



Assessing information, media and data literacy in academic libraries: Approaches and challenges in the research literature on the topic

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ABSTRACT

A review of the research literature on the assessment of information, media, and data literacy in academic libraries has been carried out with the intention of learning about the main approaches taken; the assessment tools, criteria, and indicators used; and the main challenges for the future. To this end, 60 relevant records were retrieved from the Web of Science Core Collection and Scopus after being filtered according to the Preferred Reporting Items for Systematic review and Meta-Analysis (PRISMA) model. A content analysis of the articles was then carried out using a detailed form based on the objectives, methodology, results, conclusions, and recommendations model in relation to the current aims. Literacy assessment has been conducted primarily in information literacy. Research in anglophone countries and Spain stands out. Much of it relates to academic libraries as a whole, although there are also numerous studies focused on a field of use, primarily health, STEM, and social sciences. Among the most commonly used methods of analysis, case studies stand out, followed by descriptive, exploratory, experimental, and comparative studies; literature reviews; and content analysis. The results are positive, and assessment helps improve programs and demonstrate libraries' impact on student learning. Despite its importance, media literacy assessment is still an emerging field, and data literacy assessment is still largely a work in progress. Academic libraries need to integrate new types of literacy and emerging challenges such as open data, open science, and generative artificial intelligence into the comprehensive framework of information literacy and conduct a systematic assessment of their training programs and activities.

Introduction

Context and research question

Libraries have become key players in training in information competencies, and assessment is a key element when it comes to diagnosing needs and implementing training activities. Academic libraries have helped students learn to identify a variety of resources, assess them, and select information. And students use library resources for academic purposes, impacting learning outcomes. Today's information society demands transversal competencies that transcend academic fields, not

just knowledge of one particular discipline. One such competency that plays a key role is the ability to process and use a range of information as the foundation for developing new knowledge (Lee et al., 2012).

As information has spread in new media and formats, and society and education have had to cope with its impact, information literacy (IL) has evolved into multiliteracy and transliteracy (Alonso Varela, 2023; Hodgman, 2005). Multiteracy—or more frequently, multiliteracies—implies the recognition that the different literacies interact with and overlap one another in a global and transcultural environment (New London Group, 1996); while transliteracy implies a native and fluid approach to the current transmedia environment (Thomas et al.,

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2007): “a fluidity of movement across a range of technologies, media and contexts” (Sukovic, 2014, p. 207). Additionally, libraries are faced with the challenge of coherently and systematically coping with this array of new informational challenges, which have been compounded in the last decade by the open Big Data movement and, recently, in a closely related way, by generative artificial intelligence.

Adapting to such major changes certainly requires a continuous effort to assess the results that the users, the agents, and their interaction, as well as the programs themselves, obtain. This assessment must be carried out strategically, that is, by addressing the totality of the interrelated challenges that the complex world of contemporary information poses. It must also conform to existing standards and best practices in the field of service assessment and teaching. When it comes to assessing plans, policies, and programs, the key benchmark is existing quality management models. In the educational field, there are agreed-upon standards in comprehensive international frameworks, such as the Guidelines of Good Practice from the International Network for Quality Assurance Agencies in Higher Education (International Network for Quality Assurance Agencies in Higher Education (INQAAHE), 2018). When it comes to student assessment, it is necessary to aim for comprehensive and authentic assessment “that replicate[s] real-world challenges and standards of performance that experts or professionals typically face in the field” (Koh, 2017).

This article examines how academic libraries have undertaken the assessment of their activities and training programs thus far by means of a systematic review of the published literature on this subject found in the Web of Science Core Collection and the Scopus database.

Literature review

The literature reviewed highlights university libraries' vital importance in needs assessment processes and in developing training programs aimed at acquiring information competencies in various university contexts, incorporating other types of literacy into IL. Assessing these programs to improve IL training becomes an emerging issue.

Libraries and IL

Although the current concept of IL dates from the 1970s (Taylor & Jaeger, 2022, 16 ff.), libraries have provided training in information competencies under different names—user training, library instruction, information literacy development, information skills development—, configuring a well-established area of research and practice within the Library and Information Science field, since its contemporary configuration (Weiss, 2003). Although initially developed by librarians, it has since become a key transversal skill, not only in academia but also in training for the public (Grizzle et al., 2021). This renewed focus led to the development of early working definitions (American Library Association and Association for Educational Communications and Technology (ALA), 1999) and the establishment of models focused on higher education (ACRL, 2000; ACRL, 2015; SCONUL, 2011). Librarians' increased interest was also reflected in the creation of IL policies in international bodies, such as the United Nations Educational, Scientific and Cultural Organization (UNESCO) (Grizzel et al., 2013, 104, 131–2), which included libraries as a priority space for research within the Library and Information Science framework. These advances paved the way for the development of theoretical work, such as models based on the IL process (Houlihan et al., 2017). In parallel, IL made its way outside of academia, including a wide variety of professional settings, such as the health sciences and engineering (Erlinger, 2018; Munn & Small, 2017).

Today, IL, which encompasses a variety of professional, social, and research areas (Grabowsky & Weisbrod, 2020; Lierman & Santiago, 2019), presents a consolidated research front, which embraces multiple types of literacy and becomes part of the core competencies for every university student (Duffy et al., 2021; Pinto et al., 2023). This takes the

form of programs and training actions aimed at developing critical competencies necessary for academic success, such as information seeking, evaluation of resources, and effective communication. It is recognized that literacy programs can improve academic quality and promote university students' success (Mandrekar & Rodrigues, 2021), as long as they adapt to new forms of mediation, to new ways to provide this training, mainly grounded in ICTs, more interactive websites, mobile applications, etc. (Pinto et al., 2021; Pinto, Caballero-Mariscal, & Segura, 2023).

Several recent publications have reviewed from the perspective of libraries papers, research, and resources related mainly to IL and, on a smaller scale, to media literacy to understand its present state (Nisha & Varghese, 2021), addressing conceptual aspects, teaching, and assessment methods, as well as this skill's importance in different educational and professional contexts (Grabowsky & Spybey, 2022). From there, libraries can learn about emerging trends and future lines of research in IL (Hammons, 2022).

New types of literacy

IL is, therefore, one of the key transversal competencies in university education (Tkachenko et al., 2023), in which libraries are indispensable agents. However, space is being given to other types of literacy that complement IL, and libraries, with their diagnostic work and training activities, are gradually following this trend. The central role of IL, although very significant, must be combined with other types of literacy, such as media literacy (ML) and academic literacy (AL), which will form a holistic and effective educational landscape. Thus, ML helps users learn to distinguish between accurate and false information (Lim, 2020; Revez & Corujo, 2021). Similarly, Morris (2020) highlights digital literacy's role as an IL skill. Erlinger (2018) and Lierman and Santiago (2019) recognize this diversification of types of literacy as an unstoppable trend to which the academic community, including libraries, have to adapt through assessment, support, and training strategies. In other words, today, multiple types of literacy are required if one wants to have the training and competencies to face the challenges of academic, scientific, news, social, etc., information management in society today. In this context, IL plays a fundamental, leading, and unifying role, as it merges with the other types of literacy. This trend is reflected in the growing use of the term “multiliteracy,” and even “transliteracy” (Alonso Varela, 2023; Hodgman, 2005).

IL in different library contexts

The literature review also provided an overview of the variety of disciplinary contexts in which IL has been deployed, including Library and Information Science, Education, Computer Science, Engineering, Business, and Health, among other fields (Pinto, Caballero-Mariscal, García-Marco and Gómez-Camarero, 2023). Although most studies still focus on the library's general role, research is beginning to reflect the importance of IL in all knowledge areas. In this vein, one should emphasize the specialized role that libraries play in helping university students to develop and acquire the competencies they require.

Several authors have reviewed the state of the art of IL in the health sciences field, as well as training programs, training activities for interventions, and diagnostic effectiveness in this field of knowledge, highlighting the active and effective role that libraries play (Boruff & Harrison, 2018; Grabowsky & Spybey, 2022; Haruna & Hu, 2018; Hicks et al., 2022; Munn & Small, 2017). In general, all this research addresses skills related to the search for, assessment of, and ethical use of information as an integral and necessary part of the curriculum, which actively involve libraries. Current IL initiatives in health are oriented toward developing effective programs capable of exactly meeting needs and adapting to the processes of change resulting from technological development. Additionally, media and information literacy (MIL) in health converges with the health literacy movement (Frisch et al., 2012; Lawless et al., 2016), which has been bolstered owing to one of the serious social effects of coronavirus disease 2019 (COVID-19): the so-

called infodemic (Ameri et al., 2022; Hashemi-Shahri et al., 2020).

Other papers address the areas of business (Gareau-Brennan & Kung, 2022); Houlihan et al., 2020) or engineering (Nisha & Varghese, 2021; Phillips et al., 2018; Stapleton et al., 2020). Not only are aspects such as IL's definition and scope, teaching and assessment methods, and technology's impact on library instruction explored but so are their impact on disciplines that require several types of literacy, such as engineering and the exact sciences.

Assessment of library literacy programs

For libraries, a strategic approach crucial to this multi-skilled IL effort is to accurately analyze the various strategies and methods to determine the effectiveness of these programs, which must be adapted both to students' needs and to the use of educational technologies. In this sense, assessment programs carried out on and by libraries become a priority to provide accurate assessments that contribute to academic advancement and breakthroughs in research (Hicks et al., 2022; Nisha & Varghese, 2021).

There are a number of literature reviews and research articles that collect IL assessment experiences. Grabowsky and Weisbrod (2020) examine a number of pertinent studies to assess library instruction's impact when it came to academic achievement, IL, and student satisfaction. Their assessment emphasizes that library instruction has a significant positive effect on the development of research skills and academic performance in undergraduates, graduates, and working professionals. In addition, Morris (2020) investigates issues such as student engagement, effectiveness of instruction, and student satisfaction. This paper offers a comprehensive view of students' perceptions of IL programs in different learning environments, being instrumental in the planning and design of specific and effective training activities. Mandrekar and Rodrigues (2021) recently discussed the importance of assessment when it comes to analyzing critical skills needed to achieve academic success, such as information seeking, evaluation of resources, and effective communication. They also examine various strategies and methods, highlighting the use of educational technology. Meanwhile, Revez and Corujo (2021) focus on strategies and approaches that librarians use to counter misinformation. After analyzing various practices, such as IL and the creation of specific guides and resources, they provide a comprehensive overview of initiatives that promote ML and help users determine what is quality information. As Gareau-Brennan and Kung (2022) did, these authors propose an assessment model with three successive phases (three-phase model): assessment, diagnosis, and suggestions for optimizing competency acquisition.

It is also essential that libraries have effective tools to assess and diagnose the implementation of activities in complementary types of literacy, as well as to review their effectiveness. In recent years, media literacy (ML) and data literacy (DL) have become particularly important (Pinto et al., 2023). In regard to the former, Pashkova-Balkenhol et al. (2019) and Lierman and Santiago (2019) highlight the importance of collaboration between libraries and other stakeholders to assess competencies and undertake IL and ML training in concert (MIL). In a similar vein, Vega García et al. (2017) and Blummer and Kenton (2018) emphasize that training provided by libraries and professionals' active participation in specific training activities help improve undergraduates' acquisition of MIL competencies. In addition, they indicate that motivation and participation in these activities are related to the competency outcomes obtained. There is a recent review by Cui et al. (2023) about DL assessment, indicating that the field is still emerging.

The studies reviewed show that the evaluation of IL (and to a lesser extent, ML and DL) programs in the context of academic libraries has had positive results in terms of improved academic performance and coping with misinformation. However, these results thus far are short term, focused on assessing participants' satisfaction and/or evaluating learning, many times on the basis of a single instrument (Booth et al., 2015). As in other areas of library services, and the service sector in general, one of the key challenges is to shift away from assessing

outcomes and toward assessing the medium- and long-term impacts that justify investing in them. The International Standard from the International Organization for Standardization (ISO 16439, 2014) has been a decisive step in this direction.

This approach to the impact of medium- and long-term evaluation is still underdeveloped in the literacy information field and represents a substantial challenge for research. Although it was addressed early on by authors such as Streatfield and Markless (2008), specific studies are still scarce. Egeland (2017) and Farrell and Mastel (2021) have identified the main challenges that librarians face in assessing the impact of their IL educational efforts: going further than simple metrics such as satisfaction surveys; determining students' level of preparedness for employment after graduation, especially in relation to their mastery of IL to be used in the workplace; addressing budget constraints that hinder investment in assessment techniques and tools; relying on diverse types of intel to ensure that the assessments are representative; using a variety of methods to assess the impact of their educational efforts, balancing the use of quantitative methods of analysis (e.g., attendance and usage statistics and the use of IL skills in the workplace) and qualitative ones (e.g., user opinions and perceptions) to gain a better understanding of their educative impact; and integrating assessment into their institutions' goals to ensure that their educational efforts are aligned with the desired outcomes of their institutions and society in general (also Brown et al., 2015).

Two of the most important moments for measuring this impact are, internally, from the first year of university to graduation or from undergraduate to postgraduate and, externally, during the employment phase to determine how the IL competencies acquired during the years of university training affect professional performance (Matthews, 2014) and other aspects such as job level or salary. Therefore, training impact assessment involves longitudinal studies (Rowe et al., 2021) and requires not only knowing the subjects' opinions but also collecting objective evidence (learning and use of these acquired competencies, qualifications, salary, etc.) on how their learning process and professional performance have improved thanks to IL programs (Catalano & Phillips, 2016).

Overall, it was evident from the literature review that libraries play a crucial role in diagnosing, assessing, and making decisions about the acquisition and improvement of IL competencies in university students. Hence, assessment is a key element in both demonstrating libraries' effective role in this task and supporting the continued improvement of programs and activities. Although many studies highlight the need for libraries to implement IL assessment programs and training activities, few studies address MIL assessment carried out by libraries, and no comprehensive reviews that addressed IL, ML, and DL assessment as a whole were found.

Objectives

The general objective of this paper is thus to analyze the scientific literature about IL, ML, and DL assessment in the context of academic libraries to find out about the major trends, as well as the assessment tools, criteria, and indicators being used and reflected in this set of research studies.

The specific objectives are principally to understand libraries' role in the literacy field and to identify the frameworks, theories, and assessment models and highlight the main objectives and subjects addressed in the works analyzed, the methodology used, and the results, as well as the conclusions and recommendations (Annex 2).

Methodology

The methodology is presented in two phases: the selection of the working corpus and the content analysis process.

Selection of the working corpus

After several pilot searches, it was decided that the work would be carried out with a sample collection that was representative, high-quality, and meaningful in terms of impact and citations in other journals. For this reason, the two large corpora offering these characteristics—Scopus and Web of Science (WoS)—were selected. In the latter, moreover, the search was limited to the Web of Science Core Collection, since WoS makes it easier to retrieve objects from a more selective corpus because it is separated into two levels—the Core Collection and the Emerging Sources Citation Index (ESCI)—on the basis of impact criteria: the citation analysis of articles, authors, and the editorial team and the importance of content that does not immediately create impact in terms of citations (Clarivate, 2023). Furthermore, it provides a different corpus than the systematic review of Brettle (2007) regarding IL assessment in health libraries, which conducted searches in databases such as the Australian Education Index; British Education Index; Cumulative Index to Nursing and Allied Health Literature (CINAHL); Education Resources Information Center (ERIC); Library and Information Science Abstracts (LISA); Library, Information Science & Technology Abstracts (LISTA); and MEDLINE.

To meet the main objective regarding the research on libraries' assessment of IL and other types of literacy (media and data literacies), the search equation was derived from the convergence of the IL, ML, and DL fields with assessment and libraries. The search was therefore carried out in the Web of Science Core Collection and in Scopus in all languages in the title field, so that the results obtained would be more specific, and with no time limitations, so that all records from the beginning of the databases' scope were included, although the search's end date was November 21, 2023.

All relevant related search terms that could be used to find documents about IL, ML, DL, and assessment were included (this was not done with libraries because the term is very consistent for this concept). Because some authors are reluctant to use the term “literacy,” the search was expanded with the most frequently used alternative terms: “skills” or “competencies”, in singular and plural. As very few results were obtained for DL, synonyms in this case were expanded to other closely related fields as statistical and quantitative literacy. Moreover, these terms had already been used in previous research and had provided very satisfactory results (Pinto et al., 2023). In addition, Boolean operators were used to cross-reference other synonyms related to assessment such as “measurements”, “indicators”, “models”, or “criteria”—some of which were similar to those used by Brettle (2007), with equally successful results.

The search was carried out in “Exact Search” mode to precisely manage the search terms and avoid automatic lemmatization and stemming. A detailed description of the search strategy is provided in Table 1.

As a result of the search equation, 55 documents were obtained from WoS and 59 from Scopus, that is, a total of 114. First, duplicates were excluded from both databases (35). Regarding inclusion criteria, it was decided that journal articles and conference proceedings would be included and that reviews, book chapters, and books would not be included, because the aim was to find research papers with original results or proposals. Though book chapters and books are also a valuable source in our field, they often republish or elaborate on previous research projects and experiences that have already been published in journals and conference proceedings, which can alter the quantitative results of content analysis studies such as this one. After determining whether potentially relevant papers met the inclusion criteria (WOS, $n = 42$; Scopus, $n = 21$), the full articles were obtained for detailed analysis. These documents were read, and we moved on to the data extraction stage.

In the data extraction stage, four additional documents were excluded for being mislabeled, having unsuitable content, or not being a research article, or because it was not possible to find a full-text version.

Table 1

Semantic field	Search terms	Synonyms and variants (with OR)
Assessment (AND)	“assess*”	“evaluat*” “measur*” “metric*” “criter*” “indicat*” “standard*”
[in] Libraries (AND)	“librar*”	
[of] Information Literacy (OR)	“information literacy”	“information literac*” “information literat*” “information competenc*” “information competent” “information skill*” “media information literac*” “media and information literac*”
[of] Media Literacy (OR)	“media literacy”	“media education” “critical media skill*” “media literacy skill*” “data competenc*” “data skill*” “data literac*” “data literate*” “data competent” “quantitative literac*” “quantitative literate” “quantitative competenc*” “quantitative skill*” “statistical literac*” “statistical literate*” “statistical competenc*” “statistical skill*” “data information literac*” “data information literate*” “data information competenc*” “data information skill*”
[of] Data Literacy (OR)	“data literacy”	

Therefore, a total of 60 studies were included in the review, as reflected in the PRISMA flow chart in Fig. 1 (Page et al., 2021), which presents the search, review, and data extraction processes. (See Fig. 2)

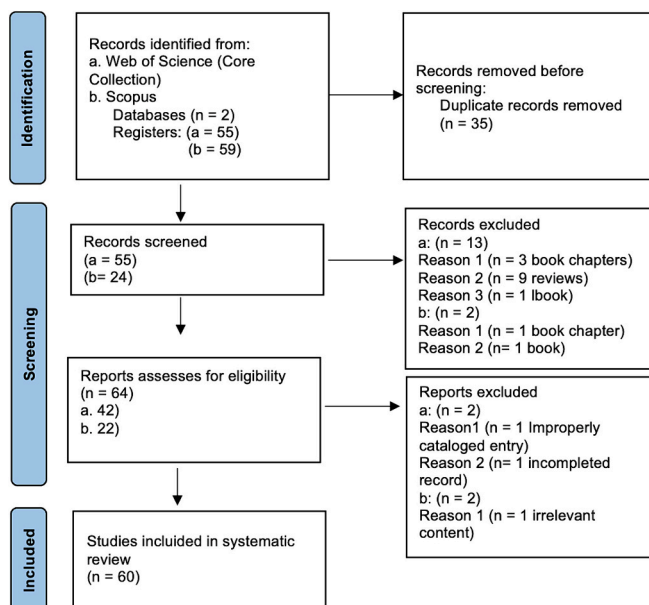


Fig. 1. PRISMA flowchart. Source: Page et al. (2021).

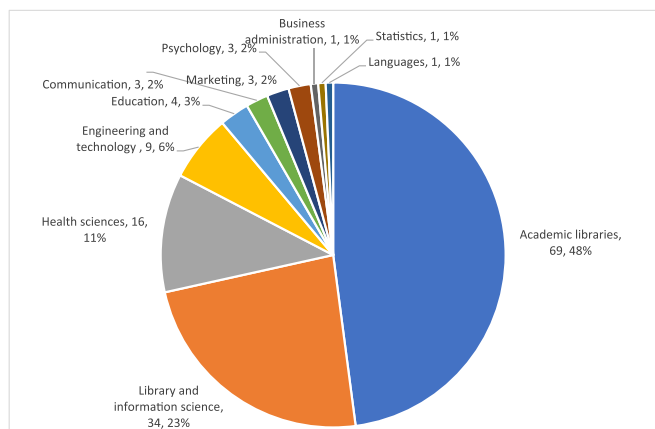


Fig. 2. Authors' disciplines.

Methodology of analysis

Once the study's objectives had been set and the studies had been identified and selected, the qualitative content analysis methodology was used to extract, interpret, and synthesize the important information from the corpus studied, following the objectives, methodology, results, and conclusions (OMRC) structure.

To this end, the corpus data were extracted and collected using a tool created in Google Forms, revised, and pilot-tested by experts; this tool included the field of study's most important elements (Appendix 2). It consisted of five broader sections—divided into 19 subsections—that expanded upon variables, and addressed a work's general characteristics (context and authorship), the research frameworks of the literacy assessment (definitions of literacy assessment; related types of literacy; and assessment frameworks, theories, and reference models); research objectives and research subjects; methodology (types of study, assessment approaches, methods/techniques, sources, tools, assessment criteria, and indicators), and assertions of knowledge (results, conclusions, and recommendations).

The interpretation of the information obtained was cross-checked in weekly plenary sessions, in which the main findings were shared and verified through feedback. At these meetings, progress was also presented, and concerns were discussed so that the upcoming activities could proceed.

In the systematic analysis of the selected papers, the same variables were studied in all the searches. These variables were established by taking into account the research objective and libraries' role in the literacy field, with special attention to the indicators and assessment tools used.

To study the research's theoretical, methodological, and evidential frameworks, the "Introduction" and "Literature Review" sections of the selected corpus were used, and information on the following aspects was extracted: definitions, disciplinary relationships, theoretical and methodological approaches, and reference studies.

The methodology was analyzed using the terminology that the authors employed in their works. The disaggregated or aggregated use of information and media literacies—IL, ML, or MIL, as they usually develop different approaches—was respected.

To analyze their objectives, objects of analysis, results, conclusions, and recommendations, relevant information was extracted from the articles, their topics were identified, and categories were created on the basis of elements that allowed them to be grouped according to common characteristics, which were later conceptually defined through brainstorming. The items were included in each category on the basis of its key characteristic; for example, those that discussed the process of assessment involving collaboration between teachers and librarians in detail were grouped into the "Collaboration between librarians and

teachers" category.

Results and discussion

Here, we present the results obtained from the content analysis of the selected articles, followed by sample characteristics, the research framework, the objectives and object of the study, the methodology, the results, the conclusions, and recommendations, as well as a discussion regarding other works on the subject.

Authorship and sample characteristics

The disciplinary background, nationality, and productivity of the 144 authors of the corpus analyzed—very diverse in all aspects—are described here. In terms of disciplinary background, most of the authors were academic librarians (69), with information and documentation teachers (34) trailing far behind, followed by teachers of health sciences (16), engineering and technology (9), education (4), marketing (2), psychology (2), communication (2), business administration (1), statistics (1), and languages (1) (Table 2).

Regarding nationality, authors from universities in the United States (91) were conspicuously predominant. There were fewer authors from other countries: Spain (11); Canada (10); the United Kingdom (8); Nigeria (6); Botswana (2); Sweden, Brazil, Venezuela, Bangladesh, and Singapore (2); and Japan, Mexico, Colombia, Cuba, and Pakistan (1) (Fig. 3).

In terms of productivity, the analyzed group was very diverse, but Pinto stood out as the author with the highest number of articles (2), followed by Marzal, Rieh, Bradley, Oakleaf, Brage, and Svensson (2).

In regard to co-authorship, for most of the papers written by several authors, they generally worked in the same field of knowledge and came from the same university. There were also papers by authors from different areas of knowledge, indicating habitual collaboration between university libraries and other disciplines: information and documentation, health sciences, communication, education, engineering and technology, and psychology. In terms of interdisciplinary teams formed by the authors, the Spain–Colombia, Spain–Cuba, and Spain–Mexico combinations were particularly noteworthy, in line with the academic relationships that these countries tend to maintain.

To sum up, evaluative research on IL-ML-DL assessment has been carried out primarily by academic librarians and secondarily by library and information science (LIS) academics, although there has been ample input from many disciplines. US and English-speaking countries have mainly undertaken this research, though other developed and emerging countries have also been involved. Finally, it is a team effort, as evidenced by the majority of papers being co-authored.

Research frameworks

The "Introduction" and "Literature Review" sections in the selected corpus were used to study the research's theoretical, methodological, and evidence frameworks, exploring the following aspects of IL, ML, and DL assessment in libraries: definitions, disciplinary relationships, theoretical and methodological approaches, and reference studies.

Definitions and conceptualizations

Authors provide relatively formal definitions when they believe that there are concepts that require clarification because these concepts are either novel or subject to debate. In our case, authors did not find it necessary to provide definitions, or even a conceptual approach to assessment and its theoretical approaches.

Only just over a quarter (17 out of 60, 28.33 %) did so, providing a total of 30 definitions, of which 27 were quotes and 3 were their own definitions. Both the purpose of the definitions (Fig. 4) and the authors cited varied widely. In terms of authors, only Oakleaf got more than one citation, and in different papers (Oakleaf, 2008, 2009). (See Figs. 5 and 6

Table 2
Skills and competencies frameworks.

Year	Title	Type	No.	%
1989	ALA 1989 A Library Advocate's Guide to Building Information Literate Communities - Information Literacy Competency Standards for Higher Education (p. 24)	IL (general)	1	1,56
1999	SCONUL 1999 Information skills in higher education: a SCONUL position paper	IL (general)	3	4,69
2000	Accreditation Board for Engineering and Technology (ABET) Accreditation Guidelines	Accreditation (disciplinary)	2	3,13
2000	ACRL, 2000 Information Literacy Competency Standards for Higher Education	IL (general)	30	46,88
2001	ANZIL/CAUL 2001 Information Literacy Standards, first edition	IL (general)	1	1,56
2003	Developing Research and Communication Skills: Guidelines for Information Literacy in the Curriculum - Middle States Commission Information Literacy Framework (based on ACRL)	IL (regional)	1	1,56
2004	ANZIL/CAUL 2004 Australian and New Zealand Information Literacy Framework: Principles, Standars and Practice	IL (general)	2	3,13
2006	ACRL 2006 Information Literacy Standards for Science and Engineering / Technology	IL (specific)	3	4,69
2008	Commission on Colleges Southern Association of Colleges and Schools Reaffirmation of Accreditation and Subsequent Reports Policy Statement	Accreditation (regional)	1	1,56
2009	Accreditation Board for Engineering and Technology (ABET) Accreditation Guidelines	Accreditation (disciplinary)	1	1,56
2010	American Nurses Association (ANA) Standards of Professional Nursing Practice	Accreditation (disciplinary)	1	1,56
2010	Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects	Accreditation (disciplinary)	1	1,56
2011	SCONUL, 2011 The SCONUL Seven Pillars of Information Literacy Core Model For Higher Education	IL (general)	1	1,56
2011	Undergraduate Public Health Learning Outcomes Model version 1.0 — health-related	Accreditation (disciplinary)	1	1,56
2013	ACRL 2013 Information literacy competency standards for nursing	IL (specific)	1	1,56
2013	WASC Handbook of Accreditation Revised 2013	Accreditation (regional)	1	1,56
2016	ACRL 2016 Framework for Information Literacy for Higher Education	IL (general)	10	15,63
2017	Oxford Centre for Evidence-Based Medicine framework	Disciplinary	1	1,56
2018	AASL National Standards for Learners, School Librarians and School Libraries	Sectorial	2	3,13
	Total		64	100

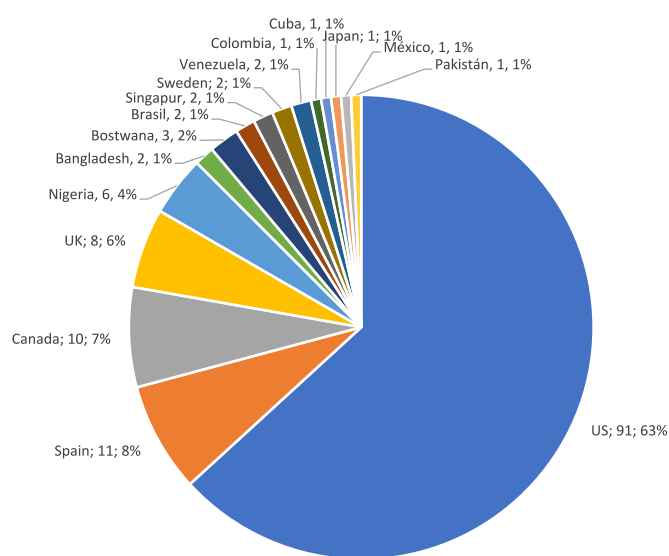


Fig. 3. Authors' countries of origin.

). The terms used show clearer patterns, particularly when ranked by inclusion (Fig. 4). Of note were the types of assessment, especially summative (2), formative (2) and authentic (2) assessments, as well as the definition for assessment of learning outcomes (2). These are technical pedagogical terms that the authors may have felt needed clarification, despite the definitions in the guidelines from Stec (2004). The most detailed section was focused on program components (students, instruction, and resources). Their diversity showed that the authors took

interest in nearly all the typical assessment topics. Thus, the authors generally did not feel the need to discuss in depth the theoretical, pedagogical aspects of the assessment process, but rather moved on to the topic and defined only specific pedagogical techniques they were using or analyzing, which they thought might be new to their readers.

Related types of literacy

In the 60 documents, only eight different types of literacy related to IL appeared in 6 different documents. This low incidence confirmed that the studies were focused on IL in the strictest sense. However, four articles analyzed the relationship of IL to the broader field of media and information literacy (MIL), and one article to ML (Kozłowska-Barrios, 2023), within the framework of both understanding and promoting together both types of literacy (IL and ML) encouraged by UNESCO. In addition, data literacy (DL) was mentioned twice (Iqbal, 2021; Islam & Tsuji, 2010), and digital literacy once (Ivanitskaya et al., 2008). This proportion is similar to that found in other recent studies (Pinto et al., 2023), which shows that the importance of working toward integrating information literacy, media literacy, data literacy, and digital/computer literacy—largely owing to their significant interconnectedness—was recognized early on.

Frameworks, theories, and reference models

The vast majority of the studies indicated the frameworks used as a reference (45 out of 60; 75 %). Table 2 presents their evolution and typology. The vast majority met the 2000 and 2015 editions of the ACRL standards, and some used specific skills and competencies frameworks, as well as professional standards to contextualize IL. Other pioneering standards in the IL field are also presented in the table.

An analysis of the theoretical and methodological frameworks showed that most of them were directly related to assessment (31 = 75.61 %). Of the most generic (10 = 24.39 %), four were from the domain of education, growth mindset, role playing in education, digital game-based (DGB) learning, and pedagogical playability heuristics (PPH), thus highlighting the field of gamification; three of these were from library and information science (LIS)—Kulthau's model of the information search process, methodology of analysis and assessment of online digital resources (Codina, 2006) and Pinto's abstracting model, which provides a cognitive theory for information analysis and synthesis skills—and one each from sociology (action theory), management (quality management); and medicine (the patient/population, intervention, comparison and outcomes [PICO] model).

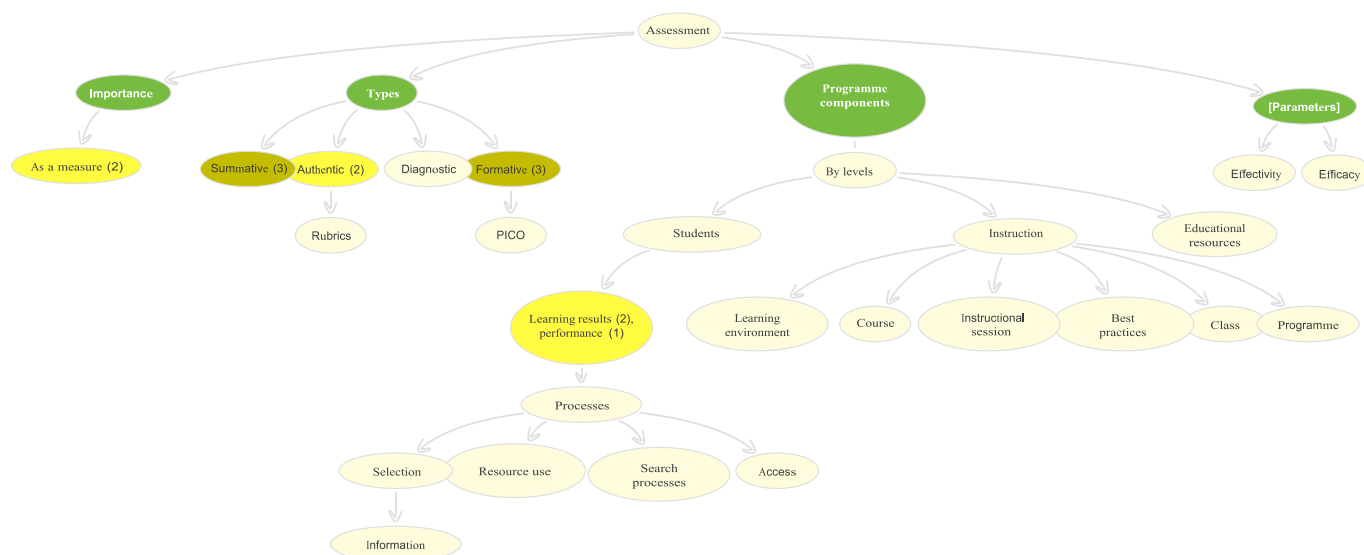


Fig. 4. Map of concepts that were defined.

Table 3
Number of studies according to their objective.

Study objectives	N°	%	References
Definition of theoretical elements on assessment of Information Literacy	5	8,3	Brettle, 2007; Fuchs & Ball, 2021; Pisté-Beltrán & García-Quismondo, 2018; Welty et al., 2012; Baggett et al., 2018
Assessment of Information Literacy (IL) competencies	17	28,3	Booke & Wiebe, 2017; Brage & Svensson, 2011a, 2011b; Lessa & Leal, 2023; Makinde et al., 2023; Marzal et al., 2011; Osorio Bernal & Chiavola, 2008; Rieh et al., 2019, 2022; Schweikhard et al., 2018; Smith & Dailey, 2013; Tran et al., 2018; Willson & Angell, 2017; Frandsen et al., 2017; Klubek, 2016; Okeji et al., 2020; Folk, 2014
Assessment of Media and Information Literacy (MIL) competencies	4	6,6	Guo & Goh, 2015; Iqbal, 2021; Kozłowska-Barrios, 2023; Squibb, 2017
Assessment of the Information Literacy (IL) learning process	12	20,1	Bradley et al., 2013; Burkhardt, 2007; Dawson et al., 2012; Gustavson, 2012; Islam & Tsuji, 2010; Ivanitskaya et al., 2008; Oakleaf & Hinchliffe, 2008; Pinto et al., 2008; Bravo et al., 2013; Noe & Bishop, 2005; Hobbs et al., 2015
Policies and plans in the development and implementation of Information Literacy (IL)	5	8,3	DaCosta & Dubicki, 2012; Davidson et al., 2002; Ishimura et al., 2007; Pinto et al., 2021; Zhang et al., 2015
Integration of Information Literacy (IL): Library and Academia	17	28,4	Ayre et al., 2014; Belanger et al., 2012; Johnson, 2005; Klipfel, 2014; Mutula et al., 2005; Naz & Casto, 2013; Oakleaf & Hinchliffe, 2008; Pinto & Fernández-Valdés, 2010; Saunders, 2007; Wakimoto et al., 2016; Whitlock & Ebrahimi, 2016; Willenborg et al., 2020; Williams, 2013; Nelson & Fosmire, 2010; Hanlan et al., 2013; Gerrity, 2018; Walter, 2009
Total	60		

With respect to assessment theories and models, five (16.13 %) were general models, applicable to any field. The first four were theoretical models—assessment for learning theory (Shepard, 1989; Wiggins, 1989, 1996; Stiggins, 1991); *Assessment in Student Affairs: A Guide for Practitioners* (Upcraft & Schuh, 1996); the assessment cycle of Bresciani (2003); and the assessment cycle of Maki (2002)—and the last one was more specific to one place—the Pierce College assessment cycle (Flynn et al., 2004). Most theoretical models were from the 1990s and the early 2000s. Specific models for IL assessment accounted for 54.84 % (17); in other words, the vast majority were very targeted on their subject. With the exception of the Information Literacy Instruction Assessment Cycle (ILIAC) from Oakleaf (2009), which appeared in five papers, there was wide variation. The tools (9 = 29.03 %) are presented in the “Methodology” section.

At a more specific level, several interesting states of art were cited (Diekema et al., 2019; Dugan & Herson, 2002; Julien et al., 2018; Koufogiannakis & Wiebe, 2006; Schilling & Applegate, 2012; Walsh, 2009). Other studies referred to specific studies. In addition to the many papers that used assessment to provide evidence of IL programs' success and the importance of libraries' work in this field, there were studies that tested novel methodologies. Those that combined diagnostic and summative assessment (pre-tests and post-tests)—for example, using students' quotations in their work to demonstrate their level of competency acquisition in their specific context—stood out for their number. These methodologies were useful when it came to both bringing to light IL and role of libraries and enhancing the student experience by fostering increased motivation and a formative and authentic assessment experience.

Objectives and purpose

For each individual (IL, ML, and DL) or integrated (MIL) literacy, the objectives and object of study addressed in the selected works were analyzed, as well as their direction—reflective or applied—in terms of a library's assessment of training programs.

Objectives

In relation to the general objectives, the highest percentage of items were focused on assessing IL competencies (17 = 28.3 %) and the collaboration between the library and the faculty (17 = 28.4 %). Another important group of studies focused on the assessment of the IL learning process (12 = 20.1 %). To a lesser extent, there were addressed the theoretical aspects in the assessment of IL competencies, IL

Table 4
Number of studies according to their object of assessment.

Object of study	N°	%	References
Definition of indicators and metrics for evaluation in Information Literacy (IL)	7	11,7	Brettle, 2007; DaCosta & Dubicki, 2012; Fuchs & Ball, 2021; Oakleaf & Hinchliffe, 2008; Pisté-Beltrán & García-Quismondo, 2018; Welty et al., 2012; Baggett et al., 2018
Specific Information Literacy (IL) Courses and Programs	19	31,6	Belanger et al., 2012; Brage & Svensson, 2011a, 2011b; Burkhardt, 2007; Davidson et al., 2002; Gustavson, 2012; Ishimura et al., 2007; Islam & Tsuji, 2010; Johnson, 2005; Makinde et al., 2023; Mutula et al., 2005; Osorio Bernal & Chiavola, 2008; Saunders, 2007; Schweikhard et al., 2018; Smith & Dailey, 2013; Williams, 2013; Okeji et al., 2020; Zhang et al., 2015; Hobbs et al., 2015
Assessment of Information Literacy (IL) competencies and skills	17	28,3	Ayre et al., 2014; Booke & Wiebe, 2017; Goebel et al., 2013; Lessa & Leal, 2023; Marzal et al., 2011; Oakleaf, 2009; Pinto et al., 2008; Pinto et al., 2021; Pinto & Fernández-Valdés, 2010; Wakimoto et al., 2016; Whitlock & Ebrahimi, 2016; Willson & Angell, 2017; Hanlan et al., 2013; Frandsen et al., 2017; Klubek, 2016; Gerrity, 2018; Noe & Bishop, 2005
Library Instruction	7	11,7	Dawson et al., 2012; Rieh et al., 2019, 2022; Tran et al., 2018; Walter, 2009; Willenborg et al., 2020; Folk, 2014
Media Literacy Training	4	6,6	Guo & Goh, 2015; Iqbal, 2021; Kozłowska-Barrios, 2023; Squibb, 2017
Information Literacy (IL) Training in Other Curriculum Subjects	6	10,1	Bradley et al., 2013; Ivanitskaya et al., 2008; Klipfel, 2014; Naz & Casto, 2013; Nelson & Fosmire, 2010; Bravo et al., 2013
Total	60		

Table 5
Learning components stated in the studies analyzed.

Learning components	N°
Search, Retrieval, Evaluation, and Ethical Use of Information Sources, Resources, and Data"	12
Library Utilization"	3

development, and implementation policies and plans (5 = 8.3 %, respectively) and those that analyzed MIL competencies (4 = 6.7 %). In general, most authors focused on IL-related objectives, and very few addressed other types of literacy, such as MIL and DL (Table 3). (See Tables 4 and 5).

In terms of timeline, objectives on the learning process are between 2005 and 2015, and those related to the assessment of IL and MIL skills and competencies between 2008 and 2023, with peaks in 2011 (2), 2017 (2), 2018 (2), and 2023 (2). The assessment of MIL competencies is present only in four scattered studies, published in 2015, 2017, 2021, and 2023. Finally, the relationship between faculty and the library and its impact on IL competencies acquisition is addressed between 2005 and 2020, with peaks in 2013 (2), and 2005, 2010, 2014, and 2016 with two papers each.

Object of study

Regarding the object of study, the largest group of articles dealt with learning through specific IL courses and programs offered by the library (19; 31.6 %), and the second group dealt with assessing students' IL competencies and skills (17; 28.3 %). Although only 11.7 % of the papers aimed to determine indicators and metrics for IL skills assessment, this percentage was consistent over time—with articles in 2007, 2008, 2012 (2), 2018 (2), and 2022—indicating a continued interest in establishing criteria for assessing training activities. Assessment of library instruction sessions (7), IL training as a component of other subjects within a specialty curriculum (6; 10.1 %), and assessment of ML skills (4; 6.6 %; Table 4) also represented a minor percentage of articles. Thus, assessment was predominantly addressed as a part of IL course design or in relation to IL competencies and skills; concern with establishing common metrics was low but consistent.

Learning components

Most of the studies analyzed did not explicitly address teaching and assessing information skills, and only 35 % did so (21). They focused on the search for, retrieval of, assessment of, and critical and ethical use of information (12). This last aspect, in particular, knowing how to recognize, critically evaluate, and ethically use information (Squibb, 2017, 544), is considered central to IL training today and in reaffirming the educational role of librarians and university libraries and their visibility. This critical thinking and ethical training should not be limited to academic sources and contexts, but rather should be generalized to all types of information. IL's relationship with ML and MIL is thus established, with the objective of providing training that gives a deeper understanding of information's social and emotional impact (Kozłowska-Barrios, 2023, 2):

Therefore, MIL educators must grapple with the essential dilemma of challenging all forms of information disorders (e.g., disinformation, misinformation, fake news, etc.) while promoting media skepticism and the importance of media pluralism and diversity regardless of the political and ideological frontier.

Finally, it is noteworthy that several papers aimed not only to assess IL using library and information science-specific frameworks or theories but also to integrate or supplement these with contributions from professional competencies frameworks and models from other disciplines, such as health sciences and engineering, using models such as PICO, ABET, or ILIAC, among others.

Methodology

The methodology used by the authors in the selected corpus was analyzed, focusing on the following variables: types of study, types of research, assessment approaches, assessment methods, methods of analysis, analysis techniques, supporting sources, and assessment tools, indicators, and criteria.

Types of disciplinary scope

Regarding the disciplinary scope of the analyzed publications, disciplinary studies were the most numerous (39 = 65 %), followed by interdisciplinary (10 = 16.67 %), transdisciplinary (8 = 13 %) and multidisciplinary (3 = 5 %). There were disciplinary studies in most of the years analyzed, with the preponderance in 2013 (6 items), 2018 (5), and 2012 (4). There were interdisciplinary studies in 2008, 2009, 2012, 2013, and 2019–2022. The transdisciplinary type was concentrated in 2005, 2008, 2009, 2011, 2016, and 2023, with more in the first and last of these years (two each). And multidisciplinary was only seen in 2007, 2015, and 2017. In short, disciplinary research's predominance was evident: authors are concentrated in their professional fields of interest.

Types of research

In relation to research modality, four types—applied, exploratory, theoretical, and experimental—were analyzed. The highest number fell into the applied type (33 = 55 %), reaching its peak in 2013 (4) and 2014 (2). The exploratory type (32 = 53.33 %) was found in most of the years analyzed, standing out in 2008, 2012, 2013, 2016, 2020, and 2023. The theoretical type (20 = 33.33 %) was noteworthy in 2009, 2012, and 2018. The experimental type (19 = 31.66 %) was spread across the period between 2005 and 2022, with more being produced in 2012. These data were consistent with the academic context of IL, ML, and DL, where there was applied research throughout much of the period analyzed, but exploratory research grew slowly starting in 2016, in step with the evolution of the different types of literacy, in particular information and media literacy. A decrease in the types of research was detected in 2019 and 2020, probably owing to the pandemic crisis.

Assessment focus

Four assessment focuses were identified: institutional, faculty, librarian, and student. Students were the main focus (35 = 58.33 %), and was seen in 2013 (4) and 2005, 2008, 2012, 2015, and 2018 (3 each). Institutions were the second (33 = 55 %) with peaks in 2007, 2012, and 2017 (4 items/year) coinciding with the development of institutional IL and MIL programs in academic libraries. Libraries the third (25 = 41.66 %) a recurring theme, especially in 2008, 2010, 2012, 2015, 2016, and 2017. Finally, faculty (teacher/tutor) (24 = 40 %) was the fourth, and found in 2007, 2010, 2012, 2016, 2016, 2021, and 2022. Although the four modalities were evenly distributed, it was noted that the institutional approach was not found in 2019 or 2020.

Assessment methods

Three assessment methods were used: behavioral, constructivist, and authentic. The constructivist method (32 = 53.33 %) was used most, with the greatest incidence found in 2008, 2012, 2013, 2013, 2016, and 2017. Authentic assessment (29 = 48.33) predominated in 2008, 2011, and 2012 (3 each). The behaviorist method (20 = 33 %) stood out in 2007, 2012, and 2018 (2).

Methods of analysis

The authors employed eight methods of analysis: content analysis, literature review, exploratory analysis, experimental analysis, case study, descriptive analysis, comparative analysis, and other. In the publications analyzed, at least one in each year involved one of these methods. The years 2012, 2013, and 2022 had the highest number of items. Case studies prevailed (36 = 60 %), with more in 2013 (5) and

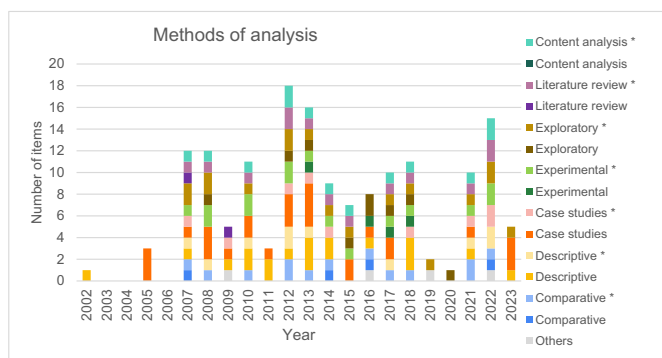


Fig. 6. Methods of analysis.

2012 (4), aimed at assessing university students' levels of IL and ML. The descriptive analysis method (29 = 48.33 %) stood out in 2013 (4) and was focused on the design of training activities. The exploratory analysis method (26 = 43.33 %) was used more in 2008 and 2012 (2). Experimental analysis (19 = 31.66 %) was used as a secondary option. Next in order of importance were the comparative analysis method (17 = 28.33 %), literature review (15 = 25 %), and content analysis (13 = 21.66 %). Other methods used novel gamification techniques, such as library role-playing, which indicates that these types of literacy are more fully developed.

Analysis techniques

Three analysis techniques—qualitative, quantitative, and qualitative–quantitative—and two data collection techniques—qualitative and quantitative—were observed. Their distribution over the period analyzed was homogeneous, with 2012 and 2013 standing out for their greater number of items and variety. The authors used qualitative analysis the most (26 = 43.33 %), with most being found in 2007 (Brettle, 2007; Ishimura et al., 2007; Saunders, 2007), 2010 (Islam & Tsuji, 2010; Pinto & Fernández-Valdés, 2010; Nelson & Fosmire, 2010), and 2013 (Goebel et al., 2013; Bravo et al., 2013; Hanlan et al., 2013). They used content analysis, expert panel, focus group, and interview techniques. To a lesser extent, they used quantitative analysis (17 = 28.33 %), with 2008 (Ivanitskaya et al., 2008; Oakleaf & Hinchliffe, 2008; Osorio Bernal & Chiavola, 2008), 2013 (Bradley et al., 2013; Goebel et al., 2013; Bravo et al., 2013), 2012 (Dawson et al., 2012), and 2022 (Fuchs & Ball, 2021; Rieh et al., 2022) standing out for the number of items. They used descriptive and inferential statistics, as well as the programs SPSS and Qualtrics. The authors frequently used qualitative–quantitative analysis (26 = 43.33 %), with 2016 (Wakimoto et al., 2016; Whitlock & Ebrahimi, 2016), 2017 (Squibb, 2017; Willson & Angell, 2017; Frandsen et al., 2017), and 2023 (Lessa & Leal, 2023; Makinde et al., 2023) standing out for the number of items. Of the two data collection techniques, the authors more often used quantitative (30 = 50 %) and used questionnaires, tests, and rubrics, with 2008 (Ivanitskaya et al., 2008; Oakleaf & Hinchliffe, 2008; Osorio Bernal & Chiavola, 2008) and 2013 (Naz & Casto, 2013; Smith & Dailey, 2013; Hanlan et al., 2013) being significant. Qualitative data collection (24 = 40 %) was carried out through interviews (Booke & Wiebe, 2017; Mutula et al., 2005; Rieh et al., 2022; Willenborg et al., 2020; Klubek, 2016) and focus groups (Dawson et al., 2012; Ishimura et al., 2007; Pinto et al., 2021).

Sources

More than a dozen sources, such as review articles, specialized databases, national standards, the ACRL Standards and Framework, institutional sources, web pages, expert panels, syllabi, courses, and training courses, were used. They were distributed throughout the period analyzed, with 2012 and 2013 standing out for their number and diversity. Review articles were used in 25 publications (41.66 %),

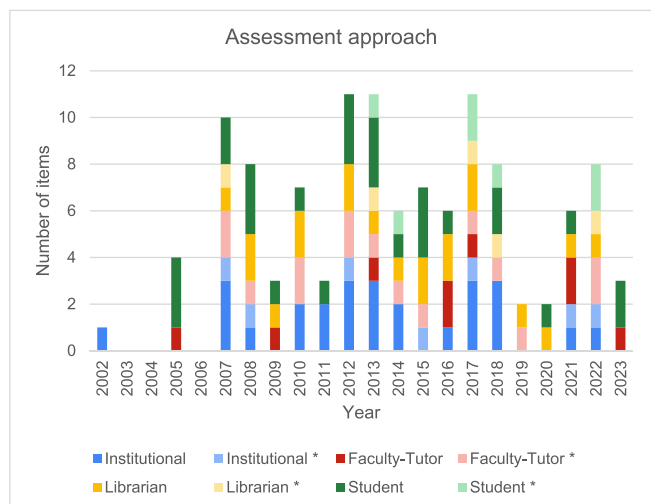


Fig. 5. Assessment approach.

specialized databases in 7 (11.66 %), national standards in 11 (18.33 %), the ACRL Standards and Framework in 24 (40%), institutional sources in 8 (13.33 %), web pages in 7 (11.66%), expert panels in 11 (18.33 %), syllabi in 2 (3.33%), courses in 15 (25 %), and training courses in 14 (23.33 %).

Assessment tools, criteria, and indicators

The tools used by the authors were questionnaires, interviews, focus groups, templates, surveys, rubrics, tests, checklists, and portfolios. Questionnaires were used in 20 publications (33.33 %), surveys in 16 (26.66 %), rubrics in 15 (25 %), interviews and focus groups in 9 (15 %) each, tests in 6 (10 %), templates and checklists in 4 (6.66 %) each, and portfolios in 2 (3.33 %). In summary, the tools were used on 85 occasions, implying that some publications used more than one.

Among the tools, it is worth mentioning those that specifically addressed the assessment of IL services that university libraries offered on their web portal, as was the case of Metrics for Library Information Literacy (MeLIL) (Pinto et al., 2021), a questionnaire based on six criteria and 38 indicators; those that assess the results of information literacy instruction such as iSkills and the Standardized Assessment of Information Literacy Skills (SAILS) (Goebel et al., 2013; Naz & Casto, 2013); the Information Literacy Instruction Assessment Cycle (ILIAC) (Gustavson, 2012; Oakleaf, 2009), focused on systematic, formative, summative, and final assessment; the Library Escape Room prototype based on educational games to assess users' skills (Guo & Goh, 2015); structured questionnaires (Iqbal, 2021; Islam & Tsuji, 2010; Lessa & Leal, 2023; Oakleaf, 2008); ad hoc rubrics for IL assessment (Pinto et al., 2008; Wakimoto et al., 2016; Willson & Angell, 2017; Klubek, 2016); the Anne Arundel Community College (AACC) rubric (Whitlock & Ebrahimi, 2016); focus groups (Ishimura et al., 2007; Makinde et al., 2023); the Research Readiness Self-Assessment (RRSA) tool for testing competencies acquired after an IL instructional program (Ivanitskaya et al., 2008); and worksheets and checklists to assess learning outcomes in MIL courses (Kozłowska-Barríos, 2023). Also, to assess Student Information Literacy Skills, tools based around gamification practices such as "librarian role-playing" (Rieh et al., 2019, 2022) and the aforementioned Library Escape Room (Guo & Goh, 2015) were employed.

Results and discussion

The results of the papers that make up the sample selected and analyzed are presented below. The results are structured following the classification of objectives presented in Section 3.3.1: definition of theoretical elements related to IL assessment, IL, and other disciplines; assessment of IL and ML competencies; assessment of processes/policies and plans; and integration of IL in academic contexts.

Definition of theoretical elements related to IL competency assessment

As observed during our analysis of definitions and conceptualizations in the literature review section, authors were not interested in introducing or developing theoretical models for IL competency assessment; rather, they preferred to use specific skills and competencies framework, such as the one proposed by ACRL (2000, 2015), to develop their research. Only two studies were identified that attempted to expand upon or improve the theoretical bases of IL competency assessment, though they were based on different theoretical and methodological approaches.

On the one hand, Welty et al. (2012) are an example of a suggesting import of models from specific disciplines to enhance IL. They proposed bringing the PICO model, developed for clinical research in health sciences, to library instruction. PICO, as its initials indicate, identifies and sequences the key elements of the clinical research process: patient or problem (P), intervention (I), comparison intervention (C), and outcome (O). Health Sciences librarians have successfully used it both to guide students and to improve their own work when it comes to referencing and searching, as it allows them to structure a well-founded research

question, and, from that, focus the selection of information sources, the search, and the selection of resources.

At another level, Fuchs and Ball (2021) attempted to clarify a core shared between the ACRL Framework (ACRL, 2015), the Common Core State Standards (National Governors Association Center for Best Practices and Council of Chief State School Officers, 2010) and the American Association of School Librarians Standards (American Association of School Librarians (AASL), 2018) with the goal of aligning all stakeholders to contribute to students' academic success. After analyzing 20 items, they decided to organize their common framework according to students' roles in their relationship with information: as consumers and as creators. As consumers, students search for, discover, locate, interpret, and use information resources to address a research need. To prepare them for this role, the following topics need to be addressed: exploration, discovery, diversification, inclusion, authority in context, interpretation, critical analysis, ethical considerations, global and cultural awareness, and collaborative and interconnected community. As creators, students create and produce research in a variety of formats and at various levels appropriate to their own research needs in a specific setting. To do so, it is necessary to educate them in information synthesis, information integration, informed participation, knowledge creation, iterative practices, reflective practices, and clear articulation of ideas.

Finally, the analysis of the selected sample highlighted the IL's centrality in the competencies assessment when compared with the other types of literacy, which were scarcely present (Table 6).

This low number of references confirmed the predominance of studies that focused specifically on IL and did not address other forms of literacy in depth. In addition, the scant mentions made of other types of literacy were linked to IL. Academic literacy (AL) (Lessa & Leal, 2023; Pinto et al., 2008; Pinto et al., 2021; Walter, 2009) emerged as the predominant literacy in a set of studies in which IL constituted a central axis, and in which a set of educational programs and experiences adapted to different situations were recounted. Such programs and

Table 6
Relationship with other types of literacy.

Type	Contribution	Authors
Academic Literacy	Information Literacy (IL) as a Structural Element of Academic Literacy: Relevance of Programs and Training Experiences Rooted in Analysis of Diverse Realities for Research. Support Plans for the Acquisition of IL and AA. Media literacy as a foundation for the acquisition of basic	Lessa & Leal, 2023; Pinto et al., 2008; Pinto et al., 2021; Walter, 2009
Media Literacy	information literacy competencies, supported by libraries in higher education for faculty, students, and information professionals. Interpreting media messages critically, discerning between reliable and unreliable sources, and understanding how media can influence perception and public opinion. Ability to actively engage in the creation and production of media content.	Guo & Goh, 2015; Iqbal, 2021; Kozłowska-Barríos, 2023; Squibb, 2017
MIL (Media Information Literacy)	Understanding the ethical and legal aspects associated with the use of information in media Information Literacy (IL) in relation to technology:	Guo & Goh, 2015; Iqbal, 2021; Kozłowska-Barríos, 2023; Squibb, 2017
Digital Literacy	Accessibility to information through ICTs (Information and Communication Technologies).	Islam & Tsuji, 2010

experiences are not only relevant to the research but also provide key support plans for acquiring both IL and AL skills.

Although it might be expected that, based on the framework that UNESCO promoted, it would be increasingly present in the higher education space—MIL was not directly addressed, but it was a topic of interest. Both Goebel et al. (2013) and Iqbal (2021) highlighted the inherent relationship between IL and the use of critical thinking to analyze media messages to elucidate the media's impact on public perception and opinion, though Goebel et al. (2013) emphasized the centrality of IL. Islam and Tsuji (2010), Guo and Goh (2015), Squibb (2017), and Kozłowska-Barrios (2023) stressed that one has to be trained to actively take part in the creation and development of media content. In this sense, understanding the ethical and legal aspects related to of handling of information in the media becomes a priority.

As we have seen, the centrality of IL in libraries is tentatively giving way to other related forms of literacy, whose competencies have a key role in higher education. In this sense, similarities were found with Revez and Corujo, 2021, who provided a comprehensive view of the initiatives that librarians have undertaken to promote ML and help users discern between true and false information. In their review, they found that IL played a pivotal role, but maintained an essential relationship with ML and AL. Morris (2020) also found a growing interest in the use of AL to complement IL, while studying methods and programs for the acquisition of competencies by university students. Other studies such as those conducted by Erlinger (2018) and Lierman and Santiago (2019) also reflected this diversification in the types of literacy, albeit tangentially and diffusely.

Assessment of IL and MIL competencies

The results indicate that papers linked to the various ACRL standards, especially the 2000 and 2015 frameworks, stood out. Other pioneering standards in the IL field were observed to a lesser degree.

Thus, the studies were fundamentally based on the ACRL standards, supplemented in some cases by other skill and competencies and accreditation frameworks in their respective areas. In addition, a variety of professional standards were used to contextualize IL standards within their specific fields.

IL. The majority of the studies have been focused on student assessment, all of them with positive results. In 2005, Noe and Bishop (2005) found the Auburn Tiger Information Literacy Tutorial (TILT) to be effective after testing students' knowledge of the ALA standards, showing a low baseline and a significant improvement after the training. Marzal et al. (2011) found positive results with their validation of an IL skills model for school libraries. Brage and Svensson (2011a, 2011b) focused on demonstrating that health science students should identify and use the key IL competencies needed to succeed as university students and future professionals. Lessa and Leal (2023), after assessing the information and digital skills of library science students, concluded that distance learning activities have a very direct impact on the acquisition of information content and skills. Makinde et al. (2023) also found a significant relationship between IL and the research skills undergraduate students in Library and Information Science, and recommended IL training at the earliest stages to improve their motivation and understanding of the research process.

Some studies have specifically addressed students' use of electronic resources in libraries (Booke & Wiebe, 2017; Tran et al., 2018; Frandsen et al., 2017; Baggett et al., 2018), asserting that training sessions significantly increased their use, but with a short-lived effect. In a novel way, Tran et al. (2018) used mindset growing to achieve progress after a single session in the library. However, they also confirmed that they competencies should be expanded upon, given the increase in fake news and predatory journals.

ML. Only four relatively recent studies directly addressed ML

competencies assessment, within the last 10 years. Folk (2014) researched the establishment of ML strategies and the material and human resources needed in libraries. Squibb (2017) studied collaborative work's implications both training activities and competencies assessment. Iqbal (2021) reviewed the assessment of various training programs to document learning outcomes and learn about students' weaknesses to improve instruction. Recently, Kozłowska-Barrios (2023) addressed the disinformation problem (fake news) in the news, focusing on how students can learn to evaluate sources, their quality, and their authority. In all cases, training activities helped improve all ML competencies, so the authors suggested strengthening the assessment tools even more to detect needs and implement measures to improve the weaknesses found.

MIL. Some authors addressed IL and ML literacies—MIL— together, among them Klubek (2016), Vega García et al. (2017) Pashkova-Balkenhol et al. (2019), Lierman and Santiago (2019) and Okeji et al. (2020). They confirmed that library training and the involvement of library professionals in specific training activities contributed to motivation and, therefore, helped optimize the acquisition of MIL competencies by university students. More specifically, Okeji et al. (2020) identified several student limitations in paraphrasing correctly, avoiding plagiarism, and using appropriate citation and referencing styles; and emphasized the importance of librarians in assessing student learning. Finally, Blummer and Kenton (2018) and Pashkova-Balkenhol et al. (2019) highlighted a novel topic: the importance of coordinating training between libraries from pre-university and university educational institutions to ensure progress at the end of the training period.

Assessment of learning process, IL programs, and IL plans

Many studies presented specific experiences wherein library training programs and activities were implemented in specific contexts, demonstrating their importance in IL and MIL development and acquisition in higher education (Table 7). The studies addressed both the assessment of the learning process and results, as well as the methodologies, programs, and plans in which they are involved.

Most studies assessed students' levels, either as a starting point (pre-test) or after the programs had been implemented (post-test). In general, the results showed these programs' effectiveness and usefulness in all the contexts in which they were implemented. As novel training activities, Welty et al. (2012) proposed using the PICO model in assessment, and Guo and Goh (2015) and Rieh et al. (2019) gamification and role playing as a strategy for student involvement.

In addition to these specific instructional experiments, a handful of studies provide a comprehensive review of the relevance of IL and MIL strategies implemented by libraries in particular. Grabowsky and Weisbrod (2020) reviewed a wide range of relevant studies to assess the impact of instruction, academic achievement, IL proficiency, and student satisfaction. They concluded that library instruction has a significant positive effect. Similarly, Morris (2020) examined student engagement and satisfaction and instructional effectiveness, providing a comprehensive view of student perceptions of IL program in different learning environments, which can inform future program planning and design. Mandrekar and Rodrigues (2021) discussed the importance of IL/MIL programs in developing the critical skills necessary for academic success. In addition to information seeking, resource evaluation, and effective communication, they discussed various strategies and methods for countering misinformation, emphasizing the use of educational technology, the creation of specific guides and resources, and collaboration with other departments. In summary, they offered a comprehensive view of the initiatives that librarians have undertaken to promote MIL and to help users determine what constitutes quality information, which is consistent with the findings of this paper.

Table 7
Studies on learning assessment.

Author	Year	Experience	Methodology
Brage & Svensson	2011	Linköping University Library (LiUB)	Postgraduate general instruction/Evaluative actions
Burkhardt	2007	Comprehensive Plan for Information / Training Literacy	General Library Instruction / Training Actions / Evaluative Actions
Davidson, McMillen & Maughan	2002	OSU Library Instruction	General Library Instruction/Evaluative Actions
Folk	2014	Pitt-Bradford's Freshman Seminar programs	General Library Instruction/Training Actions for First Year/Evaluation
Frandsen et al.	2017	Kilimanjaro Christian Medical Centre (KCMC) Hospital	General Health Student Instruction/Evaluation
Goebel et al.	2013	Alberta Assessment Pilot (ILAAP)	Evaluative Actions using the WASSAIL software
Guo & Goh	2015	Library Escape	Gamification /Role Playing
Hanlan et al.	2013	ES1020: Introduction to Engineering Design, a first-year, project-based design course at Worcester Polytechnic Institute (WPI)	General Library Instruction/Training Actions for Engineering Students/Evaluation
Noe & Bishop	2005	Auburn University Libraries' Tiger Information Literacy Tutorial (TILT)	General Information Literacy Instruction/ Student Training Actions/Final Evaluation Using the Assessment of Information Literacy Skills (SAILS) (a globally recognized general program but applied to U. Montgomery)
Oakleaf	2009	Information Literacy Instruction Assessment Cycle (ILIAC)	General Library Instruction/Training and Evaluative Actions for Librarians
Rieh et al	2019	Role Playing	Gamification /Role Playing
Schweikhard et al.	2018	Allied Health EBP	General Library Instruction/Training Actions for Health Sciences/Evaluation
Welty et al.	2012	PIL. Project Information Literacy U. Arizona	PICO Model for General Library Instruction/ Training Actions in Health Sciences/ Evaluation
Zhang et al.	2015	Information Literacy Standards for Science and Engineering/ Technology.26 ES1050 library instruction	General Library Instruction/Training Actions for STEM Students/Modular Programs/Evaluative Actions

IL integration in academic contexts

As shown in Table 8, a large group of the studies (25 = 41.66 %) reported specific academic library training programs and activities that included IL assessment, without focusing on specific disciplines or areas of knowledge (Goebel et al., 2013; Grabowsky & Spybey, 2022; Gustavson, 2012; Johnson, 2005; Lierman & Santiago, 2019; Pashkova-Balkenhol et al., 2019; Schilling & Applegate, 2012; Smith & Dailey, 2013; Vega García et al., 2017; Williams, 2013). In several studies, librarians presented accurate and comprehensive assessments, combining quantitative and qualitative questionnaires; detailed diagnoses; and proposals for improvement that could be applied in other contexts (Oakleaf, 2009; Whitlock & Ebrahimi, 2016). In the case of Rieh et al. (2022), the combination of diagnostic methodologies focused on critical

Table 8
Disciplines of application.

Disciplines	Authors	Number
<i>Libraries</i>	Belanger et al., 2012; DaCosta & Dubicki, 2012; Fuchs & Ball, 2021; Goebel et al., 2013; Guo & Goh, 2015; Gustavson, 2012; Iqbal, 2021; Ishimura et al., 2007; Johnson, 2005; Kanazawa & Maruyama, 2008; Kozłowska-Barrios, 2023; Oakleaf, 2009; Pinto et al., 2021; Pisté-Beltrán & García-Quismondo, 2018; Rieh et al., 2019; Saunders, 2007; Smith & Dailey, 2013; Wakimoto et al., 2016; Whitlock & Ebrahimi, 2016; Willenborg et al., 2020; Williams, 2013; Klubek, 2016; Baggett et al., 2018; Gerrity, 2018	25
<i>General Libraries</i>		
<i>Social Sciences</i>		12
<i>Business Administration</i>	Bravo, Lucia & Martin, 2013	1
<i>Education</i>	Ivanitskaya et al., 2008; Marzal et al., 2011; Walter, 2009	2
<i>Political Sciences</i>	Booke & Wiebe, 2017	1
<i>Social Sciences</i>	Davidson, 2012; Davidson et al., 2002	2
<i>Communication and Documentation</i>	Islam & Tsuji, 2010; Lessa & Leal, 2023; Makinde et al., 2023; Mutula et al., 2005; Pinto, Fernández-Ramos, & Doucet, 2008; Okeji et al., 2020	6
<i>Humanities</i>	Davidson, 2012; Davidson et al., 2002	4
<i>Arts</i>	Brage & Svensson, 2011a, 2011b	2
<i>Language</i>	Noe & Bishop, 2005	1
<i>Health Sciences</i>		8
<i>Health</i>	Ayre et al., 2014; Brettle, 2007; Perryman, 2016; Schweikhard et al., 2018; Willson & Angell, 2017; Hobbs et al., 2015	6
<i>Public Health Sciences</i>	Ivanitskaya et al., 2008; Welty et al., 2012	2
<i>Biology</i>	Brage & Svensson, 2011a, 2011b	4
<i>Physics</i>	Davidson, 2012; Davidson et al., 2002; Frandsen et al., 2017	1
<i>Engineering</i>		3
<i>Engineering</i>	Bradley et al., 2013; Hanlan et al., 2013	7
<i>Technology</i>	Cavanagh, 2016; Naz & Casto, 2013; Tran et al., 2018; Nelson & Fosmire, 2010; Zhang et al., 2015	2
		5

thinking. Willenborg et al. (2020) addressed the less—but important—studied topic of librarians' perceptions of teachers' IL and their role in undergraduate instruction.

In the health sciences and STEM fields, students' need for developing IL competencies has been emphasized, even considering the global framework of lifelong learning (Nelson & Fosmire, 2010). Thus, Brettle (2007), Ayre et al. (2014), Hobbs et al. (2015), Perryman (2016), Willson and Angell (2017), and Schweikhard et al. (2018) recommended that curricula include subjects that incorporate IL. However, as demonstrated by Nelson and Fosmire (2010), Naz and Casto (2013), Zhang et al. (2015), and Tran et al. (2018), curricula lack subjects that develop the IL competencies needed by STEM students. In the absence of such subjects, libraries play a crucial role in the development and implementation of IL. Particularly in health sciences, several recent studies reviewed various programs, measures, or publications from various health sciences libraries, thus demonstrating the increasing demand from the student body and the faculty for training methods and activities implemented by specific libraries (Munn & Small, 2017; Boruff & Harrison, 2018; Haruna & Hu, 2018; Tran et al., 2018; Grabowsky & Spybey, 2022; Hicks et al., 2022).

In social sciences, library and information science was the most prominent (6 of 60 articles, 10 %) (Islam & Tsuji, 2010; Lessa & Leal, 2023; Makinde et al., 2023; Mutula et al., 2005; Pinto, Fernández-Ramos, & Doucet, 2008; Okeji et al., 2020). Although library and information science degrees imply a high level of information competencies, studies showed limitations in students' actual competencies.

Thus, the studies stressed that it was advisable to promote IL through training activities and programs, and demonstrated their effectiveness when it came to acquiring and developing competencies and to the positive engagement of both students and the teachers in the subjects that they teach. Finally, the authors stressed that libraries need to adapt to students' new demands in terms of accessing, searching, managing, and disseminating information.

Finally, some studies crossed disciplinary boundaries using a comparative perspective. Davidson (2012) y Davidson et al. (2002) concluded that IL assessment needs are very similar in social sciences and experimental sciences (physics). Although she noted that both students and teachers of social sciences had a higher level of IL competencies, both the demands of students and teachers and the methods that librarians provided were similar in both fields. Brage and Svensson (2011a, 2011b) obtained similar results when comparing arts and biological sciences and proposed the novel idea of integrating collaborative work and IL assessment.

Conclusions and recommendations in the analyzed corpus

Prominence of IL versus MIL, ML, and DL

The general conclusions of the works analyzed showed the prominence of IL assessment compared with other types of literacy. Only four papers referred to MIL (Guo & Goh, 2015; Iqbal, 2021; Kozłowska-Barrios, 2023; Squibb, 2017), and none to DL. This scarcity of MIL in the literature review can be explained by the fact that libraries remain focused on IL training, as is their custom, rather than MIL, a training more often offered in the field of communication—journalists—and not so much in library and information science (Potter, 2022). Thus, it is necessary to highlight the need to continue exploring the basic ML competencies that must be developed: the ability to critically analyze media messages and distinguish between reliable and unreliable sources so as to understand the media's potential impact on perception and opinion. Given the lack of attention to DL competencies assessment, it appears that much remains to be done in this emerging and increasingly important field (Pinto et al., 2023).

Need to fill the gap in student training

In general terms, the authors indicated that the student body, both undergraduates and graduates, lack skills when it comes to accessing and using information (Dawson et al., 2012; Osorio Bernal & Chiavola, 2008), and that the activities that libraries provide to address these needs are limited. Although IL implementation is a priority, there is no agreement when it comes to introducing these competencies into curricula (Smith & Dailey, 2013; Okeji et al., 2020). For this reason, the responsibility still falls on teachers—individually—or libraries—through their training activities (Ishimura et al., 2007; Gerrity, 2018). Therefore, it is important to integrate IL into curricula, and there is a need for all the agents involved to more effectively coordinate to optimize training activities (Burkhardt, 2007; Ivanitskaya et al., 2008).

Success of training programs and activities that deeply engage students

The importance of implementing training courses that have an impact on information analysis right from the beginning so as to improve students' skills was corroborated (Baggett et al., 2018). In most cases, after the training activities, the students were able to use critical thinking to understand and analyze the information. Thus, there is a clear relationship between IL acquisition and critical thinking. Increasingly, training activities must be adapted to new technologies, and students must be directly involved in learning these competencies. Hence, student peer-to-peer collaborative experiences and mentoring were shown to be effective (Fuchs & Ball, 2021; Frandsen et al., 2017; Folk, 2014).

Collaboration between librarians and teachers

Most authors emphasized the librarian's role in defining and

implementing IL programs in collaboration with faculty (Booke & Wiebe, 2017; Brage & Svensson, 2011a, 2011b; DaCosta & Dubicki, 2012; Marzal et al., 2011; Osorio Bernal & Chiavola, 2008; Schweikhard et al., 2018; Smith & Dailey, 2013; Tran et al., 2018; Willson & Angell, 2017; Frandsen et al., 2017; Klubek, 2016; Folk, 2014). Training activities provided skills and knowledge and helped change attitudes toward information access, management, and dissemination (Johnson, 2005; Zhang et al., 2015). In particular, collaboration has improved the results and efficiency of students using information sources (Davidson et al., 2002; Walter, 2009). Courses implemented by librarians have been well received and have proven to be effective, but, to be most successful, required teacher collaboration, content integration, and appropriate technologies (Mutula et al., 2005; Noe & Bishop, 2005; Hobbs et al., 2015).

Flexibility and methodological integration

In terms of teaching methodology, the combination of classroom and online training optimized results. The inclusion of active, participatory, and gamified methodologies—especially, the role-playing method—appeared to be effective in developing metacognition and critical thinking skills. Some authors also insisted that the motivational aspect was key to acquiring competencies (Ayre et al., 2014; Guo & Goh, 2015; Rieh et al., 2022; Wakimoto et al., 2016). They also confirmed that both training activities and the effectiveness of IL programs need to be continuously assessed. Hence, assessment is an important method when it comes to determining students' training needs, their learning outcomes, and how to improve IL instructional programs (Iqbal, 2021; Pinto, Fernández-Ramos, & Doucet, 2008; Pinto & Fernández-Valdés, 2010). Some authors highlighted that certain methodologies and tools—MELIL and Ways to Improve School Effectiveness (WISE; for self-assessment and continuous improvement of IL planning), PICO, pre/post-test rubrics, focus groups, and closed-ended questionnaires—have proved useful in assessment processes (Belanger et al., 2012; Pinto et al., 2021; Tran et al., 2018; Willson & Angell, 2017; Welty et al., 2012).

Conclusions

In large part, librarians (48 %) and Library and Information Science academics (23 %) lead the effort to assess IL and, to a lesser extent, ML training programs and activities, although the contribution of specialized academic disciplines, especially health sciences and STEM, is also very notable. Production was not carried out by only a few authors; rather authorship was rather varied. Research was mainly carried out in English-speaking areas (75.69 %), with the United States leading the pack (64 %); however, Spain (11.8 %) also showed a great deal of interest. Although the largest group of studies addressed assessment carried out by academic libraries in general, there were also many studies in specific disciplines, especially in health sciences, STEM, and social sciences.

The studies were very much focused on documenting and assessing specific training activities, and did not consider the field to be somewhat problematic or a work in progress—one that needs its main concepts to be carefully defined. In keeping with the topic being studied, definitions focused on clarifying the types of assessment as well as technical pedagogical terms. The relationship to other types of literacy was not addressed in detail in the state of the art or introductory sections. On the contrary, the most commonly seen skills and competencies frameworks were those that act as taxonomies for competencies assessment, notably the original version from ACRL (2000) followed at a distance by the new version (2015), which was also noted in the “Results,” “Discussion,” and “Conclusions” sections. Additionally, the prominence of the professional skills and competencies frameworks of specific degrees could primarily be seen in the health sciences and STEM. Well-established and widely accepted standards outshined other theoretical studies—which, though used, are in a mere scattering of studies—partly because their most notable findings have been integrated into said standards.

In general terms, the methodologies used by the authors in the corpus analyzed was diverse, current, and innovative. Of note were the applied disciplinary studies that were more focused on assessment using the student, institutional, and librarian approaches. The most commonly used assessment methods were constructivist and authentic assessment. Among the most commonly used methods of analysis, case studies stood out, followed by descriptive, exploratory, experimental, and comparative studies; literature reviews; and content analysis. For the first time, the role-player gamification method was used. Regarding the analysis techniques, qualitative and mixed techniques were the most commonly used. In this respect, we found similarities to other research (Boruff & Harrison, 2018; Lierman & Santiago, 2019; Pashkova-Balkenhol et al., 2019; Morris, 2020), whereby reviews that collected mostly qualitative and qualitative–quantitative studies predominated (Blummer & Kenton, 2018; Grabowsky & Weisbrod, 2020; Haruna & Hu, 2018; Schilling & Applegate, 2012). When it came to data collection techniques, quantitative techniques were used somewhat more frequently than qualitative ones, with questionnaires, tests, and rubrics standing out.

There was a general consensus in the analyzed publications on the importance of IL and ML assessment using a librarian approach as a preliminary step in diagnosing and implementing specific training actions. The tests allowed us to confirm both that there is a need for IL, given the deficiencies that students demonstrated, and that the training programs and activities carried out were effective. A variety of studies analyzed the assessment tools, library instruction's impact on academic performance, and the information literacy skills of university students in different degrees. They concluded that such instruction has a positive and significant effect. Fundamental factors in this success were adequate motivation and students' direct involvement and participation. Despite the fact that different educational programs and training activities have been included in different curricula, we are still far from reaching the optimal targets when it comes to integrating IL competencies into the curriculum, and the remaining work lies largely with librarians and motivated teachers.

The learning components assessed in the studies were mostly related to the search for, retrieval of, and assessment of information, aspects fundamentally associated with IL competencies acquisition. By comparison, the incorporation of media (ML) and data (DL) skills—essential so that citizens can make better use of media content and the open data movement, be aware of their online rights, and counter misinformation—has not progressed as quickly in the library environment.

Literacy assessment has been carried out primarily in information literacy. Despite its importance, ML assessment is still an emerging field, and DL assessment is largely a work in progress.

Despite the fact that it has now been 50 years since Paul G. Zurkowski (1974) coined the term in his well-known report *National Commission on Libraries and Information Science*, IL continues to be increasingly necessary in digital society so that students, professionals, and citizens can appropriately interact with information in its diverse typologies, from various sectors, in a variety of formats, etc. Managing to interact responsibly in such a large and complex environment requires a coordinated action plan. Therefore, it is essential for libraries to embrace IL as a literacy that supports and interrelates with other types of literacy, to broaden their training approaches and achieve the necessary multi-literacy. However, as demonstrated in the corpus of documents, libraries are still mostly focused on IL. Gradually, different libraries around the world (Pinto et al., 2021; Pinto, Uribe-Tirado, & Manso-Rodríguez, 2023) have been incorporating these other types of literacy into their training offerings, although these are still specific cases. Therefore, it is imperative that these other types of literacy (MIL, ML, and DL) are incorporated into the training and services that university libraries provide. The same is true for other interactions and current issues, since AI literacy's impact on research, institutions, professionals, etc., is already being discussed (Flierl, 2023; Heck et al., 2021; Kim & Lee, 2022; Kong et al., 2021).

CRedit authorship contribution statement

Maria Pinto: Writing – review & editing, Supervision, Methodology, Conceptualization. **Javier Garcia-Marco:** Writing – original draft, Software, Data curation. **David Caballero:** Methodology, Conceptualization. **Ramón Manso:** Writing – review & editing, Visualization. **Alejandro Uribe:** Writing – review & editing, Visualization, Formal analysis. **Carmen Gomez:** Writing – review & editing, Data curation.

Declaration of competing interest

We affirm the absence of any conflict of interest regarding this research, which has been conducted following all principles of quality, ethics, and academic rigor.

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Appendix A. Supplementary data

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