative methods (e.g., questionnaires with open-ended questions that were analyzed thematically).

The included 84 articles are published in 49 journals. By way of illustration, the list of journals with at least two included mixed methods articles is presented in Table 2. The highest number of articles using mixed methods come from the *Journal of Medical Internet Research (JMIR)* (17.9%). In 37 cases (44.0%), only one mixed methods article was published in a given journal during the period covered by this review. With respect to the four core LIS journals included in Fidel's review (2008), only the *Journal of the Association for Information Science and Technology (JASIST)* provided articles describing mixed methods studies that are included in the review.

The first authors of included articles are affiliated to institutions spanning the globe, coming from 28 countries (Fig. 2). The top three



Fig. 2. Distribution of included articles by countries of first authors' affiliations.

countries of primary affiliations are the United States (USA) (20%), the United Kingdom (UK) (14%), and South Africa (8%).

Out of 84, 65 articles are self-identified as mixed methods (77.4%). In other words, most articles that match the commonly accepted definition of mixed methods, also explicitly use the mixed methods terminology, and/or name a mixed methods design, and/or refer to mixed methods methodological texts. The following sections present the findings of applying the reporting guidelines (i.e., GRAMMS) and the types of integration framework only to the articles self-identified as mixed methods (N = 65, list of references available upon request).

6.2. How is mixed methods research described?

Of the 65 included articles, 29 (44.6%), cite methodological texts by mixed methods scholars to support the chosen approach. The top five most frequently referenced methodological works were by Prof. John W. Creswell (Table 3).

As for the terminology used, 56 articles (86.2%) explicitly report using 'mixed methods' or 'mixed methodology'. Six articles (9.2%) refer explicitly to 'multiple methods' or 'multiple methodology'. In one article (1.5%), the authors use both terms, 'mixed methods' and 'multiple methods'. The decision to classify both terms (i.e., mixed and multi methods) as self-identified mixed methods is aligned with the systematic review of methodological reviews by Ullah and Ameen (2018), who have considered them to describe the same research methodology. Of self-identified mixed methods articles, two (3.1%) did not use mixed or multiple methods terms. However, these two articles are considered as self-identified mixed methods given that both refer to a specific mixed methods design (sequential exploratory) (Alharbi, Papadaki, & Dowland, 2017; Lin, Hsu, Chen, & Fang, 2017) and one of them also references John W. Creswell (Alharbi et al., 2017).

6.3. How are mixed methods reported compared to GRAMMS?

The following section is organized according to the six elements of the 'Good Reporting of a Mixed Methods Study' guidelines (GRAMMS) (O'Cathain et al., 2008). The GRAMMS was applied to the 65 articles self-identified mixed methods.

6.3.1. Justification for using a mixed methods approach

According to GRAMMS, researchers need to provide a justification for using mixed methods to answer their research question (O'Cathain et al., 2008). In mixed methods, such justification refers to the value added that is expected to "result from integrating both forms of data" (Creswell & Plano Clark, 2018, p. 154), and must be clearly stated in the purpose statement. Of self-identified mixed methods articles, 44 articles (67.7%) include a justification for combining quantitative and qualitative methods. For example, in a user study on collaborative academic information-seeking behaviour, the researchers justify using quantitative and qualitative methods as follows: "To supplement the quantitative data collected by questionnaires, we conducted one-on-one interviews to collect qualitative data to explore deeper implications. The interview questions were designed to explore in depth the feelings of the participants from different groups about the experimental settings and tasks." (Wu, Liang, & Xiang, 2017, p. 55).

6.3.2. Description of mixed methods study design

In 30 out of 65 articles (46.2%), the researchers mention by name a type of mixed methods design. Among those, the most popular is convergent, appearing in nine out of 65 articles (13.8%). Seven articles (10.8%) name a sequential exploratory design, and six articles (9.2%) name a sequential explanatory design. In 8 articles (12.3%), researchers use other names such as 'multi-phase'.

In reporting their mixed methods study design, the GRAMMS

Table 3

Top five most-cited methodological works in mixed methods.

Bibliographic information	Number of citations	% (n = 30)
Creswell, J. W., Plano Clark, V. L., Gutmann, M. L., & Hanson, W.E. (2003). Advance mixed methods research designs. In A. Tashakkori & C. Teddlie (Eds.), Handbook of Mixed Methods in Social and Behavioral Research (pp. 209–240). Thousand Oaks, CA: Sage Publications.	12	40.0%
Creswell J. W. and Plano Clark V. L. (2011). Designing and Conducting Mixed Methods Research (2nd edition). Thousand Oaks, CA: Sage	8	26.7%
Publications.		
Creswell J. W. (2014). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches (4th edition). Thousand Oaks, CA: Sage	6	20.0%
Publications.		
Creswell, J. W. (2009). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches (3rd edition). Thousand Oaks, CA: Sage	6	20.0%
Publications.		
Creswell, J. W, and Plano Clark, V. (2007). Designing and conducting mixed methods research. Thousand Oaks, CA: Sage Publications.	6	20.0%

Table 4

Distribution of studies by integration strategy.

Туре	Strategy	n	% (n = 65)
Cannot tell		6	9.2%
Connection of phases	Qualitative phase connected to quantitative phase	13	20.0%
	Quantitative phase connected to qualitative phase	20	30.8%
	Following a thread (special case)	0	0
Comparison of results	Qualitative and quantitative results are obtained separately	26	40.0%
	Qualitative and quantitative results are obtained in an interdependent manner	17	26.2%
	Divergence of qualitative and quantitative results	0	0
Assimilation of data	Qualitative data into quantitative data	1	1.5%
	Quantitative data into qualitative data	0	0
	Merging of qualitative and quantitative data	0	0

guideline suggests that researchers should describe the purpose, priority and sequence of methods, as well as when the integration occurs (O'Cathain et al., 2008). Out of 65 self-identified mixed methods articles, 56 (86.2%) describe these elements (while most do not name a design).

6.3.3. Description of quantitative and qualitative methods

Most articles describe quantitative and qualitative methods in terms of sampling, data collection, and data analysis: 54 articles (83.1%) include a detailed description, with at least one paragraph for each method. The other 11 articles (16.9%) name each method, but detail only one of the used methods (i.e., provide details on sampling, data collection and analysis).

6.3.4. Description of integration

Integration is essential in mixed methods research. As per GRAMMS, the description of integration should include where and how it has occurred, and who has participated in it (O'Cathain et al., 2008). Of 65 articles, 50 (76.9%) describe the integration as per the recommendation. An example from a sequential explanatory study on undergraduate students' understanding of scholarly communication stated: "An initial analysis of survey responses informed the development of the interview protocol, also performed separately on each campus. Next, the researchers collected and analyzed qualitative data from semi-structured interviews to elaborate on and further inform the survey data and research questions. After coding interview transcripts and identifying themes from the qualitative data, connections and anomalies were explored among and between both data sources." (Riehle & Hensley, 2017, p. 153). Integration strategies were coded in the 65 self-identified mixed methods articles. In the present review, each article was coded for any integration strategy used (codes, i.e., themes), in other words, one or more than one integration strategy (Table 4).

Of 65 articles self-identified as mixed methods, 42 (64.6%) describe one integration strategy, and 16 (24.6%) present two strategies. In one article (1.5%), all three integration types (connection of phases, comparison of results, and assimilation of results) are used (Wright, Roberts, & Wilson, 2017). For six other articles (9.2%), no specific strategy is identified, while integration is mentioned (i.e. description deemed insufficient to infer a type of integration).

The most popular integration strategy, reported in 26 articles (40.0%), is that of comparing quantitative and qualitative results obtained separately. The second most popular is the connection of quantitative to qualitative phases, used in 20 articles (30.8%). Some strategies like 'follow a thread', 'divergence of qualitative and quantitative results', 'assimilation of quantitative into qualitative data', and 'merging of qualitative and quantitative data' are not present in the examined articles.

6.3.5. Description of limitations

As is the case with all research publication, researchers are expected to describe specific study limitations. For mixed methods studies, it is recommended to report on the limitations of "one method associated with the presence of the other method" (O'Cathain et al., 2008, p. 97). Out of 65 articles, only two (3.1%) report specific limitations related to sampling. For example, participants who dropped out of the quantitative intervention phase could not be interviewed, preventing the researchers from exploring the reasons behind their dropping out (Buwule & Ponelis, 2017).

6.3.6. Description of insights

The GRAMMS suggests that researchers should communicate any insights gained as a result of mixing methods (O'Cathain et al., 2008). Reporting insights in the results or discussion sections complements the initial justification of the expected value added by mixing methods. Moreover, insights may exceed the anticipated value added. Only 32 articles (49.2%) self-identified as mixed methods report the gained insights. For example, in a study on exploratory information searching in an oil and gas enterprise, the researchers explicitly state: "This is also a good example of how mixed methods research provides insights that a single method would miss. Analysis of only interview data (qualitative) or only search log data (quantitative), would probably not have surfaced the theme of 'forgetting'." (Cleverley, Burnett, & Muir, 2015, p. 90).

7. Discussion

The present review identified 84 articles reporting mixed methods studies published in LIS journals between 2017 and 2018 that match the most common definition of mixed methods (Creswell & Plano Clark, 2018). Of those, 65 articles were coded as self-identified mixed methods. Overall, the results illustrate explicit changes since Fidel's review published in 2008. LIS authors do not only identify their studies as mixed methods, but also refer to methodological publications (44.6%) and specific mixed methods designs (46.2%). Also, 67.7% of self-identified mixed methods articles provide a justification for using mixed methods research. For example, Achterbosch, Miller, and Vamplew (2017) explicitly report using mixed methods, state the specific design (sequential explanatory), and provide methodological references. Moreover, the authors describe the integration and the justification: "During the first phase, the collection and analysis of quantitative data occur. The second phase builds upon the results of the first through the collection and analysis of qualitative data. This strategy is especially useful in examining results from the quantitative data in more detail via the qualitative approach." (Achterbosch et al., 2017, p. 848).

Integration is a crucial element of mixed methods research (Creswell & Plano Clark, 2018). Integration is clearly described in 76.9% of the analyzed articles. The most frequently used integration strategy is comparison of qualitative and quantitative results, which were obtained separately (40.0%). Given that the conceptualization of integration types and strategies used in the analysis is recent (Pluye et al., 2018), the authors of the self-identified mixed methods articles do not name the strategies they use. Therefore, they were inferred from the methodological descriptions, the results, and discussion sections.

As seen in other reviews on mixed methods research (Kaur et al., 2019), the present review found that several integration strategies can

be used in one mixed methods study. For example, in a sequential design, the results of a qualitative strand can be used to inform the data collection of the quantitative strand (strategy connection of phases) and the results of both strands are compared (strategy comparison of results). This is seen in the study by Naicker and Jairam-Owthar (2017) on information quality and executive decision support for a financial service. First, the authors conducted semi-structured interviews to inform the design of a quantitative survey questionnaire (i.e., strategy 1a. Connection of phases QUAL→QUAN). Consequently, the authors compared the quantitative and qualitative results (i.e., strategy 2b. Comparison of results collected in an interdependent manner); "Triangulation of results took place by the researcher to increase the validity and reliability of the research, through manually comparing the results emanating from the semi-structured interviews to the survey questionnaires" (Naicker & Jairam-Owthar, 2017, p. 7). This example illustrates that integration strategies are not mutually exclusive and different types can be used within the same mixed methods study.

Certain integration strategies seen in other fields were not found in the self-identified mixed methods articles analyzed in the present review. This finding may encourage LIS authors, interested in mixed methods research, to incorporate rarely-used strategies such as 'follow a thread', 'divergence of qualitative and quantitative results', 'assimilation of quantitative into qualitative data', and 'merging of qualitative and quantitative data', contributing to the diversity and originality of their methods.

At the same time, there is still room for improvement in terms of naming the mixed methods designs, using various integration strategies, and reporting the studies. For example, 35 out of 65 self-identified mixed methods articles (53.8%) do not reference a specific mixed methods design. Out of those that do, the convergent design (QUAN +QUAL) (Creswell & Plano Clark, 2018) is the most popular, similar to findings from mixed methods research in health sciences (Pluye et al., 2018). This finding differs from Ngulube's, where all included mixed methods studies used a sequential mixed methods design ($OUAN \rightarrow$ QUAL or QUAL→QUAN) (Creswell & Plano Clark, 2018), leading to a conclusion that mixed methods may be used in a limited way (Ngulube, 2010). Furthermore, only 49.2% of analyzed articles describe insights gained by mixing methods, and very few articles (3.1%) discuss the limitations of one method associated with the use of another. In 2008, Fidel called on LIS researchers to describe why each method was used, what it contributed, and how the data collected with each method was analyzed and integrated. This call is still valid today.

More than a decade ago, Fidel (2008) recommended that journals establish reporting standards requiring authors to clearly describe their research design, data collection and data analysis before presenting the results. Based on the results of this review, an interesting avenue for future research may be in exploring if and how the journals are affecting the reporting quality of mixed methods studies. For example, word count may constraint the authors of mixed methods studies, who need to report the methods used in quantitative and qualitative components, as well as the integration. In other words, in LIS mixed methods studies, it could be interesting to explore if and how the reporting quality is 'driven' by the researcher, the reviewer, or the journal.

In mobilizing recent methodological knowledge on mixed methods reporting and integration (O'Cathain et al., 2008; Pluye et al., 2018), the results of this review contribute to and extend on Fidel's (2008) seminal review of mixed methods research in LIS. It was assumed that LIS researchers are more aware of mixed methods research and are more likely to use the term 'mixed methods' over a decade after Fidel's study. This assumption was supported by the scoping searches. For example, a search in LISTA and LISA looking for mixed methods terms in title and abstract, covering the period of 2015–2016, retrieved 708 unique records. In other words, the term 'mixed methods' is used more frequently compared to Fidel's findings, where none of the included 22 articles employed it.

The synthesis was extended to include data on the reporting of and integration used in the selected mixed methods articles, given the availability of GRAMMS reporting guidelines and a typology of integration strategies (O'Cathain et al., 2008; Pluye et al., 2018). Reporting quality can be defined as accuracy, completeness, and transparency (Simera et al., 2010). As encountered by O'Cathain et al. (2008), more explicit and transparent descriptions are needed for the overall mixed methods design, and especially for the types of integration. The lack of transparency and detailed reporting makes it difficult to assess the quality and rigor of research, as well as effectively reproduce research methods (O'Cathain et al., 2008; Roberts, Dowell, & Nie, 2019). Specifically, these issues ieopardize the peer-review of scientific publications, and the training (role modeling) of novice mixed methods researchers. As articulated by Roberts et al., the demonstration of rigor helps research stakeholders "determine the relationship between [scientific] knowledge and practice" (2019, p. 1).

The intention of this analysis is not to criticize, but to describe which elements are missing from the angle of contemporary standards for planning, conducting, appraising and reporting mixed methods research in health and social sciences (standards admitted in MMIRA conferences and specialized journals such as the *Journal of Mixed Methods Research*). As noted by Fidel (2008), LIS researchers may not always be aware that they are conducting mixed methods research. With this review, it is hoped to further raise awareness of mixed methods research, to bring LIS researchers' attention to mixed methods reporting guidelines (O'Cathain et al., 2008) and the diversity of integration strategy combinations (Pluye et al., 2018), which could strengthen their empirical work and publications. In addition, this review may help educators providing research training to future LIS professionals and researchers.

The strength of this review is the detailed description of methodology and methods, from the identification to the synthesis steps, contributing to the reproducibility of the review. To increase the reliability of results, two independent coders carried out the screening of titles/abstracts, selection of full text articles, and data extraction. However, as in all research studies, there are some limitations. For example, not all LIS literature was searched as only two databases were used. In addition, future research can expand the 18-month inclusion period to study the evolution of trends over a longer publication period.

8. Conclusion

This article is a step towards assessing and ultimately improving how mixed methods are planned, conducted and reported in LIS. The goal of this methodological review is to advance the discussion with researchers, educators, and journal editors on how to improve LIS mixed methods studies. Our discipline may benefit by adapting lessons and guidelines from methodologists coming from other disciplines, such as health research. For example, editors and reviewers for LIS journals may adapt the reporting guidelines proposed by O'Cathain et al. (2008) and can appraise the methodological quality of mixed methods research using existing tools such as the Mixed Methods Appraisal Tool (Hong et al., 2018). Specifically, high quality mixed methods studies reported in an explicit and transparent manner would benefit LIS students, researchers, educators, and practitioners. This will directly improve the scientific peer-review processes and the reproducibility of studies, thereby contributing to the overall development of research methods in LIS.

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