Scientific Output from Latin America and the Caribbean – Identification of the Main Institutions for Regional Open Access Integration Strategies[1]

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Abstract

Latin America is a region in which two thirds of the investment in research and development are funded by State resources. It can be foreseen that in the near future governments in the region will encourage and promote, or require by law or mandates, that scientific output from the region become visible and accessible in open access repositories and portals. This paper presents the results of a survey to identify the institutions of the region with the largest volume of scientific output and most exposure of their output on the Web, in order to help make those institutions visible to national, regional and international organizations involved in open access strategies and programs in Latin America and the Caribbean. The results show a leading position by universities from Brazil; a strong presence of universities from Mexico, Colombia, Argentina, Chile and Venezuela, and some presence of universities from Ecuador, Peru, Costa Rica, Cuba, Puerto Rico and Uruguay.

Keywords

Open access, scholarly communications, research universities, institutional repositories, Latin America, Caribbean

Resumé

L'Amérique latine est une région où les deux tiers des investissements dans la recherche sont financés par des ressources d'État. Il peut être prévu que, dans un futur proche, les gouvernements de la région encourageront et favoriseront, ou exigeront par la loi ou des mandats, que la production scientifique de la région devienne visible et accessible dans des répositoires de libre accès. Cet article présente les résultats d'une enquête visant à identifier quelles sont les institutions de la région avec le plus de production scientifique et exposition de cette production dans le Web, avec le but de rendre ces institutions visibles pour les organismes nationaux, régionaux et internationaux impliqués dans les stratégies et programmes d´accées libre en Amérique latine et les Caraïbes. Les résultats montrent une position de *leadership* des universités du Brésil; forte présence des universités du Mexique, Colombie, Argentine, Chili et Venezuela, et une certaine présence

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d'universités de l'Équateur, Pérou, Costa Rica, Cuba, Puerto Rico et Uruguay.

Keywords
Libre Accès, dissémination de la recherche, universités de recherche, archives ouvertes institutionnelles, Amérique latine, Caraïbes

Introduction

"There is a strong demand in the region to apply more active policies in the pursuit of social impact derived from the efforts made by countries in science, technology and innovation."
(Albornoz, 2010)

Latin America is a region in which two thirds of the investment in research and development are funded by State resources (UNESCO, 2010), and the majority of researchers are in public universities (Didriksson, 2008). It can be foreseen that in the near future governments in the region will encourage and promote, or require by law or mandates, that scientific output from the region become visible and accessible in open access repositories and portals. Open access is understood as free Web-based access to full-text research results (Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities, 2003; Salvador Declaration on Open Access-Declaración de Salvador sobre Acceso Abierto, 2005). Within the region, proposals for national open access legislation are already under debate in Congress in Brazil (Brasil, 2011) and in Argentina (Argentina, 2010). Advances in the open access international movement, promoting mandates that require self-archiving in institutional repositories (ROARMAP), and the existence of journal publishers who allow self-archiving in institutional repositories (SHERPA-RoMEO), also presage that a growing number of journal articles published in international journals by researchers from Latin America and the Caribbean will also be available in open access institutional repositories. Today, institutional repositories are promoted as the adequate option allowing each institution to manage and give visibility and access to its own output (Harnad, 2007; Babini, D., González, J., López, F., Medici, F., 2010) and as the way to ensure open access to colleagues and researchers from the same region (Kirsop et al., 2007). Latin America is a region in search of improved links of science and technology with productive and social development (Villanueva, 2008; Arocena & Sutz, 2001) and seeking to produce research that may contribute to the growth of knowledge both in local economies and worldwide, since world approaches are, in this twenty-first century, truly global in scope (Altbach, 2007).

Peer-reviewed publications are the contents of main interest to national, regional and international agencies promoting and supporting the development and coordination of digital repositories. The purpose of this paper is to identify the institutions in the region with the greatest volume of scientific output and of exposure of their output on the Web, in order to help make those institutions more visible to national, regional and international agencies involved in open access strategies and programs in Latin America.

This paper is divided into five sections. The first section gives a general background for regional open access coordination initiatives. The second section provides a brief introduction to regional open access information systems. This then leads to introducing the problem of the scientific output from the region which is not yet available in open access form. The fourth section

describes the procedure adopted by the present survey to identify the institutions of the region with the largest scientific output and Web visibility for its output, and the fifth section contains the resulting lists of institutions within each information source selected. The conclusions present a list of 109 universities and institutions in the region that have been identified as being very active as regards size of scientific output and visibility on the Web for that output – a small percentage of a total of more than 1,000 universities reported in the region by The Union of Universities from Latin America-UDUAL (Santamaría Ambriz, 2001), and smaller still of a total of 2,940 universities reported by the Network for Science and Technology Indicators – Ibero-American and Inter-American (RICYT, 2002).

Identifying those institutions that lead in scientific output and in the Web visibility of their output is this paper's contribution to national, regional and international open access coordination initiatives. The reason is that the promotion and development of institutional repositories featuring the universities and institutions of the region that have most scientific output will contribute to increasing the probability and the possibility of having significant scientific contents in national and regional open access coordination initiatives.

Regional open access coordination initiatives

"The question is no longer 'if' we should have open access. The question is about 'how' we should develop it further and promote it" (Kroes, 2010). According to Jean-Claude Guédon (2008), the international power structure in science is affected by open access, and this structure must be taken into account when designing strategies to promote open access. The latter author holds that one cannot separate the promotion of open access from the search for a different power structure in science, particularly in developing countries, to correct existing inequalities.

National initiatives gathering institutional repositories have in recent years been implemented in several countries of Latin America to promote, support and coordinate the development of institutional repositories in each country and plan their interoperability with Iberoamerican and international open access initiatives. Regional open access strategies started in 2010, as part of RedCLARA (Latin American Cooperation of Advanced Networks), when the Inter-American Development Bank (IDB) provided support for a Regional Strategy and Framework for Interoperability and Management of a Latin American Federated Network of Institutional Repositories of Scientific Documentation (Red Federada Latinoamericana de Repositorios Institucionales de Documentación Científica en América Latina), gathering institutional repositories national systems from countries of Latin America. This project will provide integrated access to peer-review articles and master/doctorate theses. The project was initiated in eight countries in the region, through national focal points in Argentina, Brazil, Chile, Colombia, Ecuador, Mexico, Peru and Venezuela (Garrido Arenas, 2010).

Another initiative for regional cooperation among institutional repositories had started in 2009 with the creation of CoLaBoRa-Latin American Community of Digital Libraries and Repositories (CoLaBoRa-Comunidad Latinoamericana de Bibliotecas y Repositorios Digitales), which brings together researchers from 30 institutions in 10 countries – Argentina, Brazil, Chile, Colombia, Costa Rica, Ecuador, Mexico, Nicaragua, Peru and Venezuela. In 2011, the International Confederation of Open Access Repositories-COAR signed an agreement of understanding with RedCLARA and with CoLaBoRa for the purpose of working towards the establishment of a regional branch of COAR in Latin America.

In all the above mentioned open access coordination initiatives from the region, work needs to be undertaken to identify peer-review contents, which have been defined as the priority contents for those initiatives. And peer-review contents are mostly provided by research-intensive universities. The purpose of this paper is an identification of those universities as a contribution to regional open access coordination initiatives, so that access to scientific output from the region is facilitated.

In the future, as scientific contents grow in national and regional digital repositories, it will be also possible to build the databases to develop regional citation indicators. Such citation indicators are needed to complement the existing citation indicators used today for the evaluation of researchers in the region, based on sets of journals that poorly reflect the scientific output from Latin America and the Caribbean (Guédon, 2008), and that have pervaded the evaluation systems of both Latin American national science councils and Latin American universities (Alperin, J.P.; Fischman, G. & Willinsky, J., forthcoming). An alternative measurement would provide a clearer picture of the effect of the OA portals in blurring the boundaries between the centre and periphery (Alperin, J.P.; Fischman, G. & Willinsky, J., forthcoming).

In this regard, the Iberoamerican Network of Science and Technology Indicators (Red de Indicadores en Ciencia y Tecnología Iberoamericana e Interamericana-RICYT) has developed guidelines for the compilation of statistics on science and technology. In the development of the Buenos Aires Handbook, RICYT explores new analytical frameworks for the development of human resource indicators in science and technology. These indicators are of a different nature from the classic conceptual model – though complementary to it – and seek to reflect the complexity and diversity of the product of researchers' daily work. They thereby enrich the traditional production indicators based solely on counting papers and patents indexed in the mainstream international databases (D´Onofrio, M.G., Solis, F., Tignino, M.V., Cabrera, E., 2010). Open access portals will begin to compensate for the limitations raised by the barriers of the cartelized system of science, in particular around SCI (Vessuri, 2008). As the visibility of journals in the SciELO and Redalyc portals increases, their acceptance as valid measurements of "quality" – however defined –ensures that the portals will play a role in researcher incentive systems (Alperin, J.P.; Fischman, G. & Willinsky, J., forthcoming).

Academic and scientific output from Latin America and the Caribbean available in open access form

"With the advent of the Open Access initiative, the outlook for building scientific capacity in developing countries has improved significantly. In particular, the establishment of interoperable open access archives that is now underway by a rapidly growing number of institutes opens opportunities for true global knowledge exchange."
(Chan, Kirsop, Arunachalam, 2005).

In Latin America there has been steady progress by regional open access services which, at no cost to either authors or to end users, offer open access to full-text scholarly and scientific publications from Latin America and the Caribbean. Among those regional open access services, two were analyzed to identify the institutions from the region that have the largest scientific output and most exposure of their output.

SciELO and Redalyc are multidisciplinary open access peer-review journal portals totaling over 1,000 refereed scientific and scholarly journals from the region, plus journals from Spain and Portugal. These portals, after a decade of service – with no charges for authors or users – have begun developing bibliometric and scientometric indicators that will complement the traditional international indicators used for the evaluation of researchers from Latin America and the Caribbean.

Among other existing services, a new development concerning journals may be mentioned: the Latindex portal of journal portals (Latindex – Portal de Portales), which allows searching for concepts and authors in journal portals from Latin America, the Caribbean, Spain and Portugal. With regard to the above mentioned open access distribution channels, Latin America is more advanced than other regions of the world (Alperin, J.P.; Fischman, G. & Willinsky, J., forthcoming).

Concerning theses, the Cybertesis portal (Cybertesis – Portal de tesis) provides open access to full-text theses from more than 30 universities of the region. Theses are also one of the main contents in institutional repositories that are being developed in the region.

Subject digital repositories, with open access to full texts, are being developed based on longstanding subject bibliographic databases promoted by UN agencies in developing regions in past decades. These subject repositories add value with specialization (Guédon, 2009; Romary and Armbruster, 2009). As examples in the region, the following may be mentioned, among others:

- **Health**. Health Virtual Library-Latin America and the Caribbean Health Science Literature, Biblioteca Virtual en Salud-Literatura Latinoamericana y del Caribe en Ciencias de la Salud, BVS-LILACS: provides open access to 153,000 full-text journal articles, monographs, reports and theses from 15 countries of the region.

- **Agriculture**. Agricultural Information and Documentation Service of the Americas-Servicio de Información y Documentación Agropecuario de las Américas, SIDALC: provides open access to 43,357 full texts (journal articles, books, theses, working documents).
- **Social sciences**. Latin America Social Science Council-CLACSO´s digital repository-Red de Bibliotecas Virtuales CLACSO: provides open access to 28,000 full texts of journal articles (together with Redalyc), book contributions, working documents and other research output from its network of 300 research institutions in 21 countries of Latin America and the Caribbean.
- **Sustainable development and environmental health**. Sustainable Development and Environmental Health Virtual Library from the Pan-American Network of Environmental Health Information-Biblioteca Virtual de Desarrollo Sostenible y Salud Ambiental de la Red Panamericana de Información en Salud Ambiental, BVSDE-REPIDISCA: provides open access to 40,000 full texts from the region.

These four examples of open access subject repositories total more than 260,000 full texts from Latin America and the Caribbean. But peer-review contents are usually not highlighted within those subject repositories, except in some cases for journal collections (BVS and CLACSO).

More recently, institutional repositories began to be developed to file, disseminate and preserve institutional scientific and academic output: journal articles, theses, working documents, books, research data, audio and video records, and other digital objects resulting from the scientific and academic activities of each institution. Again, however, these institutional repositories usually do not identify peer-reviewed contents.

Of the above-mentioned open access regional initiatives, only SciELO and Redalyc were selected as information sources for this survey, because they both only accept peer-review journals.

Scientific output from Latin America and the Caribbean which is not available in open access

A decade of open access initiatives in Latin America and the Caribbean, as described above, shows minimal presence in those initiatives of articles published by researchers from the region in international journals. In Latin America, it was foreign (and mostly English-language) journals that were recognized as the place of “real” scholarship, which contributed little if anything to the growth and development of scholarly communication and publishing within the region (Alperin, J.P.; Fischman, G. & Willinsky, J., forthcoming).
In the 1997-2007 period, the number of documents by Latin American authors has doubled in journals covered by the Science Citation Index-SCI (Thomson Reuters), mainly due to the dynamism of Brazil (Albornoz, M., Matos Macedo, M., Alfaraz, C., 2010). But the SCI includes very few Latin American journals and is comprised in large part of English-language publications (Alperin, J.P.; Fischman, G. & Willinsky, J., forthcoming). The contents offered today in open

access initiatives such as the SciELO and Redayc journal portals contrast with the large volumes of scientific output from leading institutions of the region that have been published in international journals which remain within the international commercial distribution of journals – invisible and inaccessible to those who do not subscribe to those services.

Considering that the international open access movement is promoting laws and mandates for open access to research results, as recommended by the Berlin Declaration (Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities, 2003), it can be foreseen that a growing number of these articles published in the international journals of commercial publishers will also become available in open access repositories. Today a growing number of international journal publishers already allow authors to self-archive their articles in open access institutional repositories, in addition to their publication in the journal (SHERPA-RoMEO-List of Green Publishers).

Considering this new reality, in order to determine which are the universities and institutions from Latin America and the Caribbean with more scientific output published in journals put out by international commercial publishers, several international information sources were analyzed, to complement the SciELO and Redalyc databases.

Procedure used in the identification of institutions from Latin America and the Caribbean with the largest scientific output and most exposure of their output in the web

From among a total of more than 1,000 universities reported in the region by The Union of Universities from Latin America-UDUAL (Santamaría Ambriz, 2001), and a total of 2,940 universities reported by the Network for Science and Technology Indicators – Ibero-American and Inter-American (RICYT, 2002), this survey needed to identify the universities and institutions from Latin America and the Caribbean with the greatest volume of scientific output and most exposure of their output in the web. For this purpose, regional and international information services were consulted in search of information classified by institutions. In the case of regional information sources, it was decided to use the above-mentioned SciELO and Redalyc because they are both journal portals that only accept peer-reviewed contents. In the case of international information sources, those that were used for this survey were mainly the rankings whose methodology includes indicators of research output published/cited in scientific journals, and Web indicators. The limitations of the rankings (Vessuri, 2008) and the diversity of methodologies, objectives, criteria, coverage and scope of the rankings used does not make them comparable. These sources were used exclusively for the purpose of identifying, within them, a set of institutions that – on the grounds that they concentrate most of the scientific output from the region and have most Web visibility for that output in the periods covered by the lists – are of interest for national and regional open access coordination strategies in Latin America.

The following regional and international information sources have been used:

a. Information services that provide lists of institutions according to scientific output published in international journals:

- **SCImago Institutions Rankings SIR 2010** (Ranking Iberoamericano SIR 2010). Based on the Elsevier Scopus database, it includes institutions that in the year 2008 have published scientific articles in the 17,000 journals indexed in that database, and the impact of the institutions' output as measured by citations received in the 2003-2008 period.
- **Academic Ranking of World Universities (Shanghai)** – North and Latin America 2010. Prepared annually by the Shanghai Jiao Tong University, China. Based on number of Nobel awards and International Medal for Outstanding Discoveries in Mathematics received by each university, highly cited researchers in Thomson Reuters journals (ISI), papers indexed in *Science Citation Index* and *Social Science Citation Index,* publications in *Nature* and *Science,* and per capita academic output of the university.

b. Peer-review journal portals that have provided the author of this paper with a list of leading institutions according to articles being indexed by those portals:

- **SciELO and Redalyc.** Multidisciplinary open access peer-review journal portals that index and give visibility to over 1,000 journals from the region. The list of institutions that have published most articles in journals indexed by SciELO and Redalyc was requested by the author for this survey and kindly provided by these portals.

c. Information services listing major institutions as per the Web visibility of their production and activities:

- **Web Ranking of World Repositories 2010.** An initiative of the Cybermetrics Lab, a research group belonging to the Scientific Research Council of Spain (Consejo Superior de Investigaciones Científicas, CSIC). Classification based on size (number of pages recovered by search engines), number of unique external links received, Rich files (pdf, doc, ppt, ps, xls) and presence in Google Scholar.
- **Web Ranking of World Universities 2010.** Also an initiative of the Cybermetrics Lab, a research group belonging to the Scientific Research Council of Spain (Consejo Superior de Investigaciones Científicas, CSIC). Classification based on size (number of pages recovered by search engines), number of unique external links received, Rich files (pdf, doc, ppt, ps, xls) and presence in Google Scholar.

On the basis of the two information sources used in this survey – regional and international – a list of the most productive universities and institutions of the region was prepared and conclusions reached. Again, due mainly to the limitations of the rankings (Vessuri, 2008), it is not the aim of this paper to present a classification of scientific institutions from Latin America and the Caribbean. The purpose is to build a list, with no order within each country, of

the institutions of the region with more scientific output and exposure of this output in the web, with the aim of making those institutions visible to national and regional projects that are underway to provide open access to scientific output across the region.

Results of the survey

The results of the survey to identify key institutions in Latin America and the Caribbean, as per their scientific output and the Web visibility of their production, are presented as follows:

a. Main institutions of Latin America and the Caribbean according to scientific output published in international journals.
b. Main institutions of Latin America and the Caribbean according to articles published in peer-review journals from the region.
c. Main institutions of Latin America and the Caribbean according to Web visibility of their production and activities.

Hereunder are the lists of major institutions in Latin America and the Caribbean in each category. Then follows a consolidated list with all this information.

a. Main institutions of Latin America and the Caribbean according to scientific output published in international journals.

The world rankings of scientific production and quality, with severe limitations and weaknesses inherent to these tools and because of the different scope and methodology applied in each case (Brunner & Uribe, 2007; Gauffriau & Larsen, 2005; Velasco, N., Fernández, R. & Martínez, Y., 2006; Billaut, J.C., Bouyssou, D. & Vincke, P.,2010), give their own vision of which are the major universities in the region on the basis of their scientific output. In this paper, these rankings were analyzed with the sole purpose of finding the institutions of the region that have high international visibility because of their scientific output, institutions of interest for national and regional open access initiatives.

a.1. *SCImago*

According to the SCImago Iberoamerican Ranking 2010 (Ranking Iberoamericano SIR 2010), out of a total of 2,833 research institutions in the world included in the ranking, the 50 institutions from Latin America and the Caribbean with the largest scientific output are those listed below. The SIR 2010 includes institutions which, in the year 2008, published scientific papers in the 17,000 journals indexed in the Scopus database from Elsevier. It considers the total number of articles published in those journals, the total number of articles co-authored with authors from other countries, and the visibility or impact of the output in the 2003-2008 period. The Iberoamerican Ranking is a Project of the SCImago Group, based on the SCOPUS-Elsevier database. Members of the SCImago Group belong to the Scientific Research Council of Spain (Consejo Superior de Investigaciones Científicas de España, CSIC) and the following universities: Granada, Alcalá de Henares, Carlos III, Extremadura

(Spain), Oporto (Portugal), La Plata (Argentina) and Pontificia Universidad Católica de Valparaíso (Chile).

1. Universidade de São Paulo
2. Universidad Nacional Autónoma de México
3. Universidade Estadual de Campinas
4. Universidade Estadual Paulista Júlio de Mesquita Filho
5. Universidade Federal do Rio de Janeiro
6. Universidad de Buenos Aires
7. Universidade Federal do Rio Grande do Sul
8. Universidade Federal de Minas Gerais
9. Universidad de Chile
10. Universidade Federal de São Paulo
11. Centro de Investigación y de Estudios Avanzados (Mx)
12. Universidad Nacional de La Plata (Arg)
13. Pontificia Universidad Católica de Chile
14. Universidade Federal de Santa Catarina
15. Universidad de Puerto Rico
16. Instituto Politécnico Nacional (Mx)
17. Universidade Federal do Paraná
18. Universidade Federal de São Carlos
19. Universidade Federal de Pernambuco
20. Universidade de Brasília
21. Universidade do Estado do Rio de Janeiro
22. Universidad Autónoma Metropolitana (Mx)
23. Universidade Federal de Viçosa
24. Universidad de Concepción (Chi)
25. Universidade Federal do Ceará
26. Universidad Nacional de Córdoba (Arg)
27. Universidade Federal Fluminense
28. Universidade Federal de Santa Maria
29. Universidad Nacional de Colombia
30. Universidade Federal da Bahia
31. Universidad Central de Venezuela
32. Universidad de la República (Ur)
33. Universidade Estadual de Maringa
34. Pontificia Universidade Católica do Rio de Janeiro
35. Universidade Federal do Rio Grande do Norte
36. Pontificia Universidade Católica do Rio Grande do Sul
37. Universidad de Antioquia (Col)
38. Universidade Federal de Uberlândia
39. Universidad Nacional de Rosario (Arg)
40. Universidad Simón Bolívar (Ven)
41. Universidad Nacional de Mar del Plata (Arg)
42. Universidade Federal da Paraíba
43. Universidad Nacional del Sur (Arg)
44. Universidade Federal de Goiás
45. Benemérita Universidad Autónoma de Puebla (Mx)
46. Universidad de los Andes (Ve)
47. Universidad de Guadalajara (Mx)
48. Universidade Estadual de Londrina
49. Universidade Federal de Pelotas
50. Universidad de La Habana

Source: Ranking Iberoamericano SIR 2010

In this list, of a total of 50 universities with the highest scientific output as measured by SCImago, 50% are universities from Brazil and the other 50% of

universities are distributed through Mexico, Argentina, Chile, Venezuela, Colombia, Puerto Rico, Uruguay and Cuba.

a.2. *Shanghai*

Another international ranking, developed by the Shanghai Jiao Tong University of China, is the Academic Ranking of World Universities – North and Latin America (Academic Ranking of World Universities-Shanghai). It includes 1,000 universities worldwide, 500 of which 500 available in the global ranking published in the Web.
This ranking is prepared each year based on: number of Nobel prizes and International Medals for Outstanding Discoveries in Mathematics (Fields Medal) received by the university*,* authors frequently cited in journals covered by Thomson Reuters (ISI), articles indexed in the Thomson Reuters *Science Citation Index* and *Social Science Citation Index*, publications in *Nature* and *Science,* and per capita academic output of each university. It should be compared with the other rankings because of its criticized methodology (Billaut, J.C.; Bouyssou, D. & Vincke, P. (2010).
Of the 500 universities published in the global ranking, the following are from Latin America.

1. Universidade de São Paulo
2. Universidad Nacional Autónoma de México
3. Universidad de Buenos Aires
4. Universidade Estadual de Campinas
5. Universidade Federal de Minas Gerais
6. Universidade Federal do Rio de Janeiro
7. Universidade Estadual Paulista Júlio de Mesquita Filho
8. Universidad Católica de Chile
9. Universidade Federal do Rio Grande do Sul
10. Universidad de Chile

Source: Academic Ranking of World Universities – North and Latin America 2010

b. Main institutions of Latin America according to articles published in peer-review scientific and academic journals available in regional open access journal portals.

b.1. *SciELO*

Presented here, without hierarchical order, is a first approximation to the 50 institutions of Latin America and the Caribbean that have published most articles in the 764 journals indexed by SciELO.

Argentina

- Universidad de Buenos Aires
- Consejo Nacional de Investigaciones Científicas y Técnicas-CONICET
- Universidad Nacional de La Plata

Brazil

- Universidade de São Paulo
- Universidade Estadual Paulista Júlio de Mesquita Filho

- Universidade Estadual de Campinas
- Universidade Federal do Rio de Janeiro
- Universidade Federal de Minas Gerais
- Fundação Oswaldo Cruz
- Universidade Federal do Rio Grande do Sul
- Universidade Federal de São Paulo
- Universidade Federal de Viçosa
- Universidade Federal do Paraná
- Universidade Federal de Santa Catarina
- Universidade Federal de Santa Maria
- Universidade do Estado do Rio de Janeiro
- Universidade de Brasília
- Universidade Federal de Lavras
- Universidade Federal de Pernambuco
- Universidade Federal de Pelotas
- Universidade Federal de São Carlos
- Universidade Federal da Bahia
- Universidade Federal do Ceará
- Instituto Agronómico de Campinas
- Universidade Estadual de Maringá
- Universidade Federal Fluminense
- Empresa Brasileira de Pesquisa Agropecuária -EMBRAPA
- Universidade Estadual de Londrina
- Universidade Federal de Paraíba
- Universidade Federal de Goiás
- Instituto Oswaldo Cruz
- Universidade Federal Rural do Rio de Janeiro
- Santa Casa de São Paulo
- Universidade Federal do Rio Grande do Norte
- Universidade Federal de Uberlândia
- Pontificia Universidade Católica de São Paulo
- Pontificia Universidade Católica do Rio Grande do Sul
- Universidade Federal do Espírito Santo
- Conselho Nacional de Desenvolvimento Científico e Tecnológico CNPQ
- Universidade Federal Rural de Pernambuco
- Instituto Nacional de Pesquisas da Amazônia
- Universidade Federal do Pará
- Universidade Federal de Mato Grosso
- Ministério da Saúde-SAUDE
- Universidade Federal de Juiz de Fora

Colombia

- Universidad Nacional de Colombia
- Universidad de Antioquia
- Universidad de los Andes
- Pontificia Universidad Javeriana
- Universidad del Valle

Chile

- Universidad de Chile
- Pontificia Universidad Católica de Chile

- Universidad de Concepción
- Universidad Austral de Chile
- Universidad de la Frontera

México

- Universidad Nacional Autónoma de México
- Instituto Nacional de Salud Pública
- Instituto Mexicano del Seguro Social

Venezuela

- Universidad Central de Venezuela
- Universidad de los Andes
- Universidad del Zulia

Source: analysis of Excel provided by SciELO, draft not standardized (February 2011)

In the above SciELO list, a strong presence of universities from Brazil can be explained because Brazil has the largest scientific production in the region (UNESCO, 2010), and also because Brazil was the first journal collection to be developed in SciELO and today has the largest number of indexed journals in that portal, together with journal collections for 12 countries of the region.

b.2. *Redalyc*

Latin American institutions that have published most articles in the 732 journals indexed by Redalyc (acquis 2005-2010):

1. Universidad Nacional Autónoma de México
2. Universidade de São Paulo
3. Universidad Nacional de Colombia
4. Universidad del Zulia (Ven)
5. Universidad de Buenos Aires
6. Universidad de Antioquia (Col)
7. Pontificia Universidad Javeriana (Col)
8. Instituto Politécnico Nacional (Mex)
9. Universidade Estadual Paulista Júlio de Mesquita Filho
10. Colegio de Posgraduados en Ciencias Agrícolas (Mex)
11. Universidad de Costa Rica
12. Universidad Autónoma del Estado de México
13. Universidad Central de Venezuela
14. Universidade Federal do Rio Grande do Sul
15. Instituto Nacional de Inv. Forestales, Agrícolas y Pecuarias (Mex)
16. Universidad del Valle (Col)
17. Universidad de Guadalajara (Mex)
18. Universidade Estadual de Campinas
19. Universidad de Chile
20. Universidade Federal de Santa Maria
21. Pontificia Universidad Católica de Chile
22. Universidade Federal de Santa Catarina
23. Universidade Federal de Vinosa
24. Universidade Federal do Rio de Janeiro
25. Universidad Autónoma Chapingo (Mex)
26. Universidad Autónoma Metropolitana – Xochimilco (Mex)
27. Universidad Tecnológica de Pereira (Col)
28. Universidade de Brasília
29. Universidad Autónoma de Nueva León (Mex)

30. Universidade Federal de Minas Gerais
31. Universidad Autónoma Metropolitana – Iztapalapa (Mex)
32. El Colegio de México
33. Universidad de los Andes (Ven)
34. Universidad Nacional de La Plata (Arg)
35. Universidade Federal do Paraná
36. Universidad Nacional Mayor de San Marcos (Peru)
37. Universidad de Concepción (Chile)
38. Escuela de Enfermería del IMSS (Mex)
39. Benemérita Universidad Autónoma de Puebla (Mex)
40. Universidad del Rosario (Col)
41. Universidade Federal de Lavras
42. Tecnológico de Monterrey (Mex)
43. Universidad Autónoma Metropolitana – Azcapotzalco
44. Universidad Autónoma de Baja California (Mex)
45. Universidade do Estado do Rio de Janeiro
46. Universidad Pedagógica Experimental Libertador (Ven)
47. Universidad Militar Nueva Granada (Col)
48. Universidade Federal Fluminense
49. Universidad Austral de Chile
50. Universidad Veracruzana (Mex)

Source: List provided to the author by Redalyc (January 2011)

A strong presence of universities from Mexico can be explained because Redalyc is an initiative of the Autonomous University of Mexico State (UAEM), and the collection of journals from Mexico is the largest among its 13 country journal collections from Latin America and the Caribbean countries.

c. Main institutions from Latin America according to the Web visibility of their production and activity.

c.1. *Web Ranking of World Repositories*

In the Web Ranking of World Repositories – an initiative of the Cybermetrics Lab, a research group belonging to the Scientific Research Council of Spain (Consejo Superior de Investigaciones Científicas, CSIC) – out of a total of 1,121 institutional repositories included in the ranking according to Web visibility (number of unique external links received), Rich files (pdf), and presence in Google Scholar, the following 52 repositories of Latin America are listed.

1. Universidade de São Paulo, Biblioteca Digital de Teses
2. Universidad de los Andes (Ven)
3. Universidade Federal do Rio Grande do Sul
4. Escuela Superior Politécnica de Ecuador
5. Universidade de Brasília
6. Escuela Politécnica Nacional (Ec)
7. Escuela Superior Politécnica de Chimborazo (Ec)
8. Universidad Politécnica Salesiana (Ec)
9. Universidad de Chile, Cybertesis
10. Universidad Nacional de La Plata (Arg)
11. Universidade Federal do Paraná
12. Universidad ICESI (Col)
13. Universidad CES (Col)
14. Universidad Nacional de Colombia
15. Universidad de la Sabana (Col)
16. Instituto Politécnico Nacional (Mex)

17. Universidad del Rosario (Col)
18. Universidad de Chile, Repositorio Académico
19. UNAM, Facultad de Filosofía y Letras (Mex)
20. Universidad Nacional de Cuyo (Arg)
21. Universidade Estadual de Campinas
22. Universidade de Taubaté-UNITAU-Departamento Ciências Agrárias
23. Universidad de Talca (Ch)
24. Universidad Peruana de Ciencias Aplicadas - Tesis
25. Universidad Austral de Chile - Tesis
26. Instituto Tecnológico de Costa Rica
27. Universidad Católica del Perú - Tesis
28. Universidad Nacional de la Plata (Arg)-Facultad de Humanidades y Ciencias de la Educación
29. Universidad Nacional de Rosario (Arg)
30. Universidad Nacional Mayor de San Marcos (Perú)
31. Universidad de Chile - Escuela de Salud Pública
32. Instituto de Estudios del Petróleo (Ec)
33. Universidad Tecnológica Equinoccial (Ec)
34. Red Peruana de Tesis Digitales
35. Universidad Nacional de Ingeniería - Tesis (Perú)
36. Universidad de Guayaquil (Ec)-Maestría Adm. Empresas
37. Universidad Central de Ecuador
38. Universidad Internacional del Ecuador
39. Universidad Nacional de Chimborazo (Ec)
40. Universidad Estatal de Milagro (Ec)
41. Universidad de Chile
42. Pontificia Universidad Católica de Valparaíso (Ch) - Tesis
43. IBICT - Biblioteca Digital Brasileira de Teses
44. Universidade Estadual Paulista
45. Universidade Federal da Bahia
46. Pontificia Universidad Javeriana (Col)
47. Universidade Estadual de Maringá
48. Universidad Autónoma Metropolitana, Iztapalapa - Tesis (Mex)
49. Repositorios Institucionais em Ciencias da Comunicação
50. Fundação Oswaldo Cruz
51. Consejo Latinoamericano de Escuelas de Administración-CLADEA (Perú)
52. Universidad Nacional del Sur (Arg) - Tesis

Source: Web Ranking of World Repositories – January 2011

Of the 52 Latin American institutional repositories on this list, 12 are from Brazil, 11 from Ecuador, 7 from Chile, 6 from Colombia, 6 from Peru, 5 from Argentina, 3 from Mexico, 1 from Venezuela and 1 from Costa Rica. In the great majority of cases, these institutional repositories concentrate on theses.

Among the main scientific institutions of Latin America and the Caribbean, namely the major universities – and perhaps because of the complexity of achieving consensus and agreement among the various departments of each university, and a lack of institutional open access mandates – progress is slow in the development of institutional repositories that host the scientific output of each university. Nevertheless, although the development of institutional repositories at major universities in the region is still at an early stage or at project level, it is important that the opinion and needs of these universities be considered in the development of open access national and regional coordination initiatives. This is because, being the main producers of scientific knowledge in the region, over the medium term these universities will definitely develop institutional repositories.

c.2. *Web Ranking of Universities*

Another classification of the Cybermetrics Laboratory of the National Research Council of Spain measures the presence, activity and contents in the Web of 20,000 higher education institutions worldwide (Web Ranking of World Universities 2010). Of a total of 100 most productive Latin American institutions on the Web – according to the size of each institution's Web presence, visibility as measured by number of links received, number of Rich files in a Web domain (pdf, doc, ppt, ps, xls), and the number of papers and citations in Google Scholar (Aguillo et al., 2007) – the first 50 are included in the following list.

1. Universidad Nacional Autónoma de México
2. Universidade de São Paulo
3. Universidad de Chile
4. Universidade Estadual de Campinas
5. Universidad de Buenos Aires
6. Universidade Federal de Santa Catarina
7. Universidade Federal do Rio de Janeiro
8. Instituto Tecnológico de Monterrey (Mx)
9. Universidade Federal de Minas Gerais
10. Universidad Nacional de Colombia
11. Universidade Federal do Rio Grande do Sul
12. Pontificia Universidade Católica do Rio de Janeiro
13. Universidad de Puerto Rico (Recinto Mayaguez)
14. Universidade Federal Fluminense
15. Universidad de Costa Rica
16. Universidad de Concepción (Ch)
17. Pontificia Universidad Católica de Chile
18. Pontificia Universidad Católica del Perú
19. Universidade Federal do Rio Grande do Norte
20. Universidad de Guadalajara (Mx)
21. Universidad Nacional de la Plata
22. Universidade Federal do Paraná
23. Universidade de Brasília
24. Universidad Autónoma Metropolitana (Mx)
25. Escuela Superior Politécnica del Litoral (Ec)
26. Universidade Federal de Pernambuco
27. Universidad de los Andes Mérida (Ve)
28. Universidad de Antioquia (Co)
29. Universidade Estadual Paulista Júlio de Mesquita Filho
30. Universidade Federal de Viçosa
31. Universidad de los Andes (Co)
32. Universidad Nacional de Córdoba (Arg)
33. Universidade Federal da Bahia
34. Fundação Getulio Vargas
35. Pontificia Universidade Católica do Rio Grande do Sul
36. Universidad Nacional Mayor de San Marcos (Pe)
37. Instituto Politécnico Nacional (Mx)
38. Universidad Simón Bolívar Venezuela
39. Universidad Autónoma de Nuevo León (Mx)
40. Pontificia Universidad Javeriana (Co)
41. Universidade do Vale do Rio Dos Sinos
42. Universidad del Valle (Co)
43. Universidade do Estado do Rio de Janeiro
44. Universidad de Puerto Rico
45. Pontificia Universidade Católica de São Paulo
46. Universidade Federal de Santa Maria

47. Universidad Nacional de Rosario (Arg)
48. Universidad Austral de Chile
49. Universidad Técnica Federico Santa María (Ch)
50. Universidad Tecnológica Nacional (Arg)

Source: Ranking Web of World Universities 2010

Conclusions

This survey has sought to identify the main institutions in Latin America and the Caribbean in terms of scientific output and Web visibility of their output, so that these institutions will be better visible at a time when national and regional projects are underway to provide open access to scientific output across the region. With the contents of the individual lists described above, the following consolidated list has been prepared. It contains 109 universities and institutions out of a total of more than 1,000 universities reported in the region by The Union of Universities from Latin America-UDUAL (Santamaría Ambriz, 2001), and of a total of 2,940 universities reported by the Network for Science and Technology Indicators – Ibero-American and Inter-American (RICYT, 2002).

The table includes the list of institutions from Latin America and the Caribbean which emerge from the information sources analyzed as the most productive in terms of scientific output and of the web visibility of that output. Most of the institutions on the list are public universities, which are the main producers of knowledge in the region (Arocena & Sutz, 2001). The diversity of national and institutional realities does not allow hierarchical classifications within each country. The purpose of this table is exclusively to identify the main institutions from the region as per scientific output and web visibility of the output, in order to provide input for national and regional agencies when deciding on national and regional strategies and programs that promote open access to the scientific output of each country and of the region at large. Ensuring the presence of scientific output from institutions on this list within national and regional repositories will contribute to increase the value and interest of these repositories, and draw the attention and contents of other scientific and academic institutions from each country. Another survey will next be necessary to investigate to what extent the scientific output of the institutions identified in this survey is present in the repositories already created in the region. In each case, peer-review contents should be distinguished from other contents that reflect academic activities.

The ordering of the table is by country; within each country there is no hierarchical order, because lists are not comparable. The columns of the table refer to the following sources of information used in the survey:

a.1. SCImago Iberoamerican Ranking 2010
a.2. Shanghai Academic Ranking of World Universities 2010
b.1. SciELO (January 2011 listing)
b.2. Redayc (January 2011 listing)
c.1. Web Ranking of World Repositories 2010
c.2. Web Ranking of World Universities 2010

Table – Main institutions of Latin America and the Caribbean as regards scientific output and Web visibility of output and activities

MAIN INST. OF LATIN AMERICA AND THE CARIBBEAN AS REGARDS SCIENTIFIC OUTPUT AND WEB VISIBILITY OF OUTPUT						
Presented by country, with no hierarchical order within each country						
	SCIM.	**SHANG.**	**SCIE.**	**REDAL.**	**Inst.**	**Univ.on**
	(a.1.)	(a.2)	(b.1)	(b.2)	**rep.**	**Web**
					(c.1)	(c.2)
Argentina						
Universidad de Buenos Aires	X	X	X	X		X
Universidad Nacional de La Plata	X		X	X	X	X
Universidad Nacional de Córdoba	X					X
Universidad Nacional de Rosario	X					X
Universidad Nacional de Mar del Plata	X					
Universidad Nacional del Sur	X					
CONICET			X			
Universidad Nacional de Cuyo					X	
Universidad Tecnológica Nacional						X
Brazil						
Universidade de São Paulo	X	X	X	X	X	X
Universidade Estadual de Campinas	X	X	X	X	X	X
Universidade Estadual Paulista Júlio de Mesquita Filho	X	X	X	X		X
Universidade Federal do Rio de Janeiro	X	X	X	X		X
Universidade Federal do Rio Grande do Sul	X	X	X	X		X
Universidade Federal de Minas Gerais	X	X	X	X		X
Universidade Federal de Sao Paulo	X		X			
Universidade Federal de Santa Catarina	X		X	X		X
Universidade Federal do Paraná	X		X	X	X	X
Universidade Federal de São Carlos	X		X			
Universidade Federal de Pernambuco	X		X			X
Universidade de Brasília	X		X	X	X	X
Universidade do Estado do Rio de Janeiro	X		X	X		X
Universidade Federal de Viçosa	X		X	X		X
Universidade Federal do Ceará	X		X			
Universidade Federal Fluminense	X		X	X		X
Universidade Federal de Santa Maria	X		X	X		X
Universidade Federal da Bahia	X		X			X
Universidade Estadual de Maringa	X		X			
Pontificia Universidade Católica do Rio de Janeiro	X					X
Universidade Federal do Rio Grande do Norte	X		X			X
Pontificia Universidade Católica do Rio Grande do Sul	X		X			X
Universidade Federal de Uberlândia	X		X			
Universidade Federal da Paraíba	X		X			
Universidade Federal de Goiás	X		X			
Universidade Estadual de Londrina	X		X			
Universidade Federal de Pelotas	X		X			

Fundaçao Oswaldo Cruz			X			
Universidade Federal de Lavras			X	X		
Instituto Agronómico de Campinas			X			
Empresa Brasileira de Pesquisa Agrop.-EMBRAPA			X			
Instituto Oswaldo Cruz			X			
Universidade Federal Rural do Rio de Janeiro			X			
Santa Casa de São Paulo			X			
Pontificia Universidade Católica de São Paulo			X			X
Universidade Federal do Espírito Santo			X			
CNPQ			X			
Universidade Federal Rural de Pernambuco			X			
Instituto Nacional de Pesquisas da Amazônia			X			
Universidade Federal do Pará			X			
Universidade Federal de Mato Grosso			X			
Ministerio da Saúde			X			
Universidade Federal de Juiz de Fora			X			
Fundação Getulio Vargas						X
Universidade do Vale do Rio Dos Sinos						X
Colombia						
Universidad Nacional de Colombia	X		X	X		X
Universidad de Antioquia	X		X	X		X
Pontificia Universidad Javeriana				X		X
Universidad del Valle			X	X		X
Universidad Tecnológica de Pereira				X		
Universidad de La Sabana					X	
Universidad ICESI					X	
Universidad del Rosario				X	X	
Universidad Militar Nueva Granada				X		
Universidad de los Andes			X			X
Costa Rica						
Universidad de Costa Rica				X		X
Cuba						
Universidad de La Habana	X					
Chile						
Universidad de Chile	X	X	X	X	X	X
Pontificia Universidad Católica de Chile	X	X	X	X		X
Universidad de Concepción	X		X	X		X
Universidad de Talca					X	
Universidad Austral de Chile			X	X	X	X
Universidad de la Frontera			X			
Universidad Católica de Valparaíso					X	
Universidad Técnica Federico Santa María						X
Ecuador						
Escuela Superior Politécnica del Ecuador					X	
Escuela Politécnica Nacional					X	
Universidad Politécnica Salesiana					X	
Escuela Superior Politécnica del Litoral						X

Mexico						
Universidad Nacional Autónoma de Mexico	X	X	X	X	X	X
Centro de Investigación y de Estudios Avanzados	X					
Instituto Politécnico Nacional	X			X		X
Universidad Autónoma Metropolitana	X			X		X
Benemérita Universidad Autónoma de Puebla	X			X		
Universidad de Guadalajara	X			X		
Instituto Nacional de Salud Pública			X			
Insituto Mexicano de la Seguridad Social			X			
Colegio de Posgraduados en Ciencias Agrícolas				X		
Universidad Autónoma del Estado de México				X		
Inst.Nac.de Inv. Forestales, Agrícolas y Pecuarias				X		
Universidad Autónoma Chapingo				X		
Universidad Autónoma de Nuevo León				X		
El Colegio de México				X		
Escuela de Enfermería del IMSS				X		
Instituto Tecnológico de Monterrey				X		X
Universidad Autónoma Metropolitana - Azcapotzalco				X		
Universidad Autónoma de Baja California				X		
Universidad Veracruzana				X		
Universidad de Guadalajara						X
Universidad Autónoma de Nuevo León						X
Peru						
Universidad Católica del Perú					X	X
Universidad Peruana de Ciencias Aplicadas					X	
Universidad Nacional Mayor de San Marcos				X		X
Puerto Rico						
Universidad de Puerto Rico	X					X
Uruguay						
Universidad de la República	X					
Venezuela						
Universidad Central de Venezuela	X		X	X		
Universidad Simón Bolivar	X					X
Universidad de los Andes	X		X	X	X	X
Universidad del Zulia			X	X		
Universidad Pedagógica Experimental Libertador				X		

This table shows a majority of universities from Brazil, a strong presence of universities from Mexico, Colombia, Argentina, Chile and Venezuela, and some presence of universities from Ecuador, Peru, Costa Rica, Cuba, Puerto Rico and Uruguay. The preponderance of universities from Brazil can be explained in part by the fact that this country represents 60% of spending on research in the region, and more than half of the publications from the region mentioned in the Thomson Reuters Citation Index (UNESCO, 2010). On the Scopus database from Elsevier, Brazil accounts for 45% of regional scientific output, and Argentina, Brazil and Mexico together reach 80% (Santos and Herrera, 2010). Brazil, Mexico, Argentina and Chile are the countries that account for more than

90% of investment in research in the region, and Brazil and Mexico alone account for 95% of new doctors from the region (UNESCO, 2010). Other studies also include Venezuela and Colombia among the most productive countries of the region (Sancho, Morillo, De Filippo, Gómez & Fernández, 2006).

In a strategic consultancy report for the creation of the Latin American network of national systems of institutional repositories (Red Federada Latinoamericana de Repositorios Institucionales de Documentación Científica) it is also mentioned that Brazil, followed at a distance by Colombia, Mexico and Argentina, are the countries with most institutional repositories in the region (Garrido Arenas, 2010). And, in the Web Ranking of World Repositories, the largest number of institutional repositories is in Brazil.

“As a body of institutional archives is established, not only will the research community in the developing world finally be a part of the international research community, but researchers in the developed world will begin to understand the value of local research and knowledge for the resolution of the world's major problems in health, agriculture, the environment and more closely defined disciplines such as taxonomy or biodiversity.”(Chan et al., 2005).

As legislation and mandates that require open access to publicly funded research move ahead, national and regional repositories will also be able to provide indicators of value when assessing the scientific production of researchers and institutions. These new indicators will complement the traditional indicators currently used and will pave the way for the globalization of scientific communication (Packer & Meneghini, 2007).

In the development of regional projects for the interoperability and coordination of repositories, the Latin American Federated Network of Institutional Repositories of Scientific Documentation (Red Federada Latinoamericana de Repositorios Institucionales de Documentación Científica en América Latina) has analyzed the methodologies used in similar experiences in other regions, such as the European case of DRIVER-Digital Repository Infrastructure Vision for European Research (described by van der Graaf, 2007) and OpenAIRE-Open Access Infrastructure for Research in Europe. In 2011, the Latin American Federated Network of Institutional Repositories of Scientific Documentation has started teamworking with COAR-Confederation of Open Access Repositories, which encourages international collaboration and the creation of a global network of digital repositories. Ibero-American cooperation is already present in SciELO, Redalyc and Latindex, which include journals from Spain and Portugal, and in the Spanish portals Dialnet and e-Revistas which include journals from Latin America, among other examples. Cooperation could also be sought with other regions, e.g. Asia with its experience with institutional repositories (Abrizah, Noorhidawati & Kiran, 2010).

Although there are clear indications in the region of the existence of a favorable climate for the development of networks of repositories, because it is a new, high impact initiative, it may face multiple problems that can hinder such development (Arenas Garrido, 2010). An active participation in these projects of

key institutions from the region in terms of scientific output, coupled with coordination from government research policy and funding agencies, supported by regional and international programs, will allow advances in national and regional open access strategies and actions that will benefit education, research and society at large in Latin America and the Caribbean.

> "Public policies for the information society can be defined as a coherent set of public strategies aimed at promoting the construction and development of an information society oriented in an interrelated manner to the social, political, human, economic and technological development in each society. They are the engine of the development of the production, use, and equitable exploitation of knowledge by all sectors of society."
> (Finquelievich, 2010)

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