The scientific production of Ibero-American authors on information literacy (1985–2013)

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Abstract The objective of this study was to make a current diagnosis of the scientific production of Ibero-American researchers on information literacy and information competences during the last four decades. The literature output on information literacy was examined using the techniques of bibliometric analysis and information visualization. The literature considered was that constituted by the articles included in the Web of Science (Thomson Reuters), Scopus (Elsevier), Library and Information Science Abstracts, and Library, Information Science and Technology Abstracts databases. The occurrence of descriptors was analysed using VOSViewer, a program that groups them into clusters and generates a map of their connections. The results showed exponential growth of some 30 % annually between 2005 and 2011, with a mean of 14.45 documents per year. Spain, with 119 documents, was the top producing country, followed by Brazil with 76. The distribution of the more than 500 authors fitted a Lotka-law pattern, and the distribution of the 105 journals fitted the three zones of a Bradford-law pattern. The visualization map showed the 62 descriptors to group into seven clusters. For its centrality, there stood out "Information literacy", strongly related with "Information Science". At the edge of the

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map were "Digital literacy" and "School library", indicative of their lack of any strong relationship with other terms. The "Education", "Knowledge management", "Universities & colleges", and "University libraries" descriptors were linked closely with the main IL theme.

Keywords   Information literacy · Bibliometric analysis · Scientific production · Ibero-America · Visualization of similarities

Introduction

Previous publications on the scientific production about Information Literacy (IL) (Rader 2002; Marzal et al. 2007; Pinto et al. 2010, 2011, 2013) have shown the volume of work to have increased exponentially over the last 10 years or so, and to have diversified into different thematic areas and contexts of application. In this work we shall consider the specific case of the countries of Ibero-America, for which purpose we shall use this term to refer collectively to the Spanish and Portuguese speaking countries of America and Europe.

Ibero-American research in IL, with the subsequent publication in specialist journals, has been relatively recent. The term Information Literacy came into use only towards the end of the last century (Benito Morales 1995; Ferreira 1995; Gómez Hernández 1995, 1996; Lau and Cortés 1999; inter alios). Then, at the beginning of the present century, there began a significant growth in scientific production. This included not only work based on the results of research projects and dissertations, but also the publication of models, instruments, and computer programs oriented towards applications in different fields of knowledge (translation and interpretation, medicine, information and documentation, communications, psychology, …). One of the first review-type IL studies of interest was the UNESCO report (UNESCO 2007). This covered the main IL initiatives worldwide, and included a brief overview of the advances and developments in Ibero-America. Other recent bibliometric studies (Dudziak 2010; Pinto et al. 2010) have focused on the terminological, conceptual, and statistical analyses of the evolution of the terms used in IL over the last 30 years, emphasizing their different acceptances according to the perspectives and contexts in which they operate, and the main research trends.

The objective of the present paper to provide a current diagnosis of the scientific production on information literacy and information competences (COMPINFO[1]) in the countries of Ibero-America over the past four decades, taking into account their specific contextual, educational, and research characteristics.

Literature review

To address the history of the scientific production of IL in the Ibero-American context, one needs to understand it in terms of two interrelated aspects: the evolutionary process of library-based education in IL, and the way in which this process is referred to.

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[1] Denomination used in the 22 Ibero-American countries to denote both Information Literacy and Information Competences: http://alfiniberoamerica.wikispaces.com/.

Although there is no agreement on the matter, if one considers different internationally-oriented (Rader 1990, 1993, 1999, 2002; Basili 2003, 2004, 2009; Lau et al. 2007; Grassian and Kaplowitz 2009: inter alios) and Ibero-American (Gómez Hernández and Pasadas Ureña 2003; Dudziak 2003, 2008; Dudziak and Ferreira 2004; Lau 2007; Pinto et al. 2010, 2011; Uribe-Tirado 2013; inter alios) works on IL, one observes that there has been an evolution from library instruction (from the XIX to the mid-XX century) and the traditional training of users (from the middle to the last decades of the XX century) towards IL, multiliteracies, and the leading role of information competences as part of life-long learning (from the 1990s to the 2000s). One also observes that this evolution was accompanied by the use of different terms to refer to those learning processes (bibliographic instruction, user training, information skill development, information competences, …).

These two aspects (the historical process and the terms used to refer to it) help us understand that, although there are references in the databases to Ibero-American scientific production from 1970 onwards, production on the concept of IL really dates back only to the late 1990s and continues to grow today. Certain countries are leaders in this sense, especially in the field of university libraries, although there has also been meaningful experience in other types of library (Uribe-Tirado 2010, 2012; Pinto and Uribe-Tirado 2012). In the development and implementation of IL in the Ibero-American context, one can distinguish six periods of studies with their corresponding characteristics:

- The first period (1985–1994) contains some thoughts on information education beyond the traditional bibliographic instruction and user training (only library services), and some initial proposals for new forms and activities of library-based training with a broad understanding of information and knowledge generation (Bernal Cruz 1985).
- The second period (1995–1999) is characterized by further reflection on the scope and needs of users for information, and on the development of new library-based training proposals. There appear the first references to the translation from English of "Information literacy", and there are held the two first International Meetings on the Development of Information Skills (DIS) in Ciudad Juárez (Mexico) with their respective final statements. These meetings comprised more than 30 papers presenting experiences in the Mexican context. They marked the passage from traditional training to one more in tune with modern lines. In the case of Spain and Portugal, which later were to influence higher education in the Latin American countries, there stands out the Bologna Declaration which calls for a European Higher Education Area (competence-based education).
- The third period (2000–2003) is marked by the following aspects: initial knowledge of the standards and models of Anglo-Saxon countries; the first translations or adaptations of key international documents to the Ibero-American context (e.g., the Ciudad Juárez Declaration-Guidelines on DIS, 2002); the emergence of new IL programs supported by some static Web instruments; and the recognition that the information society, with all its strengths (multiple sources, full text, communication) and threats (digital divide), needs other forms of information teaching and learning.
- The fourth period (2004–2007) is characterized by a considerable increase in publications on the subject. This was influenced by the celebration of the 2004 IFLA Congress in Argentina with a section on IL, and of the 4th International DIS Meeting in Ciudad Juárez (Mexico), which contributed to disseminating some of the developments and proposals coming from Ibero-American countries. We would highlight the following facets of this period:

- Greater differentiation between digital/computer literacy and information literacy or other related areas of literacy training.
- Increasing internalization of IL as a necessary educational process for every citizen and professional, not just in the context of formal education (lifelong learning, critical thinking).
- Pioneering experiences in implementing IL in different types of libraries other than those of universities, especially in school libraries in certain countries.
- Publication of the first report of the state-of-the-art in IL (albeit with little information about the countries of Latin America or Portugal).
- Greater recognition and implementation of IL in processes of knowledge management, competitive intelligence, and e-government.
- Increase in IL training programs adapted to the recommendations of national, regional, or international accreditation or quality certification processes.
- Preparation and dissemination of the first strategic plans or policies on IL in certain Ibero-American universities, and the achievements attained so far in this line.
- Presentation of different ideas and the first steps to make IL training (in educational, informational, and technological competences) a part of academic information and documentation curricula.
- Increase in theoretical and applied research in different Ibero-American countries.
- Application and development of curriculum proposals for the acquisition of IL in certain areas of knowledge (health sciences, translation, languages, engineering, education, social work, administration, economics, …).
- Greater qualification of instructors and librarians in order to favour the educational success of the above processes.

- The fifth period (2008–2011) is marked by the following: two UNESCO/IFLA Workshops "IL Training of Instructors" in Granada (Spain) and Lima (Peru); transforming libraries into "Resource Centres for Learning and Research"; the critical role of IL for different disciplines, organizations, and educational levels; the emergence and growth of blogs and other dynamic Web resources as key sources for the development and understanding of IL in different contexts; the teaching profession's use of new active teaching methods for teaching IL in the e-learning context; the growth of IL programs in school, public, and national libraries in certain countries; the presence of a strategic plan for IL in REBIUN, Spain's Network of University Libraries; a greater explicit presence of IL in the curricula of different professions and in certain universities; the importance of evaluating information competences; and finally, there stands out the growth and impact of specific publications on the subject.
- The sixth period (2012–…) is one of positioning and growth of IL in the various countries of Ibero-America, as evidenced by the following facts:

  - Growing presence of IL in discussions of the National Education Plans and the Strategic Plans of Universities thanks to the UNESCO initiatives set out in the Moscow Declaration (2012) and in the Media and Information Literacy Recommendations as a key strategy in the education of all countries (2013).
  - Steadily growing volume of publication of theoretical/conceptual and applied developments in both international and Ibero-American journals.
  - Increased participation in global conferences, and taking advantage of dynamic Web resources as a means of academic disclosure and interchange among Ibero-American countries.

- Development of collaborative proposals as set out in the Declaration of Havana (2012).

The analysis of these periods shows a major effort to have been made in Ibero-American countries to conceptualize, denominate, present, and implement the philosophy and practice of IL in education. This has especially been so in the context of higher education. From the late 1990s, works have evolved from traditional user training to training in IL and multiliteracies. Their focus has been on the acquisition of key competencies that contribute to the generation of critical thinking and lifelong learning. Clearly, ICTs have played a key mediating role in this acquisition.

Methods

We used the methods of documentation and bibliometrics to analyse the selected corpus of articles on scientific production in Ibero-America constructed from a set of reference databases.

We began with a conceptual analysis of published research in Ibero-American countries in the IL field. The concepts selected for search were: "Literacy", "Information literacy", "Information skill", "Information competence", and "Ibero-america" (Spain, Portugal and/or Latin America). Only these terms are used, and no others, which also can be referred to this subject in the Iberoamerican context (in Spanish: *desarrollo de habilidades informativas, destrezas en información*, etc., or Portuguese: *competência em informação, literacia informacional*, etc.) as has been shown in other texts (Uribe-Tirado et al. 2013; Correia 2013), since the translated these terms into English if there is a common terminology for both these terms in Spanish and Portuguese, which is: "Information literacy", "Information skill", "Information competence" (Pinto et al. 2014).

The search strategy had to be adjusted in each case to the interrogation system of the selected bibliographic databases. Variants of the search terms, such as singular and plural, were allowed. No limit was set on the publication date.

Since it is difficult to find a single database that covers a particular discipline comprehensively, the following databases with international coverage were selected as information sources:

- Web of Science (Thomson Reuters): Bibliographic database and citation index, with a carefully selected and evaluated multidisciplinary coverage of over 12,000 journals and over 120,000 conference proceedings in science, social sciences, arts, and humanities. It contains data from 1900 to the present.
- Scopus (Elsevier): Multidisciplinary database of abstracts and citations in the scientific literature since 1966. It covers all the fields of science, technology, medicine, social sciences, arts, and humanities. It is updated daily, with scientific information from over 100 countries.
- Library and Information Science Abstracts (LISA): Bibliographic database for librarians, information professionals, and Library and Information Science students. It contains indexes and abstracts of over 440 periodicals from more than 68 countries and in over 20 languages. Its coverage is from 1969 to the present. It was accessed through the ProQuest platform.
- Library, Information Science & Technology Abstracts (LISTA): This resource indexes more than 560 core journals, approximately 50 priority journals, and about 125 selected

journals, plus books, research reports, and conference presentations. The coverage of topics includes librarianship, classification, cataloguing, bibliometrics, online information collection, information management, etc. Coverage dates back to the mid-1960s. It was accessed through the EbscoHost platform.

As can be seen, we have considered both the two most important academic-scientific databases (Web of Science—Thomson Reuters; and Scopus—Elsevier) and the two specialist databases that include the worldwide production in the area of Library and Information Science (LISA and LISTA). Moreover, these last two also include publications in local and national journals of the Ibero-American region, which the other two databases do not address. Looking at the SCImago (2013) ranking of scientific journals (http://www.scimagojr.com/journalrank.php), one finds that of the 205 journals in the category Library & Information Sciences only 12 journals are published in Spanish and/or Portuguese—7 from Spain, 3 from Brazil, 1 from Mexico, and 1 from Argentina (Fig. 5).

The need to query various databases involved a series of difficulties that had to be overcome:

- Since the databases index documents differently, for the search terms we used both natural language and controlled language.
- Each database has its own particular structure. Although their fundamental fields are the same (i.e., title, authors, and keywords), this is not the case for the author affiliation field. We therefore had to adapt the search strategy to each particular case.
- Since the output formatting options differ, this also had to be taken into account in exporting the results.

The documents resulting from the consultation of the four reference bibliographic information sources were exported to a custom database using the RefWorks (ProQuest) reference management software, in which the data was then cleansed appropriately for its subsequent processing.

Because of the high degree of overlap of the WoS, Scopus, LISA, and LISTA databases (Escalona et al. 2010), the first step in this processing was to remove all duplicates. For this purpose, we began by using the "View Duplicates" module of the software package. This was found to be insufficient, however, since the titles were not indexed uniformly. In particular, they could appear in three languages: English, Spanish, and Portuguese. It was therefore necessary to remove the remaining duplicates manually. The case was similar for the descriptors and author names, which had to be made uniform manually.

Once the duplicates had been eliminated, we exported the data to be analysed (authors, sources, year of publication, document type, and keywords) to a new database and spreadsheet using the Microsoft Office 2007 software package (Access and Excel).

We selected from the descriptors retrieved those which occurred at least 5 times, and they were used to construct a (square, symmetric) co-occurrence matrix. The elements of this matrix are the number of times that the corresponding pair of descriptors appear together in the articles analysed. They provide the necessary information to map the knowledge space referring to the presence of the "Information literacy" area in Ibero-American research.

A Pajek-format file was generated from the co-occurrence matrix using the UCINET software package (Borgatti et al. 2002). Then this file was processed in the freely available VOSViewer computer program (Van Eck and Waltman 2007a; Van Eck et al. 2010) to create a map displaying the similarities among the concepts of the two-dimensional space (Van Eck and Waltman 2007b). This is done by grouping the descriptors into clusters

based on a weighted, parameterized variant of the modularity function of Newman and Girvan (2004). The resulting graph gives a visual representation of the proximity or distance between the concepts in this field of knowledge.

The results of this process are presented in the following section. The preferred publication type, the identification of the authors, the journals with most publications on the subject, and the thematic trends over time will allow one to visualize how the concepts have evolved, which are the preferred descriptors, the interrelationships between concepts, and the major lines of research.

Results

In this section, we shall present the results of using the techniques of bibliometric analysis and information visualization on the corpus of Ibero-American IL literature.

Evolution of the scientific production on IL in Ibero-America

For the period 1985–2013, the total number of unique IL documents retrieved was 340. Figure 1 shows the temporal evolution of the annual number of records. The year with the greatest production was 2011, with 59 documents. From 2005 until 2011, there was exponential growth in production, with an annual growth rate close to 30 %. The mean annual number of documents in this period was 14.45. The fall in the graph at the end of the period is logical due to delay in publication or because documents had yet to be registered in the databases.

Distribution of documents by country

There were a total of 12 Ibero-American countries with scientific production in IL. Figure 2 shows the distribution of the production by country. Spain, with 119 documents, had the greatest production, followed by Brazil (76). At some distance, with 38 documents, was Cuba, followed by Mexico, Colombia, and Portugal.
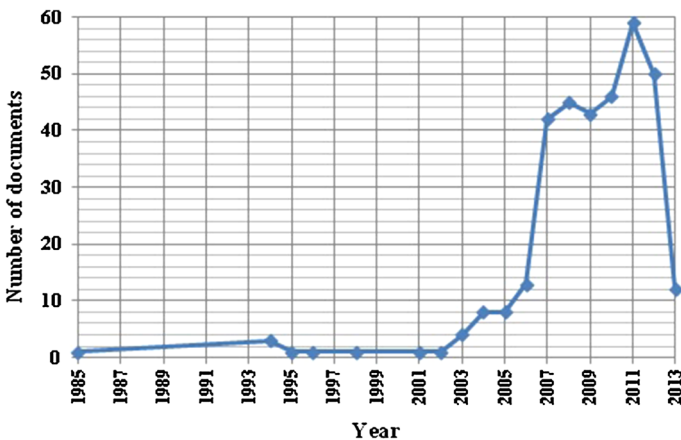

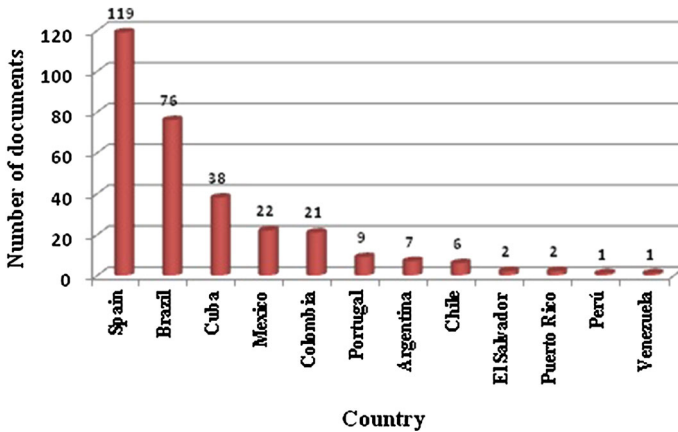**Fig. 1** Evolution of the number of documents per year

Fig. 2 Number of documents by country

The total number of documents corresponding to these 12 countries was 304. The difference with respect to the initial number (340) is because some did not have all the author affiliations in the databases.

Scientific productivity of the authors on IL

In total, 568 authors from Ibero-American countries have published papers on this topic.

Figure 3 shows the distribution of the authors binned into three levels of productivity: $LP = 0$ (log 1), authors with one published document; $0 < LP < 1$ (log 1+ to log 9), authors with from 2 to 9 published documents; and $LP \geq 1$ (log 10+), authors with 10 or more published documents. The number of authors with a single document was 493, with from 2 to 9 documents was 72, and with 10 or more documents was only 3.

The production of the most prolific authors (4 or more published documents) is listed in Table 1. Topping the list are M. Pinto with 27, M. A. Marzal with 12, and A. Uribe also
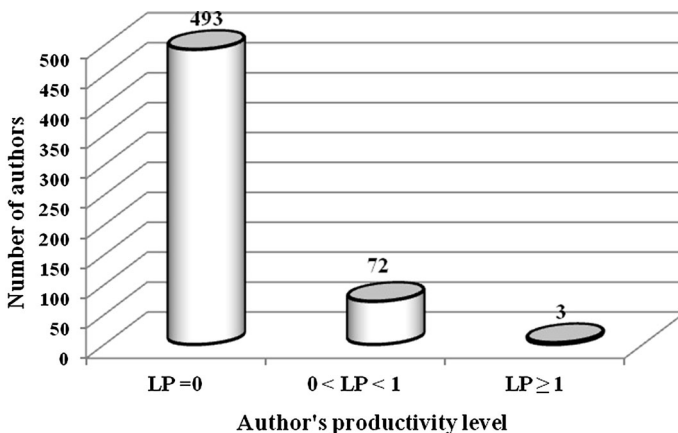

Fig. 3 Productivity levels of authors in IL

Table 1 Distribution of authors with productivity ≥ 4

Authors	No. of documents published
María Pinto	27
Miguel Ángel Marzal	12
Alejandro Uribe-Tirado	12
Dora Sales	8
José Antonio Gómez Hernández	7
Judith Licea de Arenas	6
Cristóbal Pasadas Ureña	5
A.V. Doucet	5
E.V. Vitorino	5
Javier Calzada Prado	4
G. Marciales Vivas	4
K.C.G.R. Gasque	4
A.M.R. Correia	4
M. Somoza Fernández	4
Elisabeth Adriana Dudziak	4
Bernadete Campello	4
G. Meneses Placeres	4

with 12. These are the three authors comprising the third level of productivity in Fig. 3 (LP ≥ 1).

In order to check whether or not the distribution of the documents among the authors fits a Lotka distribution, we applied the Kolmogorov–Smirnov non-parametric goodness-of-fit test. If the distribution does follow the inverse power law of Lotka (1926) then a log–log plot of the data will be a straight line whose slope is the law's exponent. The result for the present case (Fig. 4) was a slope of –3.27 with a coefficient of determination (R^2) of 0.9848. The second parameter of the law (the constant C, equal to the fraction of authors with a single publication), calculated once the value of the slope had been determined (Pao 1985), was 0.8648 (Table 2).
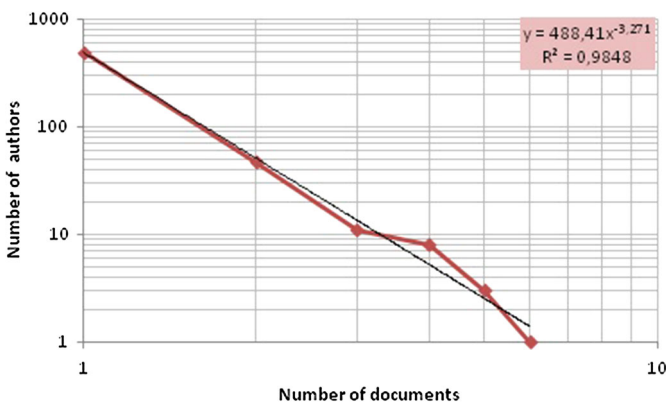

Fig. 4 Lotka distribution—author productivity

Table 2 Non-parametric Kolmogorov–Smirnov test

Publications = x	Authors = y	Authors %	Cum. y %	F_e (estimated)	Cum. F_e	D_{max}
1	493	0.8679	0.8679	0.8648	0.8648	0.0031
2	47	0.0827	0.9507	0.0896	0.9545	−0.004
3	11	0.0193	0.9700	0.0238	0.9783	−0.008
4	8	0.0140	0.9841	0.0092	0.9876	−0.003
5	3	0.0052	0.9894	0.0044	0.9921	−0.003
6	1	0.0017	0.9911	0.0024	0.9945	−0.003
7	1	0.0017	0.9929	0.0014	0.9960	−0.003
8	1	0.0017	0.9947	0.0009	0.9970	−0.002
12	2	0.0035	0.9982	0.0006	0.9977	0.0005
27	1	0.0017	1.0000	0.0004	0.9981	0.0018
	568					

For the present case, the value obtained for the Kolmogorov–Smirnov statistic (D_{max}) was 0.008, and the calculated weighted critical value (*c.v.*) of the Kolmogorov distribution at significance level $\alpha = 0.05$ was 0.068. Since this critical value is greater than D_{max}, the null hypothesis that the data fit a Lotka distribution can not be rejected.

Dispersion of the scientific literature (Bradford's law)

One of the milestones in the development of Information Science was evidence for the regularity in the distribution of scientific journals, known in the literature as Bradford's law (1934, 1948).

Figure 5 shows the distribution of the articles among those journals with a production of 5 or more articles. The top-ranked producing journal was ACIMED (24), followed by Informação & Sociedade (22) and Perspectivas em Ciência da Informação (21). The 329
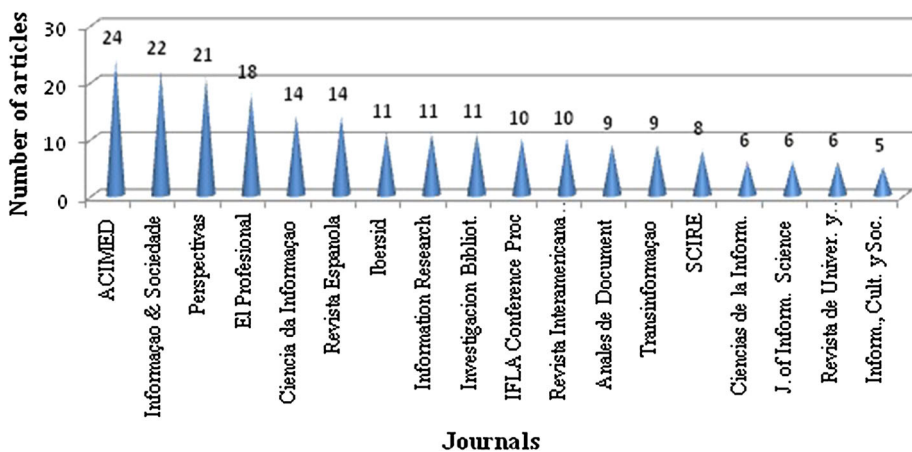
Fig. 5 Distribution of articles produced by Ibero-American authors in journals

articles constituting the scientific output of the study (from the total sample, 11 records were discarded as corresponding to books) were published in a total of 105 journals.

The empirical law of the dispersion of scientific literature was put by Bradford in the following words: *If one arranges scientific journals according to their decreasing productivity of articles on a given topic, they can be divided into a core of journals most particularly devoted to that topic and several groups or zones each containing the same number of articles as the core so that the quantities of journals in the latter and in the successive zones are in the relation 1: k: k²: ….* Bradford's law is nothing more than a description of a quantitative relationship between journals and scientific articles in a bibliography on a specific topic. The law seeks to demonstrate that there is a highly unequal distribution in the production of articles in journals, with most articles being concentrated in a small population of journals. In the process of concentration, the first zone, called the "core", would contain the journals devoted to the topic of the literature being studied.

One can arrange journals in zones of declining productivity on the scientific topic under study. The number of journals in each zone will increase as productivity decreases (Table 3).

To illustrate the law, Bradford presented a plot (Fig. 6) in which the horizontal axis is the logarithm of the cumulative number of journals in descending order of productivity (1, 2, 3, …, r…), and the vertical axis is the cumulative number of articles, $R(r)$ The curve is, of course, invariably monotonically ascending.

Egghe (1986, 1990) further developed the theory behind Bradford's law, deriving a theoretical formula to calculate the Bradford multiplier and the number of articles produced by the most productive source in each Bradford zone. Egghe applies these results to certain classical areas ("Applied Geophysics", "Lubrication", "ORSA", "Mast Cell", "Schistosomiasis", etc.), determining the underlying law of Leimkuhler (1967) and the different Bradford zones. In the article of 1990, Egghe uses the following notation:

Table 3 Distribution of journals by production of articles

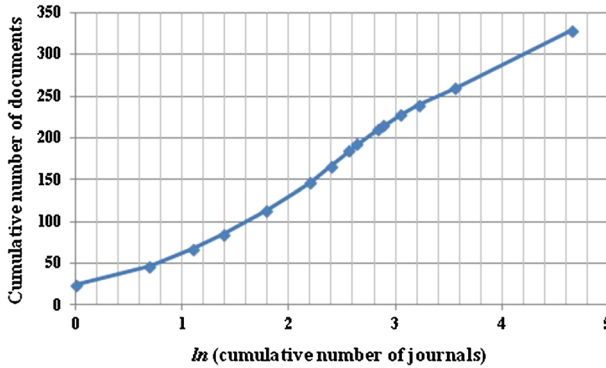| Journals = a	Articles = b	$a \times b$	Cum. journals = c	Ln c	Cum. articles
1	24	24	1	0	24
1	22	22	2	0.6931	46
1	21	21	3	1.0986	67
1	18	18	4	1.3862	85
2	14	28	6	1.7917	113
3	11	33	9	2.1972	146
2	10	20	11	2.3978	166
2	9	18	13	2.5649	184
1	8	8	14	2.6390	192
3	6	18	17	2.8332	210
1	5	5	18	2.8903	215
3	4	12	21	3.0445	227
4	3	12	25	3.2188	239
10	2	20	35	3.5553	259
70	1	70	105	4.6539	329

Fig. 6 Dispersion of the scientific literature (Bradford)

r_0 Number of sources in the first Bradford zone

y_0 Number of articles in each Bradford zone (all zones are of equal size)

K Bradford multiplier

y_m Number of articles in the most productive journal (rank 1, when the sources are arranged in order of decreasing productivity)

$R(r)$ Cumulative number of articles produced by the journals of rank 1, 2, 3,… r

a & b Constants appearing in the following formula of Leimkuhler:

$$R(r) = a \cdot \ln(1 + br)$$

In the earlier article (1986), Egghe had shown that: $a = \frac{y_0}{\ln k}$, in the present case: $a = \frac{y_0}{\ln k} = \frac{(329/3)}{\ln(3.496)} = \frac{109.66}{1.25} = 87.73$, and $b = \frac{k-1}{r_0}$, and in the present case: $b = \frac{k-1}{r_0} = \frac{(3.496-1)}{6.28} = 0.397$.

p Number of groups or Bradford zones (chosen in the range 3–10)

Once selected p (in our case $p = 3$), one can determine k.

Egghe (1986) finds that: $k = (e^\gamma \times y_m)^{1/p}$

$$\gamma = \text{the Euler constant} = 0.5772, \text{ so that } (e^\gamma = 1.781)$$

$$k = (1.781 \times y_m)^{1/p} = (1.781 \times 24)^{1/3} = 3.496$$

One can then calculate both y_0 and r_0:

$$y_0 = y_m^2 \cdot \ln k; r_0 = (k - 1) \cdot y_m$$

These last two formulas are not strictly necessary since, knowing p and k, it is easy to calculate y_0 and r_0:

$y_0 = \frac{A}{p}$, where A is the total number of articles in the literature set;

$r_0 = \frac{T}{1+k+k^2+\cdots+k^{p-1}} = \frac{T(k-1)}{k^p-1}$, where T is the total number of sources.

In the present case: $r_0 = \frac{T(k-1)}{k^p-1} = \frac{(105 \times 2.496)}{(3.496^3-1)} = \frac{262.08}{41.728} = 6.28$,

To calculate the number of journals in each Bradford zone (r_0, $k * r_0$, $k^2 * r_0$, …), Egghe recommends using the exact values of r_0 and k without rounding them off.

In summary, one can deduce Leimkuhler's law from knowledge of the parameters a and b, obtained using the exact formulas of Egghe (1986).

For the present case, the distribution of all the journals into three Bradford zones is given in the Table 4:

The fitted equation (for $p = 3$) is:

$$R(r) = a \times \ln(1 + b \times r) = 87.72 \times \ln(1 + 0.397 \times 105) = 87.61 \times 3.73 = 327.2$$

Collaboration index

The 340 works on IL in Ibero-America were signed by 728 authors, with the Collaboration Index thus being 2.14 authors per work. Table 5 presents the distribution of the number of authors per paper. Two documents (0.59 %) were signed by eight authors, three by seven authors, down to 119 documents (35 %) signed by a single author. In total therefore, 65 % of the works were published in collaboration.

Co-occurrence map

Figure 7 presents an overview of the IL literature registered in international databases and published by authors from Ibero-American institutions. The figure uses the English terms to facilitate interconnections and to obviate noise from the effects of the different denominations and languages considered: Spanish, Portuguese, English.

The map presents descriptors related to the central concept of IL, while also providing information on how they relate to each other. The larger the size of the disc and the label, the more occurrences there were in the literature analysed. Of the 61 descriptors selected, that of greatest centrality was "Information Literacy", being the descriptor related with the greatest number of other terms. There stands out its strong relationship with "Information Science". Terms at the edge of the map have little relationship with other terms. One example is "Digital literacy".

The descriptors assigned to a particular cluster are represented by the same colour. The size of a cluster has no direct interpretation. It depends on a number of factors including the number of terms in the cluster, the frequency of occurrence of the terms, and the strength with which they are related to each other.

Descriptors located close together indicate a close relationship between the corresponding topics, while descriptors far from each other indicate minimal or little relationship. The map has a structure which is completely circular, with all the descriptors being distributed around the central point of "Information literacy".

Table 4 Distribution of all the journals into three Bradford zones

Zones	Journals	Articles	K
Core	6	113	–
1st zone	22	117	3.6
2nd zone	77	99	3.5
Totals	105	329	

Table 5 Ibero-American IL index of collaboration per work

No. of authors (a)	No. of works (b)	a × b	%b	∑ %
8	2	16	0.588	0.588
7	3	21	0.882	1.471
6	6	36	1.765	3.235
5	5	25	1.471	4.706
4	26	104	7.647	12.353
3	49	147	14.412	26.765
2	130	260	38.235	65.000
1	119	119	35.000	100.000
	340	728	100.000	

Collaboration index = 2.14

Fig. 7 Map of co-occurrences of IL descriptors

The descriptors "Education", "Universities & colleges", and "University libraries" are closely related to the main theme of IL. To avoid overlapping labels, only a subset of all labels is visible.

Table 6 lists the descriptors grouped into 6 clusters.

Table 7 lists the 61 descriptors having a frequency of occurrence of at least 5. Those of greatest frequency are "Information literacy" and "Information science". Those of lowest

Table 6 Descriptors grouped into 6 clusters

Cluster 1 (16 items)	Brazil; Computer literacy; Cuba; digital libraries; digital literacy; information and communication technologies; information literacy; information literacy-research; information needs; information resources; information society; information-seeking behaviour; internet; internet in education; research; search engines
Cluster 2 (13 items)	Academic libraries; access to information; article; assessment; evaluation; higher education; information competences; information society concept; latin america; literacy programs; Mexico; User training; university libraries
Cluster 3 (10 items)	Associations, institutions, etc.; developing countries; electronic data processing; information resources management; information science; information services; information technology; knowledge management; library science; training
Cluster 4 (8 items)	E-learning; education; humans; information; information management; information skills; library education; universities and colleges
Cluster 5 (7 items)	Electronic information resource literacy; Information professionals; librarians; libraries; literacy; school libraries; technological literacy
Cluster 6 (7 items)	Information literacy-study and teaching; Information retrieval; information science-study and teaching; learning; Spain; students; teaching

frequency are "Search engines", "Information society concept", "Information science—study & teaching", "Information needs", "Electronic data processing", "Digital literacy", "Digital libraries", "Developing countries" and "Assessment".

The same table presents the strengths of the different links. There stand out "Information literacy", "Information science", "Literacy", "Education", "Knowledge management", "Information technology", "Information resources management", "Information retrieval", "Universities & colleges" and "University libraries".

Discussion

In the present section, we shall address two aspects: first, a description of some of the IL trends that seem to be occurring in Ibero-America, and second, a comparison of the present results with those of similar studies in the global context, in order to identify commonalities and differences.

With respect to the results specific to Ibero-America, we would highlight the following:

- The scientific literature on this topic has shown an increasing trend since 2002 (Fig. 1). This is evidence for the importance of IL in the reflection, research, and professional practice of Ibero-American librarians to meet the training needs of their users. Consistent with this growing trend are the results reported in the Ibero-American IL Wiki (http://alfiniberoamerica.wikispaces.com) that the number of documents has risen from 979 in October 2011 to 1788.
- Although the commonest and most strongly linked term was "Information literacy" (Table 7), that of "Training in information competences" is gradually gaining presence in other areas such as education, informatics, and communication. This is in line with the implementation of the "Resource Centres for Learning and Research" and the UNESCO policy of integrating the concepts of media and IL (http://milunesco.unaoc.org/).
- Regarding the terminology, the terms which identify the area under study are clearly "Information literacy" and its commonest translations into Spanish "Alfabetización

Table 7 Number of occurrences and link strengths in descriptors with a frequency ≥ 5

Descriptors	No. of occurrences	Total link strength
Information literacy	212	863
Information science	47	370
Brazil	23	120
Spain	22	128
Article	21	98
Information competences	20	98
Literacy	17	128
Higher education	17	90
Education	17	122
University libraries	17	106
Cuba	15	74
Information technology	14	108
Evaluation	14	88
Knowledge management	13	110
Information retrieval	13	106
Information resources management	13	106
Universities and colleges	12	106
Research	12	102
Library science	12	98
Libraries	12	86
Information skills	12	80
Academic libraries	12	74
User training	12	84
School libraries	12	60
Internet	11	70
Learning	9	66
Information society	9	52
Information management	9	68
Electronic information resource literacy	9	66
Computer literacy	9	42
Access to information	9	46
Teaching	8	44
Librarians	8	62
Internet in education	8	48
Information-seeking behaviour	8	52
Information services	8	76
Information literacy—research	8	66
Information and communication technologies	8	42
Training	7	38
Library education	7	42
Latin America	7	28
Information professionals	7	28
Technological literacy	6	40

Table 7 continued

Descriptors	No. of occurrences	Total link strength
Students	6	24
Literacy programs	6	32
Information resources	6	46
Information literacy—study and teaching	6	36
Information	6	26
E-learning	6	46
Associations, institutions, etc.	6	44
Search engines	5	50
Mexico	5	38
Information society concept	5	28
Information science—study and teaching	5	46
Information needs	5	38
Humans	5	28
Electronic data processing	5	48
Digital literacy	5	20
Digital libraries	5	40
Developing countries	5	24
Assessment	5	34

informacional" and Portuguese "Competência em informação". Nevertheless, for many authors there is an interrelationship with other terms such as information skills, computer literacy, and user training, or these other terms may even be used indistinctly.

- Regarding the countries and the authors, there was an interrelationship between these two variables in the study since the countries that were most productive (Fig. 2) and with most collaborative work and the strongest links (Table 7) were mostly the same countries of origin of the most productive authors (Table 2). In particular, for more than a decade Spain, Brazil, and Mexico have been the prime promoters of research and applied developments in this area. They have been joined in recent years by other countries such as Cuba, Colombia, and Portugal.

- As one observes from Fig. 2 and Tables 2 and 7, there are only a few Ibero-American countries and authors who have significant collaborations. Analysing the degree of collaboration between Ibero-American and non-Ibero-American (Europe, USA, etc.) authors, one observes that such collaboration is still in an incipient stage (Crawford et al. (2004)/Spain-Britain; Torras and Saetre (2009)/Spain-Norway; Wyer and Silva (2009)/Brazil-USA; Silva et al. (2011)/Brazil-USA; Tavares et al. (2011)/Brazil-Britain; Zylka et al. (2011)/Portugal-Germany; Domínguez-Flores and Wang (2011)/Puerto Rico-USA; Machin-Mastromatteo and Virkus (2013)/Venezuela-Estonia; Machin-Mastromatteo et al. (2013)/Venezuela-Mexico-Estonia).

- The practice of IL training is most present in academic and universities libraries and universities (Table 7: University libraries, Universities & colleges, Higher education, Academic libraries). Surprisingly, Public libraries and Citizenship are not among the frequent descriptors.

- Although the scientific literature on IL is preferentially published in the languages and journals of these Ibero-American countries, such as ACIMED, Perspectivas em Ciência da Informação, El Profesional de la Información, Revista Española de Documentación Científica, Ciência da Informação, Investigación Bibliotecológica, etc., one also observes a growing tendency to publish in international journals of impact published in English, such as Scientometrics, JDOC, JIS, JAL, MITL, PORTAL, College and Research Libraries, and Information Research.

Comparing the present results with those of similar studies conducted in recent years (Pinto et al. 2010, 2011, 2013; Uribe-Tirado 2013), one finds the following relationships:

- Those studies also find IL to have been an emerging and growing issue for a decade.
- The predominant terms and areas in the international literature also show that, as in the Ibero-American context, production is greater in the area of Information and Documentation, although there also appear other areas related to education, informatics, and communication. One detects, however, a major difference. This is the weight in the international IL literature of works in the area of health (medicine, nursing, public health, dentistry). At the Ibero-American level, this is only a recently emerging topic.
- The terminological process in the international context has been similar to that of Ibero-America in that the term "Information literacy" has been the most broadly accepted. However, in the relevant decades of the twentieth century (1970s, 1980s, and 1990s), it shared predominance with other terms from the areas of informatics and of information and documentation. Currently, one observes that the term "Information literacy" is often interrelated with other types of literacies, leading to the appearance of such terms as transliteracy or multiliteracy. This aspect is as yet reflected neither in the Ibero-American context nor in its scientific production.
- In the international context, the most productive countries are the United States, Britain, Australia, Canada, etc., and it is also in those countries in which the journals are published which have most publications on the topic. Gradually, however, some journals published in Ibero-American countries are beginning to gain a presence in the scientific context with their contributions and visibility, as has been noted above.
- One also notes that there is an increasing presence of authors from different Ibero-American countries in international journals.
- With respect to the type of information unit and the educational level, the present results for Ibero-America show the same orientation as the global trend, with academic libraries and universities generating most research. One observes, however, that, unlike the international context, the body of Ibero-American publications on IL in school and public libraries is still in its infancy.

With respect to the scientific productivity of the authors who have published on IL:

- The analysis gave a Lotka law slope of −3.27. Such a value in this present analysis of IL is consistent with those found in previous studies in two similar fields—Information Science (Pao 1986; Martín-Sobrino et al. 2008) and Social Science and Humanities (Pulgarín 2012).
- The two Lotka's law parameters are known to correlate positively with each other and negatively with the average number of papers per author (Pulgarín 2012). They are high (as in the present case) when the concentration of authors is low, i.e., when there are many authors who have published only a few papers. The interpretation is that the field under study is in a phase of dynamic development (Egghe 2012).

Conclusions

It is important to emphasize the need for bibliometric studies of the scientific literature on IL in the Ibero-American context to be conducted periodically. This will allow researchers, academics, and information professionals in the Ibero-American context to monitor the emerging trends in research and collaboration in this area, and to see which authors and journals are the most productive.

In this sense, the present analysis of the interrelationship between the Ibero-American and the global contexts implies that there is a need to continue working in especial depth on various fronts:

- Promoting the transferability of IL between disciplines so that it will naturally permeate the different areas of knowledge, in particular, for there to be a deep interplay between the culture of the disciplines of the different academic programs and the development of information competences in university students.
- Fostering collaborative developments between the different information units and the educational organizations that are leading this university level training.
- Disseminating literacy practices in the remaining types of information unit (public libraries, school libraries, etc.) at different educational levels (primary and secondary), and among citizens in general, so that they can take advantage of this training and share their experiences and lessons learnt.
- Raising awareness of the importance of the diagnostic (information behaviour) and assessment aspects of IL in order to monitor the learning acquired and to orient the necessary educational intervention.
- Systematizing and sharing knowledge, experiences, and learning about IL via various channels, events, and forums, so as to spread awareness of those achievements for them to be recognized and shared by the international scientific and professional community.

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