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Are we there yet?: Mixed methods research in library and information science

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ABSTRACT

Mixed methods research (MMR)—which integrates qualitative and quantitative methods in one study to improve the study's quality—is not common in library and information science (LIS) and has not been discussed in its literature. While still evolving and generating much discussion about its nature and standards for its evaluation, MMR has been employed in the social and behavioral sciences for more than three decades. It is already considered the third approach to research, along with the quantitative and qualitative approaches. How did this approach shape research in LIS? An analysis of 465 articles published in four major LIS research journals revealed that 22 articles (5%) employed MMR. However, the recognition of MMR by name or as a research method was absent from these articles and from the methodological literature in LIS. The various strengths of MMR suggest that being cognizant of its possible use in LIS would benefit researchers in the field.

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1. Introduction

Mixed methods research (MMR) employs a combination of qualitative and quantitative methods. It has been used as a distinct approach in the social and behavioral sciences for more than three decades. MMR is still generating discussions and debates about its definition, the methods involved, and the standards for its quality. Although still evolving, MMR has become an established approach. It is already considered the third research approach, along with the quantitative and qualitative approaches, and has its own emerging world view, vocabulary, and techniques (e.g., Creswell & Plano Clark, 2006; Johnson, Onwuegbuzie, & Turner, 2007; Tashakkori & Teddlie, 2003a, p. x). It was the focus of several books (e.g., Axinn & Pearce, 2006; Brannen, 1992, Brewer & Hunter, 2006; Tashakkori & Teddlie, 1998, 2003a). Some classic textbooks in qualitative research have introduced it (e.g., Miles & Huberman, 1994; Patton, 1990, 2002), and other books are devoted to all three approaches (e.g., Creswell, 2003). Interest in issues related to MMR has been growing constantly. In January 2007, the cross-disciplinary *Journal of Mixed Methods Research* published its first issue. By April 2007, this quarterly journal had received more than 100 submissions. Some discussed theory and methodology, and others reported on studies that had utilized MMR (Creswell & Tashakkori, 2007).

In its inaugural issue, the editors explained that there was no shared understanding of what constitutes MMR. While scholars often agreed that an MMR project included a mixture of both quantitative and qualitative components, they disagreed on how these components should relate to one another and what level of integration was required. To be inclusive, the editors proposed a broad definition: MMR is "research in which the investigator collects and analyzes data, integrates the findings, and draws inferences using both qualitative and quantitative approaches or methods in a single study or program of inquiry" (Tashakkori & Creswell, 2007, p. 4).

On a general level, the motivation to mix methods in research is the belief that the quality of a study can be improved when the biases, limitations, and weaknesses of a method following one approach are counterbalanced, or compensated for, by mixing with a method belonging to the other approach. This general view has manifested itself in various specific ways, changing with the context of MMR use. Reports about MMR work and discussions about its nature and methodology have come from various disciplines, including sociology, education, nursing, anthropology, management, social policy, healthcare, and psychology. Is library and information science (LIS) another field to adopt MMR? To date, it is not known if and how this approach has shaped research in LIS.

The purpose of this paper is to bring MMR to the attention of LIS researchers and to open a discussion about its applications to LIS. The paper describes very briefly some issues related to MMR, and reports on a study that explored the prevalence of MMR in LIS.

2. Mixed methods research

Researchers in the social and behavioral sciences found the need to use multiple methods as early as the beginning of the 20th century, even before quantitative research and qualitative research were defined as distinct research approaches. Johnson et al. (2007) briefly described the development of MMR and explained that social and behavioral sciences were primarily quantitative at that time, influenced by the philosophical positions of the day. To a certain extent, the qualitative approach developed in reaction to the dominance of the quantitative approach. It became an established and acceptable

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approach in the 1980s and 1990s. The mixed methods approach received a distinct name and began to evolve as a synthesizing approach in the 1970s in reaction to the polarization between the qualitative and quantitative approaches. Early MMR researchers objected to this polarization not for epistemological reasons, but rather because they found that it unnecessarily constrained their work. Focusing primarily on the phenomenon to be studied and on the research questions at hand, they postponed the philosophical and methodological discussions about the "purity" of the methods they used.

Methods can be mixed in different ways and for various purposes. Based on research in sociology, Sieber (1973) demonstrated a number of ways to integrate qualitative and quantitative research. Some such combinations are presented here through two hypothetical scenarios in Tables 1a and 1b.

As MMR has evolved, researchers from a range of fields have been using more complex versions of MMR. They have been employing more than two methods and using diverse instruments in addition to surveys, observation, and interviews. For example, Bernardi, Keim, & von der Lippe (2007) investigated the effects of social influence on family formation in a comparative study in Eastern and Western Germany. They employed three instruments for their analysis: a semi-structured interview that was subjected to qualitative analysis, a network chart and network grid that provided data for both quantitative and qualitative analyses, and a socio-demographic questionnaire that was analyzed quantitatively.

In another study, Lockyer (2006) explored the ethics of humor through instances of comic offense caused by a magazine published in London. She collected data from the magazine pages, readers' letters, press reports about libel litigations, and semi-structured interviews with some of the magazine's journalists. She analyzed the data using different methods in an integrative mode. The quantitative analysis included content analysis. The qualitative analyses were composition analysis, linguistic discourse analysis, symbolic cultural analysis, and linguistic textual analysis.

The methodological literature in MMR is rich and constantly growing. This paper offers only a small glimpse of some of the topics addressed. In particular, it focuses on the discussions about the strengths of MMR and the current challenges that generate discussions among scholars and methodologists.

Table 1a
An example of MMR use in a hypothetical scenario

Mr. White was interested in understanding the Web searching behavior of elementary school students. For that purpose he developed and tested a few hypotheses about the association between variables describing the student population (independent variables) and those illustrating web searching behavior (dependent variables). He collected data through a multiple-choice questionnaire that he administered to students. To make sure that the sample was representative of all students, he needed to know how to stratify the population before administering the questionnaire. To answer this question, he observed class and Web searching sessions, and conducted open-ended interviews with several students to explore their perception of the differences among students. This qualitative investigation provided additional useful information. At its conclusion, Mr. White re-considered his study design because he discovered that teachers were important players in shaping students' searching behavior. He decided to include them in the investigation. Mr. White used this qualitative analysis to enhance data collection as well. Through his interactions with the participating students he had created rapport with the potential respondents to the questionnaire; this helped him achieve a satisfying response rate. He also noticed that students thought web searching was fun and they liked to talk about it. He concluded that they would be rather patient in answering questions on the subject. This directed him in phrasing the questionnaire's questions and in his decision about the questionnaire's length. When Mr. White analyzed the data, he was not satisfied with the interpretation he could come up with for some of the correlations he found, and a couple of them were highly surprising. To understand better the study results and to verify his interpretations, he conducted additional open-ended interviews, this time focusing on the study findings.

Table 1b
An example of MMR use in a hypothetical scenario

Ms. Black was also interested in Web searching behavior of elementary school students. She, however, preferred to explore it to provide a thick description of the process. For that purpose, she collected data through observation and open-ended interviews. To support her study design and data collection, she initially administered a simple questionnaire to the student population from which she would draw her qualitative sample. The data collected from the questionnaires helped her to improve the study in several ways. Through them she created a profile of the population which guided her sampling. This was particularly important because she had planned to employ purposeful sampling. To select the participants, she needed information about individuals that could be collected only from the students themselves—such as their searching experience or whether they have Internet connection at home. In addition, the questionnaires provided background information about each participant that she took into consideration when she conducted the observation and interviews with individual students—such as the student's first language or favorite topic. Analyzing the qualitative data, she discovered some prominent themes in the students' searching behavior. She thought these were important findings but she could not generalize them because she drew the participants from a relatively small sample of students in only one school. To generalize the findings, she administered a questionnaire to a diverse population. The data collected this way also verified her interpretation of the qualitative results.

2.1. Strengths of MMR

To LIS researchers, the most familiar form of MMR use is triangulation, one of the methods to test the validity and accuracy of a study. Triangulation is employed primarily in qualitative research. However, not all triangulations require the use of MMR. For example, Patton (2002) identified four types of triangulation:

1. *Methods triangulation:* Checking the consistency of findings generated by different data collection methods
2. *Triangulation of sources:* Checking the consistency of different data sources within the same method
3. *Analyst triangulation:* Using multiple analysts to review findings
4. *Theory/perspective triangulation:* Using multiple perspectives or theories to interpret the data (p. 556).

Of the four types, only methods triangulation may suggest the use of MMR. It does not require the use of MMR because the different data collection methods may be of one approach only, such as interview and observation for qualitative analysis. Axinn and Pearce (2006) explained that this type of triangulation is particularly useful for both qualitative and quantitative studies that aim at establishing causal relationships. Triangulation, however, is not the only motivation to employ MMR. The material reviewed here includes few examples of how the use of MMR can improve the quality of a research project.

Although a number of methodologists have devoted themselves to the study of MMR, researchers do not apply it simply for the joy of mixing. Rather, researchers use MMR when no single approach can fully investigate the phenomenon, particularly when the phenomenon is complex and multifaceted. At the same time, MMR can contribute to studies for which a single method may provide acceptable results.

Generally speaking, using MMR allows researchers to address issues more widely and more completely than one method could, which in turn amplifies the richness and complexity of the research findings. This can materialize in different ways. The hypothetical scenarios described earlier (Tables 1a and 1b) show some specific ways in which mixing can improve a single-method study. The development of the main method in a study can be supported by applying another method. This was the case when Mr. White talked to students and observed them before he designed the questionnaire and administered it and when Ms. Black used the data from a questionnaire to guide her qualitative sampling. Another case is when qualitative, exploratory investigation generates hypotheses to be tested. Hypotheses generated this way add depth to the evidence available for testing them. Such hypotheses are based not only on

previous research of others, but also on evidence collected by the research through close, first-hand, and in-depth knowledge of the tested phenomenon.

The use of inherently different methods fosters flexibility in the research process. This may create new insights and possibilities that one method alone could not produce. Mr. White benefited from this advantage twice: first, he discovered that students had fun searching the Web, and second, he carried out open-ended interviews to provide explanations for the quantitative results. Ms. Black also enhanced her interpretation of her results by using a different approach: generalizing the results and testing their validity through a questionnaire. Although neither investigators found a contradiction between the qualitative and quantitative results, other researchers may face conflicts or paradoxes. Paying attention to such contradictions is highly beneficial because it may lead to new insights and novel ways of thinking.

A qualitative component may contribute greatly to studies of populations in context because it promotes the investigator's direct involvement in the study site. This, in turn, enhances the researcher's grasp of the participants' context. In addition, researchers themselves can benefit from applying MMR, particularly in projects that employ experts in each approach. Such projects enrich the experience and competencies of all involved through collaborative research.

These are just a few examples of the benefits of using MMR. Its strengths and advantages are widely analyzed in the MMR literature. In addition to the theoretical and methodological papers, most papers that report on actual MMR studies explain the advantages of mixing methods in general. At times, they show how it supported their study.

2.2. Current challenges to MMR

Being in a relatively early stage of development as the third research approach, MMR scholars still face open questions and are discussing many basic issues related to the approach. Most central to the MMR community are the various definitions for the approach. Although most leaders in the field agree that MMR mixes qualitative and quantitative approaches (Johnson et al., 2007), this understanding is not shared by all. Axinn & Pearce (2006), for instance, present MMR strategies for data collection and focus on the instruments used for this purpose. They explain that it is not useful to label data collection on its own as qualitative or quantitative because data collected by any instrument—including observation and conversational interview—can be analyzed quantitatively. They define MMR as the mixing of highly structured instruments for data collection with much less structured ones.

Axinn & Pearce's (2006) view of MMR points to another theme that differentiates MMR definitions: In which stage of a research project should mixing occur to qualify as MMR? Johnson et al. (2007) reported that most definitions specify the mixing stage. For example, Axinn & Pearce (2006) centered on data collection, Tashakkori & Creswell's (2007) definition included most stages, and O'Cathain, Murphy, & Nicholl (2007) showed that different stages in a study—design, sampling, analysis, and interpretation—can benefit from MMR. The diversity of definitions is of concern to MMR methodologists because homogeneity in definitions helps establish the approach. Johnson et al. (2007), on the other hand, maintained that heterogeneity should be valued because of the diversity among MMR researchers and projects.

"What is MMR?" is not the only challenge and open question at the center of discussions among MMR scholars. Other questions range from epistemological questions to highly practical matters associated with the actual implementation of the approach. This broad range of questions motivated Tashakkori & Teddlie (2003c) to develop a typology of MMR questions. Some of their categories are used here to sketch an introduction of a few examples of open questions in MMR.

2.2.1. The nomenclature and basic definitions used in MMR

Adding to the diversity of MMR definitions, the terminology used in this approach is not consistent. While various factors can generate inconsistencies, the synthesizing and multidisciplinary nature of MMR is an important source for them. For instance, scholars in qualitative and quantitative research understand terms such as *validity* and *sampling* differently. What should be the interpretation of these terms in MMR? Similarly, a discipline may employ a term differently than other fields. An example is the unique use of the term *triangulation* in nursing research. While it is used in many fields, its highly prevalent use in nursing research strips it of its generally accepted meaning (Tashakkori & Teddlie, 2003c, p. 14). How can a common understanding among researchers from different fields be created?

2.2.2. The utility of MMR (why do we do it?)

The various advantages of MMR that motivate researchers to turn to it elucidate some facets of the utility in this approach. These advantages are accepted by most methodologists, even if their weight in an individual researcher's work may vary. Nevertheless, they can present challenges on the practical level. An important question here is: How can one demonstrate that a MMR project produced "better" results than if it were limited to one approach or if the two approaches were not integrated? To resolve this issue, the MMR community needs to start by addressing the basic question: What standards should be used to judge the quality and credibility of a MMR project?

2.2.3. The paradigmatic foundations for MMR

A link between a research approach and an epistemology that supports it can provide a solid justification for choosing the approach. The quantitative approach is usually linked to logical-positivism and post-positivism, and the qualitative to several epistemologies and metatheories, such as interpretivism, hermeneutics, or constructivism. To which epistemology, ontology, or paradigm should MMR be linked? Which epistemology can support this approach? A basic question that is still under discussion is: Is there a need at all for a link between MMR and an epistemology? If there is a need, should MMR be linked to a single epistemology, or is it better to connect to several? Should all research projects be linked to the same epistemologies, or should a researcher select the ones that best support the specific research design?

If a single epistemology is required, should MMR select one of the existing epistemologies or develop its own? If linking to a single existing epistemology, which one would fit best? If linking to a number of epistemologies, how will they relate to one another? Should all be present, or should the researcher choose the dominant one for each research project? If they are all present, how should they be used: in a complementary way, dialectically, or any other way? These and other questions are remain open.

2.2.4. Design issues in MMR

Mixing qualitative and quantitative research opens many possibilities for research designs. For each design, a host of decisions need to be made, such as how to combine the quantitative and the qualitative components of a study, in what order this combination takes place (sequentially or simultaneously), and what role each component plays (e.g., explanatory, confirmatory, or exploratory). Each combination of these decisions creates a research design of a certain type, and several methodologists have created typologies of research designs. Greene, Caracelli, & Graham (1989), for example, created a typology according to the purpose of the mixing. It includes categories such as *triangulation* (for a design that seeks conversion, corroboration, and/or correspondence of results from the different methods) and *expansion* (for a design that seeks to extend the breadth and range of inquiry by using different methods for different inquiry components).

Many contributions to the methodological literature have addressed the open question: What are the types of research designs

in MMR, how do they relate to one another, how exhaustive should researchers be in delineating them, and what criteria should be used to create typologies of research designs? The purpose of such typologies is to help researchers to select the best design for a study. A question then arises: Are typologies the only way to support an individual's research design? The most basic issue, however, is the need to establish a common understanding of the nature of research design (e.g., fixed or dynamic design) and the vocabulary to describe it.

2.2.5. The logistics of conducting MMR

The major challenge in conducting a research project is mixing two very different research approaches. A MMR project can be led through collaboration between researchers from both traditions or by a single researcher. A team of experts from each approach is likely to face a variety of challenges because the basic viewpoints and nomenclatures differ from one approach to the other. One of these challenges is a situation where experts in one approach consider the other approaches to be secondary. Patton (2002), for instance, stated that it is not unusual for quantitative researchers to consider their approach primary (p. 557). How could these differences be bridged so team members collaborate harmoniously?

A project carried out by a single researcher presents its own challenges because not many researchers are equally comfortable with qualitative and quantitative research. Tashakkori & Teddlie (2003b) believed that researchers' education did not prepare them for implementing MMR. Because there are very few university courses devoted to MMR, researchers who want to conduct studies on their own need to get proficient in both qualitative and quantitative methods. At this point in MMR development, researchers need courses to prepare them for both MMR and multi-approach collaboration. Scholars are beginning to discuss the syllabi for such courses and ways to integrate them into educational programs.

MMR methodologists are still discussing these questions and others. But the overarching question is: Should researchers and methodologists strive to find a single answer to each question, or would a plurality in answers serve MMR better?

3. Mixed methods research in LIS

The status of MMR in LIS can be revealed through examining books and articles about research methods in LIS and by analyzing published research reports. This paper focuses on the latter, but it also takes a quick look into books and articles about research methods.

The term *mixed methods* is missing from most methodological books (e.g., Boyce, Meadow, & Kraft, 1994; Emery, 1993; Gorman & Clayton, 1997; Gustafson & Smith, 1994; Losee & Worley, 1993; Mellon, 1990; Pickard, 2007; Powell & Connaway, 2004). Some books touch upon the concept in a few sentences (e.g., Glazier & Powell, 1992; Williamson, 2002), most often without using the term *MMR*.

Gorman & Clayton (2005) were the only authors to introduce MMR in their book on qualitative research, which includes a short section about mixed methods. The authors interpreted the concept differently than the study presented here. They explained that this term was selected to replace the term *triangulation*, which for a while was changed to *multiple methods*. Given this broad interpretation of the concept, they added that "ideally" MMR would encompass both qualitative and quantitative methods. They stated that since the early 1980s "mixing methods has become much more commonplace in library and information research generally" (p.13). Although common in the LIS methodological literature, this interpretation of MMR might not be useful because it makes distinct concepts interchangeable. As stated earlier quoting Patton (2002), only one of the triangulation types may require the use of more than one method, and even then there is no requirement that the methods originate from different approaches. In addition, much of the strength of MMR and many methodological issues and innovations stem from mixing different methods, which is not required when using multiple methods. It is important, therefore, to distinguish between the concepts of triangulation, multiple methods, and mixed methods. One method of triangulation, among others, is to employ multiple methods to the study of the phenomenon. Mixed methods are multiple methods in which qualitative and quantitative methods are integrated.

Several researchers have investigated the research methods used in LIS, categorized them, and measured trends and use-frequency of various methods. Powell (1999) presented a methodological essay about trends in LIS research. Although previous studies had shown an increase in the use of multiple methods, MMR was not found in any of them or in Powell's essay. McKechnie, Baker, Greenwood, & Julien (2002) found a similar growth when they studied the research literature in the area of human information behavior (HIB). In their analysis of 180 articles that mentioned the use of one or more methods (out of a total of 247), 55% used multiple methods and 15% employed both qualitative and quantitative approaches. The study's finding was supported by a previous study about HIB research (Julien & Duggan, 2000), which analyzed 439 articles from the 1980s and 1990 s and reported an increase in triangulating methods.

Insights and support of MMR were provided by other types of articles, both conceptual and empirical. Sonnenwald & Iivonen (1999), for example, proposed a general conceptual framework to guide the selection of methods in multiple methods research in HIB, some of which might be mixed. Bishop et al. (2002) provided brief examples of how they had used mixed methods (which they termed triangulation) in their empirical study of digital libraries' use. In addition, they delineated some of the benefits yielded from a mixed approach and the challenges they had encountered. Similarly, Williams & Gunter (2006) referred to triangulation when they reported on a study about the use of electronic health information systems to demonstrate how qualitative analyses can inform transaction log analysis. They termed this mixing *deep log analysis*.

None of the LIS articles analyzed for this study referred to MMR by name. Some researchers explained at the beginning of their articles that they had used both quantitative and qualitative methods, but this was not prevalent. It seems that the concept has not yet gained recognition in LIS research. Nevertheless, it is likely that researchers have employed it. To explore MMR use in LIS, this study analyzed journal articles to

- gain an initial assessment of the prevalence of MMR use in LIS;
- find out in which stages of a study—design, data collection, data analysis—the mixing was typically applied;
- uncover the types of mixing in such studies; and
- note which topics were most attractive to MMR.

Although not intended, analyzing these articles revealed the complexity one faces when examining the use of MMR.

4. The method

This study analyzed all articles reporting on empirical research published during 2005–2006 in the following journals:

- *Information Processing and Management*
- *Journal of Documentation*
- *Journal of the American Society for Information Science and Technology*
- *Library and Information Science Research.*

These research journals were selected because they are prominent, well established, international in scope, and general in their coverage rather than addressing a particular subfield in LIS.

This analysis yielded a total of 465 research articles. To focus on the study's goals required an in-depth analysis of these articles. The complexity inherent in MMR makes the use of crisp concepts, as

required for a quantitative analysis, challenging at times. Therefore, some concepts and procedures were defined explicitly to secure consistency in the analysis. These are presented below.

- *What is an empirical research article*? For this study, any article that included a description of a research method was considered reporting on empirical research.
- *What is MMR*? From the various definitions available, researchers selected the one provided by Tashakkori & Creswell (2007) because of its inclusive nature: MMR is "research in which the investigator collects and analyzes data, integrates the findings, and draws inferences using both qualitative and quantitative approaches or methods in a single study or program of inquiry" (p. 4).
- *Is a method qualitative or quantitative*? The fact that there is no agreed-upon definition for qualitative methods (Fidel, 1993) makes this distinction tricky at times. It is beyond the scope of this paper to present the various facets along which these definitions can be made. This study, however, required a clear-cut understanding of whether a certain method is qualitative or quantitative, and therefore it called for an operational definition for these concepts. For the purpose of the study these definitions were as follows.
  - Qualitative methods are methods that produce text (including images, drawings, etc.) as the outcome of their application.
  - Quantitative methods are methods that produce numbers as the outcomes of their application.

Even with such simple definitions, identifying the nature of a method is not always straightforward. For example, what type of method is used in a study that collected data from unstructured sources, applying unstructured instruments, in order to conduct a quantitative content analysis? While some may consider it qualitative because of the nature of the instruments and sources for data collection, using our definition, it was considered a quantitative study. In fact, the study reported here is an example of such a quantitative study. Similarly, content analysis of text that was guided by pre-defined codes and that reported only numerical results was considered a quantitative method.

- *Is a study a MMR or just multiple-methods one*? A MMR study mixes qualitative and quantitative methods. Mixing means that the methods support one another. A hypothetical example of using both approaches without mixing is a study of an experimental retrieval system that qualitatively analyzes participants' searching behavior and quantitatively measure their satisfaction ratings. Data analysis includes two parts: A rich description of searching behavior, and averages of satisfaction in using the system. Such a study cannot be considered MMR because the qualitative and the quantitative analyses answer different questions—the one: How participants search?, and the other: What is the level of their satisfaction? There is no relation between the two approaches.

Deciding whether mixing is present can be complicated. For instance, consider a hypothetical study that set out to develop new variables. The goals were achieved by qualitative analysis. However, when the new variables were discovered, the frequency in which they were used was also reported. The study was considered a qualitative one because the numeric portion was not integrated with the qualitative portions and provided no contribution toward accomplishing the study's goal. On the other hand, if a qualitative analysis discovered variables or factors, but the main goal of the study was to employ these newly discovered elements to create and test hypotheses or to quantitatively compare systems, the study was considered MMR with the mixing occurring in the design stage.

- *How to count*? The unit of analysis in this study was a research article, not a research project or a research program. If a MMR project generated several articles, only those that reported the mixing were considered MMR articles. A specific case is a research project in which researchers based one research article on a previous one that employed a different method and was published earlier; For instance, one article reported finding the variables to study through qualitative analysis, and the next one reported collecting quantitative data about these variables and conducting statistical analyses. Using an article as a unit of analysis, neither of these articles could be considered MMR. Therefore, this way of counting may have detected fewer MMR projects than have been conducted.

To test coding reliability, all articles in the study's sample were coded first by one person who flagged those that were challenging to code, even on a minute level, and provided a possible code for each. The second researcher then examined these articles to check the consistency of coding. Of the 11 articles so identified, 2 were not consistent among the 2 coders, bringing the inter-coder reliability to 82% on the most challenging articles.

Using these definitions, the analysis of the 465 articles found 80 articles (17%) that employed multiple methods. An in-depth analysis of these articles identified those that employed MMR, which facilitated addressing the other goals of the study.

5. Findings

5.1. The prevalence of MMR use in LIS

When using multiple methods, researchers may select methods from a single approach or from both qualitative and quantitative methods. Of the 80 multiple-methods articles, 39 used both qualitative and quantitative methods, comprising 49% of these articles and 8.3% of the total research articles examined (N=465). The other 41 articles (51%) used multiple instruments and procedures to collect data, but the analysis was guided by one approach. These included studies that collected data using a combination of various instruments and procedures—such as observations, interviews, and analysis of texts written by the participants—that were submitted to either qualitative or quantitative analysis. In the sample for this study, quantitative studies and qualitative studies used multiple methods to the same degree. Of the 41 articles that employed multiple instruments and procedures, about half (21 articles; 51%) employed a qualitative approach. The other 20 articles (49%) used a quantitative one.

Because MMR requires that quantitative and qualitative approaches be integrated, not all multi-approach articles belonged to this category. Arriving at the number of MMR articles required further examination of these 39 two-approach articles to determine whether or not the methods were mixed. This analysis revealed that 22 (56%) of these 39 articles could be classified as MMR (27% of all 80 multiple-methods articles; 5% of the total 465 articles examined. See Table 2).

The most common mixing was to use qualitative analyses to support a predominantly quantitative research—half of these articles (11) reported on such studies. Only 4 articles (18%) reported predominantly qualitative studies that were supported by quantitative analyses. In seven articles (32%), the methods supported one another equally. Although indicative of this sample, one cannot conclude that quantitative studies in LIS are more likely to employ MMR than qualitative ones. Various reasons could have contributed to these results. It is possible, for instance, that quantitative research was generally more prevalent in the 4 journals that published the 22 articles, or that reports of qualitative studies were more likely to span over more than one article. Therefore, the use of MMR in such studies could have been missed, given that the unit of analysis was a single article.

Table 2
The prevalence of MMR articles in the sample's articles

Attributes	Number of articles	All articles (*N*=465)	Multiple methods (*N*=80)	Two approaches (*N*=39)
Multiple methods	80	17%		
Two approaches	39	8%	49%	
MMR	22	5%	27%	56%
Not reported	5			12%

An example of using the two approaches without mixing was a typical procedure in qualitative, behavioral studies in which the researchers administered a questionnaire to the participants to collect demographic data before the participants began to work on their task. They presented the data from these questionnaires in aggregates to create a profile of the participants' population, which was completely separated from the qualitative analyses. Such articles were not considered MMR because each approach answered a different question.

Because it was not always easy to determine whether or not the methods were mixed, identifying the 22 articles was sometimes complicated. Most of the challenges to this analysis were caused by poor or incomplete reporting of research methods, particularly about data analysis. These challenges required additional decisions about how to classify an article. The simplest case was when authors reported using two approaches but neglected to describe if and how the methods were integrated. In such cases, and when it was difficult to determine from the Findings section if mixing took place, researchers recognized the use of different approaches and noted that mixing was "not reported." Five articles (12% of the 39 articles with both approaches) did not report if mixing took place. This case was typical of articles that included detailed (and often highly technical) descriptions of how the methods, procedures, and instruments were applied. However, the authors reported the results without clarifying what contribution each instrument and procedure provided.

In other cases, researchers employed both qualitative and quantitative methods but reported only the results derived from one type of analysis. Such articles were classified as "single-method." An example here would be a hypothetical study that investigates the effect of students' awareness of the available information sources on their searching behavior. Students fill out pre- and post-search questionnaires, search for information while thinking aloud, and rank the relevance of documents they retrieve. The article reporting the study offered quantitative analyses only, with no apparent contribution of the qualitative analysis of the verbal protocols.

These cases suggest that a data analysis section in a research report may eliminate these and other challenges. The section could inform readers on issues such as: Why was each instrument used? What did it contribute to the study as a whole? How was the data collected from each instrument analyzed (e.g., descriptive statistics, qualitative discovery of patterns)? What type of analysis was used to answer each of the research questions? If more than one type was used for a research question, how did the analysis integrate the data? An impressionistic assessment of the 80 multi-methods articles suggested that many of them were missing this information. Addressing these and similar issues would not only help to determine if an article is reporting on MMR, but would help all readers to understand better the study described and its contribution. Publication venues of research projects may want to consider a standard that requires authors to report about the design, data collection, and data analysis before they report the results.

Researchers also investigated the distribution of multiple methods and MMR articles in individual journals (see Table 2). Even though this study cannot provide any conclusive and valid results because of its sampling, the results indicate that there might not be great differences among the journals. At the extremes, *Information Processing and Management* had a relatively low percent of multiple-methods articles, but the portion of MMR articles among them was the highest among the journals. *Journal of Documentation* was leading the other direction; it had the largest proportion of multiple-methods articles but the lowest percentage of MMR ones.

5.2. The stage of study in which mixing occurred

To determine the stage of the study in which mixing occurred, the study employed the following interpretations:

- In the *design* stage, using one approach provided information that supported the design of the study in which the other approach was dominant.
- In the *data collection* stage, one approach provided insights that improved the process of data collection for an analysis dominated by the other approach.
- In the *analysis* stage, data collected from both approaches were integrated or supported each other in the interpretation of the results.

While these definitions seem unambiguous, it was not always easy to identify the stage in which mixing took place. Challenges presented themselves, particularly with regard to the design stage. Consider a study of Web searching in which a qualitative analysis of verbal protocols uncovered a number of factors that seemed relevant to the research questions. These factors were then submitted to a quantitative analysis with data collected through other instruments (e.g., questionnaires, transaction logs) to answer the study's questions. If these factors were uncovered *only* to facilitate the quantitative analysis, the study is a clear example of mixing in the design stage. But what would be the stage of mixing if the factors uncovered also answered one of the research questions without the additional analysis? This study would still be considered as design mixing because the *integration* occurred at this stage, even though the qualitative analysis contributed to the study findings.

Using these definitions revealed that mixing occurred in the design stage in half of the articles (11 articles) and in the analysis stage in the other half. Mixing in the data collection stage was used in two articles (9%). All but two articles employed mixing in one stage only. These two articles employed mixing in two stages (see Table 3).

5.3. Types of mixing

The research stage in which mixing was applied shaped the type of mixing used. The design stage included two types of mixing (variables discovery and system design); one type was used in data collection and two in data analysis (Triangulation and Interpretation) (see Table 4). These are explained below.

5.3.1. Variables discovery

Researchers performed qualitative analysis to uncover factors relevant to the phenomenon they studied. To answer the research questions, they conducted statistical analyses on the factors, sometimes including other variables as well. Nine (41%) of the 22 MMR articles selected this type of mixing. A weaker form of variables

Table 3
Distribution of types of articles by journal

Journal	Multiple-methods among all research articles	MMR among multiple methods
IP and M	11%	35%
Journal of Documentation	26%	0
JASIST	22%	22%
LISR	25%	33%

Table 4
Distribution of MMR use by research stage, subject, and type

Category	Number of articles	% (*N*=22)
Research stage		
Research design	11	50%
Data collection	2	9%
Analysis	11	50%
Two stages	2	9%
Subject		
Web searching	9	40%
Searching	3	14%
IR	3	14%
Information seeking behavior	2	9%
Other	5	22%
Type		
Interpretation	10	45%
Variables discovery	9	41%
System's design	3	14%
Triangulation	3	14%
Data collection	2	9%

discovery was exemplified by articles in which frequency of these discovered factors was required by the research questions and made up the only quantitative analysis.

5.3.2. System design

Another type of MMR in the design stage occurred when researchers planned to design an information system or to improve an existing one. They used qualitative analyses of searching behavior to collect requirements for the design of the new system and then developed it. Once the new system was ready for testing, experiments and statistical analyses helped to evaluate its quality. Researchers determined quality either through a comparison with another system (possibly the old one) or by applying certain standards for performance. Three articles (14%) reported mixing of this type.

5.3.3. Data collection

The two articles (9%) that used mixed methods in this stage collected statistical data about the potential participants in order to guide the process of qualitative data collection. The statistical data supported decisions on whom to ask to participate, what issues to emphasize in each interview, and how to formulate its questions.

5.3.4. Triangulation

Although this is most familiar case of MMR, only three articles (14%) applied it. Researchers collected data for quantitative analyses to test the validity and accuracy of findings arrived at through qualitative analyses.

5.3.5. Interpretation

This type was employed most frequently; it was used in 10 articles (45%). Researchers used findings from the qualitative analyses to support their interpretation and explanation of the quantitative results and to explain or resolve uncertainties. Three articles reported studies in which both triangulation and interpretation were used.

An examination of the role of each approach with relations to the mixing stage shows that when mixing occurred in the design stage, qualitative analyses were typically employed to support the quantitative ones, which were often designed to answer the research questions. But in the analysis stage, the approaches supported one another. This finding is not revealing, however, because unlike mixing in the other stages, mixing at the analysis stage was often executed poorly. Most frequently, it was applied sparingly and unsystematically, without explaining the motivation for applying it in a particular instance but not in another. Because 50% of the mixing occurred in the analysis stage, a stricter definition of MMR—one that requires mixing to be systematic and rigorous—would have significantly reduced the number of MMR articles in the collection examined for this study.

5.4. Topics attractive to MMR

Not surprisingly, all MMR articles reported on studies that investigated processes (see Table 3). The most popular topic was Web searching (9 articles, 40%), followed by searching and information retrieval (IR), each with 3 articles (14%). Articles about searching focused on certain aspects of searching—such as cognitive processes, and use of help—regardless of the information system used. Studies in IR addressed factors in query formulations or in a retrieval system that could be changed to improve performance. Two of the articles (9%) reported on studies in information-seeking behavior in which researchers looked for general patterns in this behavior. The remaining five articles (22%) were each dedicated to different topics: Interface design, scholarly communication, librarian's work, designer's work, and digital reference services.

6. Discussion

The portrayal of MMR use in LIS revealed that the approach has not yet established itself as a concept in LIS research. Only one textbook in LIS research (Gorman & Clayton, 2005) referred to it, using a definition that is broad in some senses and limiting in others. Only 5% of the 465 examined articles that described empirical research reported on its use, and no article mentioned MMR explicitly. Clearly, LIS is behind several fields in the social sciences—such as sociology, social policy, and management—in recognizing this approach. Is this disturbing? Should the LIS research community act to increase the recognition and use of MMR?

Answering these questions requires recalling the role of the approach. While MMR is sometimes necessary for an investigation to be carried out or to ensure its quality, it is not an all-encompassing solution to issues in research. Researchers apply it because they think it is needed, not because they wish to use a new approach. It is possible, therefore, that most of the research articles examined for this study did not require MMR use, which can explain the low rate of its application. Another plausible explanation of the low use, however, is the notion that the researchers who published these articles were unaware of the approach, even when they applied it. This explanation relies on the fact that this study found no educators, researchers, or methodologists in LIS who mentioned it in their publications—at least not in the way that it is understood by the larger research community. The observation that a considerable portion of the MMR articles reported on sparing and unsystematic application also supports this explanation. At times it seemed that mixing was used as an afterthought. It is reasonable to assume that awareness of the approach would have led to a more systematic application.

The first explanation is reassuring. There is no reason to be disturbed by the low use of MMR if it was not needed. The second one suggests possible improvements. There is no benefit to being unaware of MMR as an approach, but there are several advantages to understanding it and its potential to improve the quality of research projects.

One example of a research activity that can be improved through MMR use is the interpretations and explanations of quantitative results. It is not uncommon in quantitative research for such explanations and interpretations to be speculative in nature. Reasons for forwarding a particular explanation or support for its "validity" are not required. Consider, for example, the explanations given here for the low rate of MMR use in LIS. The first one (there was no need to use it) has no empirical basis, because determining if a study required MMR was not in this study's scope. On the other hand, the second explanation (researchers are not aware of MMR) is based on qualitative analysis (though not rigorous and systematic). While

readers of quantitative research are used to accepting unsupported explanations and interpretation of the results, grounding them in a deeper understanding of the studies phenomenon—which may require additional investigations—may increase their power, acceptance, and validity. Researchers who are familiar with MMR and its benefits are more likely to provide additional support for their explanations than those who are not aware of it. Other ways to benefit from MMR in LIS are evident from the descriptions of the types of mixing found in the study's articles and from the examples presented by the hypothetical scenarios of how mixing can be done (Tables 1a and 1b).

7. Conclusion

Awareness of MMR among LIS researchers can be increased through various channels. When authors who employ the approach explain their motivation for its use—along with its advantages and challenges and the mixing procedures they followed—readers enrich their understanding of these issues and may be exposed to new ways of thinking about the approach and its implementation. Methodological books in LIS that treat MMR as a new approach that is equal to the others have the potential to spread this awareness among new researchers, as would courses about MMR in LIS programs. Journals publishing articles reporting on MMR use can increase the clarity of the description and the analysis of the methods used for study design, data collection, and analysis and thus provide a useful foundation for future work. At this stage, a good beginning for raising familiarity with MMR is putting it on the LIS research map.

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