

Visibility in Internet of the Scientific Production and Activities of the National Autonomous University of Mexico (UNAM) Research Institutes

Jane M. Russell¹, Shirley Ainsworth² and Janet Díaz-Aguilar³

¹*jrussell@servidor.unam.mx*

Centro Universitario de Investigaciones Bibliotecológicas, Universidad Nacional Autónoma de México, Ciudad Universitaria, 04510 México DF (Mexico)

²*shirley@ibt.unam.mx*

Instituto de Biotecnología, Universidad Nacional Autónoma de México, Av. Universidad 2001, Cuernavaca, Morelos 62210 (Mexico)

³*jdaaidol@hotmail.com*

Programa de Posgrado en Bibliotecología y Estudios de la Información, Facultad de Filosofía y Letras, Universidad Nacional Autónoma de México, Ciudad Universitaria, 04510 México DF (Mexico)

Abstract

In the present study we determine to what extent the scientific production and research activities of a group of National Autonomous University of Mexico (UNAM) research institutes in the sciences, social sciences and humanities are visible on the Internet. We do this by analysing the relevant information content and dynamics on their websites and by comparing institutional listings of scientific production between 2005 and 2006, with papers reported in the international, multidisciplinary online services of the *Web of Science* and *Scopus*, as well as in *Clase* and *Periódica* which cover production in Latin American journals. Findings indicate general poor visibility of research activities and production in the institutional websites with only limited access to full text articles. Websites of the institutes in the sciences score better than those in the humanities and social sciences where book publication is an important research output. Official publication lists in the form of annual reports were found not to accurately represent production with additional papers attributed to the different institutions appearing in commercial databases. It is suggested that more effort should be directed towards improving the information content and access to research data on these institutional websites, possibly through linkage to an UNAM repository.

Introduction

In today's world, university websites are essential channels for the dissemination and access to institutional information, many of which have become authentic portals offering friendly interfaces, robust content architecture and advanced interactive services (Pinto Molina *et al.*, 2004). The value of the web for institutions in developing countries has not escaped the notice of the National Autonomous University of Mexico (Universidad Nacional Autónoma de México), UNAM, the country's largest and most prestigious university. Recognising the importance of creating, updating and maintaining institutional websites, the UNAM states in an official document that it is inconceivable for an institution of such a high level of national and international standing, not to sustain an important presence in global networks as these constitute the "shop window" through which many institutions and interested parties throughout the world discover and get to know our institution (Consejo Asesor de Cómputo, 2007). In 2008, the UNAM was ranked 51 in the web rankings of universities and reached the top position of the Latin American universities (Web Ranking of Universities, 2008). This favourable position in world web rankings could well be due to the large volume of UNAM webpages, its active distance education programmes with their large rich file content on the web, as well as the presence of large digital libraries, although this requires further investigation. The same year, the UNAM occupied position 150 in the Times Education ranking of world universities, the only Latin American institution in the top 200 (Times

Higher Education, 2008). Interestingly, the lowest scores obtained by the UNAM were in the category of citations received and numbers of international students.

In spite of the generally agreed importance of a high institutional profile on the web and the advantageous position of the UNAM with respect to other Latin American universities in the different systems of world ranking of higher education institutions, we have observed important variations, for instance, between the different research areas of the UNAM with respect to the structure and content of their web sites. The fact that each faculty, school, centre or institute, as examples of the distinct units that make up the poli-faceted UNAM, has its own subdomain and is responsible for the conformation and upkeep of its own webpages, not all of which are adequately linked from the UNAM main website (<http://www.unam.mx>) results in an uneven presence in the Internet of the parent institution.

To determine just how great these differences are and to catalogue their main characteristics, we investigate to what extent and concerning what aspects of the UNAM's research activity, could be uncovered via the institutional websites of the research institutes in different knowledge areas. In addition, we look at the representation of the research output of these same institutions in the online databases of the *Web of Science* and *Scopus*. Taking into consideration that the production in the humanities and social sciences is poorly covered by the international databases, particularly that from developing countries which do not publish primarily in English, we also searched for papers in the *Clase* (<http://www.dgb.unam.mx/clase.html>) and *Periódica* (<http://www.dgb.unam.mx/periodica.html>) databases produced by the UNAM, which cover exclusively Latin American journals. Both databases date from the beginning of the 70s and cover approximately 1,500 journal titles in each case.

Methodology

Our sample consisted of ten UNAM research institutes, two in each of the following five general knowledge areas: exact sciences, natural sciences, applied sciences, social sciences, and humanities, according to the strategy developed by Russell and Liberman, 2002. Table 1 provides a general picture of the dimensions of the research capabilities, activities and output of each of the ten institutes, according to the annual statistics of the UNAM.

The number of researchers and technical staff varies considerably; for instance there are more than three times as many researchers in the Institute of Philological Research than in the Institute for Historical Research. As expected, the publication of books is a greater general priority in the social sciences and humanities than in the scientific research areas. Individual differences between institutes in the same general area is exemplified by the fact the Engineering Institute published 80% of its production in proceedings while for the Biotechnology Institute, it was only 6%. In spite of such differences it is apparent from Table 1, the significant research capabilities and output of these ten institutes which we would expect to be manifest on their websites and visible through online bibliographic information services.

Table 1. General Research Characteristics and Statistics, 2006

Area and Discipline of the Institutes		No. Full-time Researchers	Technical Staff	No. National Researchers#	No. Books	No. Book Chapters, Articles, Proceedings	No. Projects
EXACT SCIENCES	<i>Physics</i>	110	47	113	9	306	109
	<i>Mathematics</i>	101	15	98	5	162	148
NATURAL SCIENCES	<i>Geology</i>	47	41	53	2	101	65
	<i>Chemistry</i>	62	25	76	2	121	177
APPLIED SCIENCES	<i>Biotechnology</i>	102	83	118	6	166	146
	<i>Engineering</i>	83	99	73	21	490	233
SOCIAL SCIENCES	<i>Anthropology</i>	47	32	39	8	99	176
	<i>Economics</i>	73	36	30	11	135	159
HUMANITIES	<i>Philology</i>	130	35	85	56	192	354
	<i>History</i>	40	18	39	7	56	120
Total		795	431	724	127	1,828	1,687

Certification by the National Council for Science and Technology (CONACyT): http://www.conacyt.mx/SNI/Index_SNI.html

Source: Dirección General de Planeación (2007) Agenda Estadística 2007. Universidad Nacional Autónoma de México <http://www.planeacion.unam.mx/agenda/2007/agenda2007.pdf.html>

Analysis of Institutional Websites

In this first stage carried out between December 2007 and February 2008, we developed and applied a classification scheme for the analysis of the general research characteristics of the websites, as well as to categorize research-related web content. Areas considered were: *General Website Characteristics; Research Related Information on the Websites; Information on Editorial Production; Access to Publication Information; Personal Pages*. Of particular interest was the placement within the websites, of information on the scientific output of the institutes. For this, we categorized the placements at three levels: on the main page (main page, first level); in departmental, group, personal or individual pages (second level); via links to external sites (third level), the first level representing the highest level of visibility and the third level, the least.

Presence of Research Output in Online Bibliographic Information Services

The second stage of online searching in the *WoS*, *Scopus*, *Clase* and *Periódica*, was carried out between August 2008 and January 2009. Only research articles published from 2005-2006 and included in the ten institutes' annual reports or lists, were taken into consideration, although in the case of Anthropology and Philology the article section of the annual reports contain both peer reviewed and non peer reviewed journals. The Anthropology reports do not include dates and all publications had to be manually checked and edited, a time consuming process as the bibliographical details were also incomplete. Other document types, as well as articles not yet published, duplicate mentions or papers whose publication date was erroneously listed as 2005 or 2006, were excluded from the analysis. The strategy adopted in each case was first to look for the specific articles mentioned in the annual reports and then to search for additional records with the specific institute names in the affiliation field.

Results

Analysis of Institutional Websites

All institutional pages are available only in Spanish with the exception of the Biotechnology Institute whose main page can be accessed in English (Table 2). The Institute of Chemistry announces an English version under construction.

Table 2. General Website Characteristics

Discipline of the Institutes	Url	Spanish	English	Other languages	Site map	Search function	
						People	Subject
Physics	www.fisica.unam.mx	●				●	●
Mathematics	www.matem.unam.mx	●			● +	●	●
Geology	geologia.igeolcu.unam.mx	●	● *			●	●
Chemistry	www.iquimica.unam.mx	●				◇	◇
Biotechnology	www.ibt.unam.mx	●	● #		●	●	●
Engineering	www.iingen.unam.mx	●				●	●
Anthropology	swadesh.iaa.unam.mx	●					
Economics	www.iiec.unam.mx	●				§	§
Philology	www.filologicas.unam.mx	●			●	●	●
History	www.iih.unam.mx	●			●	●	●

* under construction # main page ◇ not functioning + The Mathematics website consists of two non integrated servers. § Economics' internal search function links to Google.

A search function for people and for specific topics is present on nearly all the websites. Some use the Google search engine. The Institutes of Philological Research and Historical Research, for instance, both offer the custom search engine option while Economics Research has an external link to Google. Only three sites provide site maps. Only the main Institute of Mathematics website was taken into consideration for the study as the different units located in other cities, have independent websites, and this consists of two separate servers: Infomatem (<https://info.matem.unam.mx/>), a Content Management System in Plone and a main page in html. The site map covers only the Infomatem area and even though there are search engines in both parts, this option is not available on the main page.

The majority of sites give an overview of research activities by providing directories of researchers, research thrusts and projects, and similar information (Table 3). The main differences between institutes, was in relation to the placement and scope of the information. For example, the Institute of Philological Research gives information on researchers by department and gives keyword description of their research interests, but does not include details of their research publications. In contrast, the Geology Institute webpage provides a directory of researchers with links to individual information which includes a description of research interests, teaching activities and recent publications. With regard to individual research projects, the Geology Institute, as well as the Institutes of Economic, and Historical Research, supply a link to the specific information for each researcher. The Engineering Institute is an interesting case in that research projects are described in detail and dates given

of congresses and conferences where results have been presented, as well as details of the journal publications ensuing from the projects.

Table 3. Research related Information on the Websites

Discipline of the Institutes	Directory of Researchers	Research Interests	Research Projects	Research News
Physics	•	•	•	•
Mathematics	•		•*	
Geology	•	•	•	•
Chemistry	•	•		
Biotechnology	•	•	•	•
Engineering	•	•	•	•
Anthropology	•	•	•	
Economics	•	•	•	•
Philology	•	•	•	
History	•	•	•	•

* Only on individual pages

Information on the publications edited by the institutes appears to be always present on their websites, taking into consideration that institutes such as Physics, Biotechnology, and Chemistry don't publish their own books and journals (Table 4). The column headed "National and International Publications" refers to publications authored by the researchers, present on the institutional websites rather than on individual or personal webpages. We define personal pages as those maintained directly by the researcher and whose content is found to be extremely varied, while individual pages show similar structure and content, if with somewhat varying update frequencies. The latter usually have an institutional character.

Table 4. Information on the editorial production of the Institutes

Discipline of the Institutes	Publications edited by the Institutes	National and International Publications	Name of researcher from the Institute indicated	Complete bibliographical details given on publications
Physics	•	•	•	•
Mathematics		•		
Geology	•	*		•
Chemistry		•		•
Biotechnology	•	•	•	•
Engineering		•		
Anthropology	•		•	•
Economics	•			
Philology	•			•
History	•			

* The production of the researchers appears in the individual pages but there is no general institutional list.

The Institute of Chemistry, for instance, has a publications section which contains a list of papers in national and international journals from 2003-2005, which appears to correspond to its total production during that period. Physics and Biotechnology provide links to their international publications, Physics from 1999 and Biotechnology from 1980. The coverage of other types of publication is poorer. The Social Sciences and Humanities institute websites on the other hand, focus on the publications they edit and give little information on what their researchers publish outside of these homegrown products.

The column headed “Name of researcher from the Institute identified” refers to the capability to recognize the institutional author or authors, perhaps by these names appearing in bold letters or via links to their individual pages. Only three sites provide this facility. In Humanities where co-authorship is less frequent, this omission is perhaps not so important. What is more worrying is the fact that complete bibliographical details are missing on half of the institutional websites, normally making it impossible to identify and locate institutional publications of interest.

Table 5 groups the visibility of publications within each institutional website, at three levels: 1) accessible from the main page, 2) less visible, accessible at the level of research groups or individual pages, and 3) hidden on personal pages. Within each of these levels, the location of the publication was divided into: locally mounted full text or links to either the publisher site or an external database. Some institutes give little importance to making their publications readily visible. Information on publications is markedly diverse on this group of ten websites, in terms of coverage, updating, and in accessibility (presence or absence of links to full text in whatever version, preprint or final version). This situation no doubt leads to confusion and frustration on the part of the user looking for dependable information on the scientific productivity of the UNAM research effort and/or details of specific publications.

Table 5. Access to Publications Information on the Websites

Discipline of the Institutes	Main page			Second Level			Third Level		
	Local	Publisher	db	Local	Publisher	db	Local	Publisher	db
Physics		●					●	●	●
Mathematics	*						●	●	
Geology	●			●					
Chemistry									
Biotechnology			●			●			●
Engineering	●	●	●						
Anthropology									
Economics									
Philology	●								
History	●								

* Broken link to publications page

It is evident from Table 5 that the majority of institutes do not take advantage of the internet except to make available a *flat* list of publications. This supposes little awareness or interest in permanently establishing ways to create and embed links. Little use is made of DOIs and urls appear to be copied including sessions ids, creating problems for later access to the

material. Few institutes store local versions (preprints or final versions from the publishers) in full text of their international articles, at least detectable from their main page; the practice, however, seems to be common at the level of personal pages. In the case of the Institute of Biotechnology, *Pubmed* with its multidisciplinary coverage and currency, richness of links to full text, makes this database the preferred means to arrive at the full text of international articles. The Institute of Physics provides full text links but directly to the publisher pdf with session ids abounding. The institutes with strong local publishing activities, such as the Institutes for Historical, Economical and Philological Research and the Engineering Institute do provide access to the full text or to the e-shop for the purchase of their editorial production, normally monographs or whole volumes of journals. The limited access that these institutes offer on their websites, to the full text of publications authored by their researchers gives general cause for concern, taking into consideration that these are the principal products of the research undertaken.

Table 6 shows the situation with respect to personal pages linked to the institutional websites. On the Biotechnology website, individual pages are generated from the main centrally administered database, such that correspondence is created between publications shown on the main page and those present on the individual pages; updates are carried out daily. The Institute of Physics website has a similar structure and process, nonetheless, updates are infrequent and information can be several months out of date.

The individual pages of the Institute of Philological Research differ widely in the information provided for each researcher, with no apparent central updating policy. Although the majority of the institutes maintain individual pages for their researchers which vary considerably in terms of construction and maintenance, we found few cases of personal pages among the institutes. The Institute of Mathematics showed the highest incidence, probably due to the familiarity of mathematicians with computer tools and, possibly, also to compensate for deficiencies in the institutional website.

Table 6. Personal Pages linked to the Websites

Discipline of the Institutes	No of personal pages	% of researchers with personal pages
Physics	15	14%
Mathematics	19	34%
Geology	0	0
Chemistry	0	0
Biotechnology	8	8%
Engineering	0	0
Anthropology	4	8.50%
Economics	0	0
Philology	0	0
History	0	0

An examination of the dynamic aspects of the institutional websites was hampered by the lack of formal timestamps on many of the pages as opposed to echoing the date of consultation, with several indicating only the copyright year (*derechos de autor*) between 2006 in the case

of Philology to 2009 in other cases. However, analysis of the changing content from the different sections indicates a wide range of updating frequency not as dependent on discipline as might have been supposed. Within the social sciences and humanities, Economics and History provide up to date information on seminars, prizes, YouTubes, radio programmes and general academic news, while Anthropology and Philology show little sign of changing content. The most dynamic site was the new Physics page in English, which interestingly differs entirely in form and content from the Spanish version.

Presence of Research Output in Online Bibliographic Information Services

Table 7 shows the complete data for the number of articles authored by the ten institutes for the years 2005-2006, corresponding to: the production officially registered in annual reports and lists of publication, that found on their webpages and that recovered from the two multidisciplinary, international databases, *Web of Science* and *Scopus*, as well as the regional databases, *Clase* and *Periodica*. In all but two cases, official production was poorly represented on the institutional webpages. The exceptions were the Institute of Physics where figures differed only by three and the Institute of Biotechnology. This latter institute's web pages include personal as well as institutional articles in international peer reviewed journals, as the underlying publication database is used both for generating individual academics' pages and the institutional publication list. The annual reports are limited to publications where at least one of the authors reports an affiliation to the Institute of Biotechnology. On the other hand, the Institute of Physics incorporates articles without the institutional adscription into the annual reports, but these are clearly marked. Geology is a particular case where its production was found to be more visible in the international databases than in its annual reports or on its webpage. It is interesting to note that only minor differences between *WoS* and *Scopus* were seen in the present analysis.

Finally, it should be mentioned the source of many of the differences found are the frequent and fundamental errors in the annual reports such as discrepancies of up to two or three years with respect to year of publication of many of the articles, incomplete or flawed bibliographical data and a lack of consensus as to what constitutes an article. Physics and Mathematics illustrate a case in point, the articles section in the annual reports include both international articles and proceedings published in journals, (though not proceedings in book format), while *WoS* and *Scopus* make a distinction in document types between journal articles and proceedings. This clearly affects the results reported in Table 7 for these institutes.

The annual reports show marked differences in terms of accuracy and coverage; in general terms, the annual reports of the scientific institutes which place a greater emphasis on publication in international peer reviewed journals for academic evaluation, showed better management of their output than institutes in the social sciences and humanities. Much of the UNAM scientific production, specifically international journal articles, is already available in electronic format on the web, so it would seem a missed opportunity not to use the web effectively to promote one of the main outputs produced by the University.

Table 7. Visibility of articles 2005-2006 in bibliographic databases

Disciplines of the Institutes	Official production *	Web page	WoS	Scopus	Clase Periódica
Physics	421	424	266	289	22
Mathematics	265	116	226	217	7
Geology	99	56	132	150	46
Chemistry	230	164	226	229	19
Biotechnology	224	314	190	184	9
Engineering	200	36	114	112	23
Anthropology	72	1	11	10	26
Economics	85	12	3	5	30
Philology	102	20	1	1	26
History	78	28	5	1	23

* Articles only, as reported in the institutional annual reports

In the case of the institutes in the social sciences and humanities as we have seen, the production of papers generally represents a smaller fraction of production than in the scientific areas and as can be expected, articles are published mainly in local and regional journals.

Figure 1 shows the relative representation in the institutional websites and the bibliographic databases of the articles included in the institutional annual reports.

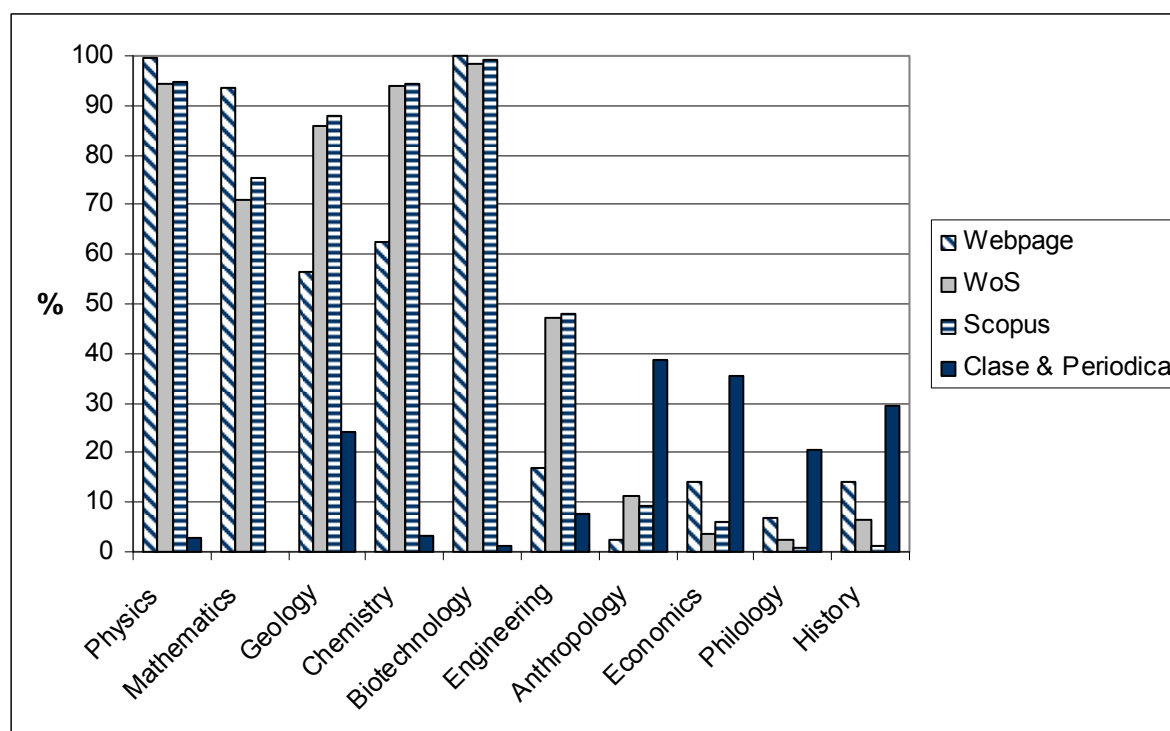


Figure 1. Visibility of the reported total article production 2005-2006 in the institutional websites and in the different databases

Easily appreciated is that production in the scientific areas is generally much more visible in all sources with the exception of the regional databases of *Clase* and *Periódica*. Physics and Biotechnology are the institutes showing the highest level of consistency in the coverage of their institutional production both on their webpages and in the international databases. In the case of the institutes of Chemistry and Geology, production is much better represented in the commercial databases than on the institutional websites. With respect to the institutes in the Humanities and Social Sciences, production is more visible in *Clase* and *Periódica* than on the websites and, as could be anticipated, in the international databases. Engineering shows a pattern distinct from the rest of the institutes, it mimics the scientific institutes in that its production is better covered in the international databases than in the Latin American databases but the reduced visibility in general of its production in all sources, is more typical of the institutes in Humanities and Social Sciences.

The numbers of articles found in the bibliographic databases which had not been included in the annual reports, can be seen in Table 8. The total numbers do not necessarily correspond to unique publications, as there is a large degree of overlap between *WoS* and *Scopus* and to a lesser extent *Clase* and *Periódica*. The high percentage of articles included in *WoS* and *Scopus* but not in the annual reports of Mathematics is due in part to the inclusion of a large section of articles accepted or in press at the time of publication of the reports, which are not then included as published articles in the subsequent year. In the case of Geology, once again we find articles published both internationally and regionally, which were missing from their institutional reports.

Table 8. Production in bibliographic databases 2005-2006 not included in the institutional reports

Discipline of the Institutes	WoS	Scopus	Clase Periódica
Physics	7	7	7
Mathematics	48	45	6
Geology	47	63	22
Chemistry	10	12	12
Biotechnology	1	2	6
Engineering	20	16	8
Anthropology	8	4	10
Economics	1	1	11
Philology	1	0	18
History	0	0	24
Total	143	150	124

Discussion

Due to its vast size, the UNAM is highly decentralised, as much for the relatively large distances between many of its research units, as for the level of administrative and functional autonomy many of them enjoy. In spite of the recent efforts of the central authorities towards standardisation, the webpages of the individual institutes continue to show large differences in structure, ease of navigation and content, thus limiting access by potential users and the consequent visibility and international image of the research carried out by the UNAM in an increasingly interconnected and global scientific community. Similar findings have been reported in the Latin American environment, specifically with regard to the research and

development activities of hospitals, in that much work needs to be done to increase visibility on the web of institutions carrying out research in the region (Macías-Chapula et al., 2007).

A limited presence of research production is less acute in the case of the scientific research institutions of the UNAM than those in the Humanities and Social Sciences. However, this should be examined in the light of the dissemination channels used by the different disciplines making up these two large knowledge areas and the growing tendency towards open access, particularly in the context of article publication. Book publication has been more resistant to the advent of electronic publication and to the open access movement, than journal publication. Research institutes in the Humanities and Social Sciences in the UNAM tend to have active publishing departments, producing both books and journals, and more often than not, their webpages are more representative of what the institute publishes rather than what their researchers are publishing. Having said that, the books they publish generally involve their own researchers as the principal contributors, and are available solely as print copies, with only bibliographical details being found on the institutional websites. With the increasing demand from the international scientific community for more universal and unrestricted access to academic information and the growing e-print culture, as well as greater familiarity with electronic resources and tools, it is not surprising to find superior web and internet presence by the scientific community than by those in the Humanities and Social Sciences.

The institutional reports analysed in the present study were generally deficient, inaccurate and, in many cases, blatantly misleading, thus complicating the type of analysis we carried out. The differences between the official lists of publications and those articles found in the international databases has already been described for Mexican institutions carrying out chemical research, included the UNAM's Institute of Chemistry (Russell, Rosas & Arvanitis, 1995). Better organizational structures for handling institutional information should be implemented which in turn should make maximum use of web facilities to increase visibility and assist access. Provision of accurate information on institutional productivity together with effective mechanisms to search, retrieve and consult original documents, will be greatly facilitated by the creation of an institutional repository in the UNAM (Galina & Jiménez, 2008).

In the future we intend to examine the visibility of research output through Google Scholar, as a highly relevant resource discovery tool, notwithstanding the difficulties presented for institutional searching due to variable metadata. The source data for this tool in terms of academic publications derive from, among others, publisher data, third party databases and also institutional webpages, and depend on their ability to be harvested by Googlebot. Although this study is focused on a particular university in the developing world, we consider that it could serve as a wake up call for similar institutions with an important research component in other parts of the world. What is simply not present or veiled under layers of ever deepening levels of webpage hierarchy, will not be taken into account in any kind of assessment whether it be international rankings or people and institutions looking for suitable environments to study or to carry out joint projects.

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