

The role of public universities and the primary digital national newspapers in the dissemination of Spanish science through the Internet and Web 2.0

Dra. María Dolores Olvera-Lobo. CSIC, Unidad Asociada Grupo SCImago, Madrid. Departamento de Información y Comunicación. Universidad de Granada. España.

Lourdes López Pérez. Departamento de Información y Comunicación. Universidad de Granada. España.

Over the past 10 years, enrollments in scientific degrees in Spain have dropped; at the same time, the level of scientific culture among Spanish digital natives is one of the lowest in Europe. This study has analyzed public Spanish universities' use of the possibilities offered by Web 2.0 for disseminating research and reversing this situation. In addition, it has studied the scientific news in the Spanish context that appears in digital newspapers with the largest readerships in the country. The results obtained reveal the effort universities are making to publicize their scientific projects. Fully 72.90% have specific channels for science dissemination and 35.4% on Facebook. As for the digital periodicals, although all currently have sections dedicated to science and health, they produce few news stories about the results of Spanish research, which is only present in 35.4% of the information published.

Key words: Web 2.0; public universities; scientific communication; social media; networks; scientific journalism

1. INTRODUCTION

Isaac Asimov's famous line on how "science gathers knowledge faster than society gathers wisdom" reflects a situation that is hardly unfamiliar to us. The continuous decline of scientific vocations in Spain during the last decade (INE, 2010), and with one of the lowest levels of scientific culture in Europe (Fundación BBVA, 2012), implies that Spanish society must confront a present in which the social building blocks surrounding scientists' ivory tower are more insurmountable than the tower itself.

But this is not a new landscape. The belated development of the R+D+I system in Spain also delayed educational, social and political institutions' interest in assimilating scientific knowledge into society. True concern about this subject doesn't emerge until the 1990s, when various initiatives are born: the inauguration of science museums all over the country; the design of scientific outreach programs; the organization of science-related street fairs; the creation of the Servicio de Información y Noticias Científicas (SINC) and of scientific culture units in universities and research centers; and the coordination of other public events in order to commemorate international science-related occasions. Additionally, bodies are formed like the Fundación Española para la Ciencia y la Tecnología (FECYT), and the first surveys are published that focus on society's perception of science.

That being said, in view of the information mentioned above, these proposals don't appear to have been sufficient. In this context, the Internet and Web 2.0 burst onto the scene; in barely a decade, they become the primary channel (Fundación Española para la Ciencia y la Tecnología, 2012) used by digital natives (Prensky, 2006) to learn about scientific matters. This influence leads to the interactive generation (Sádaba Chalezquer & Brigué Sala, 2010) and quickly reaches society in such a way that the Internet's permeation in Spain has risen from 16% in 2004 (Asociación de Investigación de Medio de Comunicación, 2011) to 47.37% in 2012, over six points more than printed newspapers (Asociación de Investigación de Medios de Comunicación, 2012).

The Internet's influence has also reached the media, which has adapted to this new scenario by publishing digital editions that respond to the demands of contemporary society, dependent as it is on new technologies.

In this study, we have analyzed whether public Spanish universities, responsible for the majority of the country's scientific production, and Spanish digital newspapers with the largest readerships, in their formative function, use the Internet and Web 2.0 to disseminate science – and whether, in this way, they contribute to the development of scientific culture and vocations among young people.

2. Web 2.0 and Digital Natives

2.1. Uses

The indispensable role occupied by Web 2.0 and its tools in the lives of young people is what has meant that most studies carried out within this field, whether of a national or international scope, are oriented toward studying age, use, frequency, and the impact that social networks, the main symbol of Web 2.0 (Flores, 2009), have on digital natives. After all, young people choose social networks as the primary means of communication and interaction with their environment (Colás et al, 2013).

In the Spanish case, 70% of Internet users between the ages of 10 and 18 have a profile on a social network – an age range that drops further if we consider the fact that access to a personal computer is situated around six years old. In the case of Andalusia, 71.7% of young people join these networks between 12 and 14 years old (Colás et al., 2013). Although these figures are very striking, they are still far removed from cases like that of Singapore, where the age at which children begin to use social networks lies around six years old and where 99% of young people between six and 24 use this communication tool (Zhen & Cheock, 2011).

Personal interests and relational social needs are the primary causes prompting the use of social networks, both in Spain (Colás et al., 2013; Flores, 2009) and in the international sphere (Notley, 2009).

In the case of university students, such causes are joined by other ones, like the desire to be up-to-date on what happens around them (Gómez et al., 2012). Social networks are essential parts of everyday life to this segment of the public, which confesses to going online multiple times a day and which affirms that using these networks is a routine activity integrated into their daily lives.

In this way, social networks are viewed as an important resource for training in terms of both personal and social values (Colás, González & de Pablos, 2013); likewise, students have a positive attitude toward the academic use of social networks, perceiving them as channels with enormous communicative possibilities that must be taken advantage of in the educational context (Gómez et al., 2012). They are valuable in encouraging social inclusion among young people (Notley, 2009); they have a great capacity to influence, which can become deeply advantageous in the educational realm (Flores, 2009); and, without a doubt, they can be extremely influential when it comes to decisions young people make in their own lives (Notley, 2009).

All of the aforementioned points emphasize the leading role played by Web 2.0 in general, and social networks in particular, as a communication channel for the youngest individuals; moreover, they reinforce the idea of what the tools should be for familiarizing this sector of the public with science, as well as the medium for encouraging vocations and advancing scientific culture. This hypothesis becomes still more persuasive when we consult the figures published by the *VI Encuesta de Percepción Social de la Ciencia y la Tecnología* (Fundación Española para la Ciencia y la Tecnología, 2012), a survey on the social perception of science and technology, which defines social networks as the primary source of scientific information for people below 25.

2.2. The Digital Press in Web 2.0

The media, entrusted with reconstructing the reality that is visible to society, has not been far from the transformation of the communication process implied by the emergence of the Internet and Web 2.0. Since *El Periódico de Cataluña* published the first online edition of a Spanish print newspaper in 1994, the media has jumped on the bandwagon of new technologies; today, all have an active presence on the Web. Of the different channels in existence, the digital press has had a key role in the history of Spanish cyber-journalism: not only because newspapers were the first to open up to the digital world in the late 1990s – television and the radio joined the Internet nearly five years after the press did – but also because they have the most extensive Internet presence, at 54.6% of the total (Salaverría, 2005).

It is an environment where the Spanish digital press has been established just as audience data conveys: the figures place the periodicals *elmundo.es* and *elpais.es* among the ten most widely read in Europe (Cea Esteruelas, 2013). The success of online newspapers runs parallel to the Internet's permeation in Spanish society; digital editions grow at the same pace as the print versions plummet. Readers feel that this new media has enormous advantages as compared to the conventional one: easy access to the news; the

personalization of content (RSS); constant information updates; and, most of all, the fact that it is free (Rodríguez-Martínez & Pedraza Jiménez, 2009).

Journalistic businesses are aware of the importance of this new channel, which has now penetrated the medium with the largest audience, television (Asociación de Investigación de Medios, 2012); practically all Spanish printed newspapers use the tools offered by Web. 2.0 – social networks, blogs, RSS channels, and so forth – to reach their readers.

If, in assessing this reality, we also consider the fact that the press users of the future are so-called digital natives, it seems clear that the online press will gain power and influence over printed newspapers, the radio, and television within just a few years.

In this context, digital newspapers become important loudspeakers for Spanish science because of their double role of forming and informing; their ability to generate opinions and ideas about Spanish research in society; and, lastly, their capacity to disseminate messages instantaneously to a mass audience. In this sense, the digital press has managed to link the excellent qualities of three great media by uniting the advantages offered by each one: the attractiveness of the audiovisual image, the instantaneousness of the radio, and the durability and invitation to reflect provided to readers of the printed press. To these qualities we must also add interactivity with the receiver, who participates in the process of constructing reality in real time with his or her comments and contributions.

As a result, it is essential to analyze the role of Spanish science in the agenda of the national periodicals with the largest readership: *elpais.com*, *elmundo.es*, *abc.es*, and *20minutos.es*. Indeed, this agenda shapes society's image of research being conducted in Spain.

3. Scientific Culture in Spain

Spain returns to the center stage of European science – not, this time, for the quantity or quality of the research conducted, but rather for the level of scientific culture among the population. The results of the 2009 student evaluation program called the Programa Internacional de Evaluación de Alumnos (PISA) place Spanish secondary school students below average for Organisation for Economic Co-operation and Development countries. This position is repeated in statistics published by other international reports, such as the *Estudio Internacional de Cultura Científica*, published by the Fundación BBVA (2012), which names Spanish society as having the least scientific culture of the 11 countries analyzed (10 European and the United States).

According to this same report, 57% of Spanish adults show a low level of scientific knowledge as compared to 22% characterizing the European average, and 46% are not even able to mention a scientist by name. For its part, the *Encuesta de Percepción Social de la Ciencia a Estudiantes de Secundaria* developed by the Fundación Española para la Ciencia y la Tecnología (2010) makes conclusions along these same lines, stating that a majority of the secondary school students surveyed could not name a scientist or a Spanish scientific institution.

In examining the low level of scientific culture, we must also refer to a decrease in vocations among young people, reflected in the drop in student enrollment at the higher levels of experimental sciences between 2000 and 2010, according to the information provided by Estadísticas de la Enseñanza Universitaria (Instituto Nacional de Estadística, 2010).

Although this situation is not exclusive to Spain – in Europe, the number of bachelor's degrees in Mathematics, Sciences, and Technologies has decreased nearly 4% from 2001 to 2010 (European Commission, 2012) – it does contribute to further intensifying the low level of scientific knowledge that Spanish citizens will have in the coming years, and it will widen the gap that already exists in this field between Spain and other European countries. This divide opened up in the eighteenth century during the Enlightenment, when Spain remained isolated from the scientific revolution (Fernández Rañada, 2003), a distance that has continued into our present day in spite of the efforts made by Spanish political, social, and cultural agents to fundamentally narrow the gap as of the 1990s.

4. Objectives

Observing the underlying situation with respect to Spain's low level of scientific culture and to the decrease in scientific vocations among young people has prompted the development of this text. It seeks to analyze how public Spanish universities use the Internet and new Web 2.0 tools to communicate their scientific results to society, as well as to examine whether the digital newspapers with the largest readerships in the country, in their educational role, publish news about scientific results emerging from Spanish universities and research centers.

This general objective is broken down into the following specific ones: *a)* to analyze whether public Spanish universities have specialized channels for circulating their research on Web 2.0, *b)* study the effectiveness of science-related communication undergone by public Spanish universities on Web 2.0 in terms of intensity and connectivity, *c)* determine whether Spanish digital newspapers with large readerships have created specific sections for science and technology, *e)* establish the contextual origin (national and international) of the main scientific news stories being published, as well as the source of their information they refer to.

5. Materials and Methods

5.1. Study Sample

As a study sample, we have selected the public Spanish universities and the most widely read digital newspapers in the national context. The study period was one month long, from December 1 to December 31, 2012.

To homogenize the sample and avoid the biases that can be prompted by the evident differences that exist, in terms of resources and objectives, between public and private universities, we have opted for the public ones. At the same time, we understand that public universities, by their own appointment, have greater social responsibility with respect to scientific communication. The selection of public universities responds to the selection established by Scimago Group in its Ranking of Spanish Universities based on SCOPUS data (2006-2010) and published in March 2012. This ranking compiles a total of 93 universities, of which 49 are public and 44 private, and is drawn from various scientometric indicators: number of documents published; international collaboration; normalized impact; % of documents published in top-quartile journals according to the SCIMAGO Journal Rank; and the number of works of excellence published by each institution. Our analysis has focused on the 49 public universities.

As for the selection of digital newspapers, we have taken the audience data into account as published by the two most relevant companies in audience measurement for digital media: Comscore (2012) and Nielsen (2012). They concur in defining the online newspapers with the largest readerships as *elmundo.es*, *elpais.es*, *abc.es* and *20minutos.es*, which complete our study sample.

5.2. Methodology

Below, we describe the methods we utilized for the analysis developed over the period in question (December 1 to 31, 2012).

A Study of Universities. To analyze how public Spanish universities disseminate the results of their research on Web 2.0, we have designed an evaluation sheet that includes the four areas of tools defined by Cobo Román & Pardo Kulinski, (2007): Social networks (Facebook, Twitter, Tuenti and Youtube); Content-generating tools (blogs and news channels); Tools used for social and intelligent organization of information (RSS) and other applications.

For our study, it has been important to evaluate not only the aforementioned presence itself, but also the effectiveness of the communication in question; for this reason, we have studied connectivity (the number of followers) and the level of intensity (number of publications or entries).

A Study of the Media. As with the case of the universities, in order to study how the media disseminates Spanish science, we have designed an ad-hoc checklist that comprises the following sections: whether they have created specific sections dedicated to scientific information; the scientific area referenced by

the published news stories; the source of information for the story; and the geographic origins of the source (national or international).

The analysis has been conducted by means of daily searches on the media included in the study: namely, elpais.es, elmundo.es, abc.es and 20minutos.es. From the scientific information discussed in these publications, we have excluded anything from the study that was not related to research dissemination.

The fact of including the source of information responds to the interest in analyzing the extent to which, as Carlos Elías indicated (2008) in 'La razón estrangulada,' the media limits itself to publishing only *media science* created by high-impact scientific journals. At the same time, this item allows us to establish correspondence between the dissemination of the research performed by universities and its impact in the media.

Additionally, including the geographic origins of the research published in the media allows us to observe the role of Spanish research in the Spanish journalistic agenda and the influence of the source's origin on the newsworthiness of scientific work.

6. RESULTS

6.1. Universities and Communication on Science on Web 2.0

Presence in Web 2.0. News channels are the primary tool for scientific communication used by public Spanish universities. Seventy-two point ninety percent have a channel specifically dedicated to scientific dissemination. This figure is followed by content syndication, a medium used by 37.5%, and Facebook, a network in which 35.41% of the universities have profiles specialized in research dissemination. A similar percentage -31,2%-, turns to Twitter to communicate its R+D+I. The figures drop in the case of YouTube, where 14.6% of the centers have a presence, and in the use of blogs, a resource employed by 14.6%. Only 8.33% of the centers use other kinds of applications. On the other hand, it is notable that not a single university has a profile dedicated to scientific dissemination on Tuenti, the network most followed by the young public (The Cocktail Analysis, 2012).

Another item analyzed in the research with respect to presence is the Campus of International Excellence category, with the goal of establishing whether this factor influences science-related communication through Web 2.0. In this sense, we must stress that nearly half of the public universities that use Facebook are Campuses of International Excellence. There is a similar figure for Twitter, with 40%; YouTube exceeds it with 57.14% of the centers. The numbers drop in the case of the news channels, with 25.71% of the centers, and blogs, with 14.28% (see graphic 1).

Use of Web 2.0 tools by public Spanish universities

Data collected from December 1 to 31

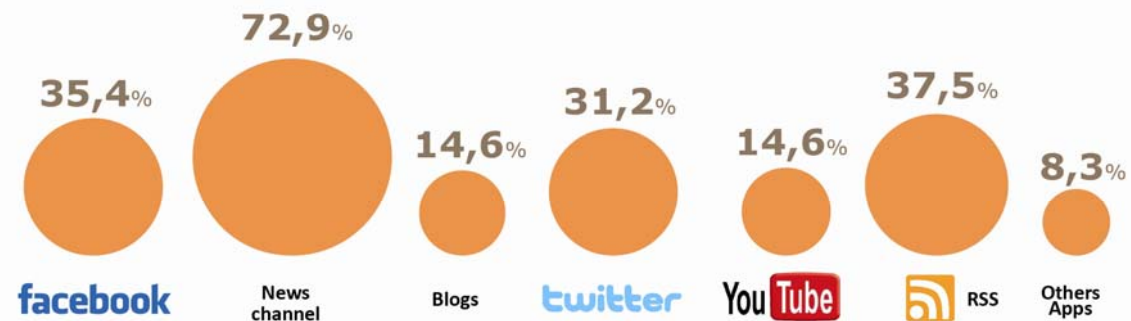


Figure 1. Use of Web 2.0 tools by public Spanish universities.

Connectivity. Of the three social networks analyzed, Twitter presents the highest values of connectivity. The Universidad Nacional a Distancia has the most followers: 3510. Twenty-six point six percent have more than 1000 followers and 73.33% have less than 1000.

As for Facebook, the Universidad Autónoma de Madrid has the most followers, at 3180. Forty-one point seventeen percent of the centers analyzed that have a profile on this network have more than 1000 followers, 17.6% have fewer than 1000, and 35.2% have fewer than 500.

The Universidad de Málaga’s YouTube channel has the most views with a total of 24,006. Of the centers that have a presence in this channel, 71.42% have fewer than 10,000 views.

Intensity. The intensity of the communication via the different channels analyzed is not very high, but it is relevant that most of the universities use these tools to disseminate their scientific research (see graphic 2). The Universidad Autónoma de Madrid has the most activity on social networks, with 122 posts published during the study period. The Universidad de Huelva has published the most scientific news stories: a total of 30. The Universidad de Granada stands out with respect to the number of tweets, 14, and the Universidad de Córdoba and la Politécnica de Cartagena tie when it comes to YouTube with two videos posted each.

6.2. The Media and the Dissemination of Science in Digital Editions

The analysis of the research dissemination conducted by the highest-circulation online newspapers corresponds to the same period as the universities: December 1 to 31, 2012.

Specific Sections and Intensity. The four periodicals analyzed dedicated specific sections to scientific news. Of the four, elmundo.es, abc.es and elpais.es concur on the names of the two sections; that is, Science and Health. While this is visible on the homepage of the first two periodicals, on elpais.es they are integrated as two subsections of the Society area. 20 Minutos has, like the others, a section dedicated to Health and another to Environment.

As for intensity, the online newspaper that publishes the most scientific news stories is abc.es with 64, followed by elmundo.es with 59, elpais.es with 33 and, in last place, 20minutos.es with five. If we add up the production of all four periodicals, 161 scientific news stories have been published between December 1 and 31, 2012.

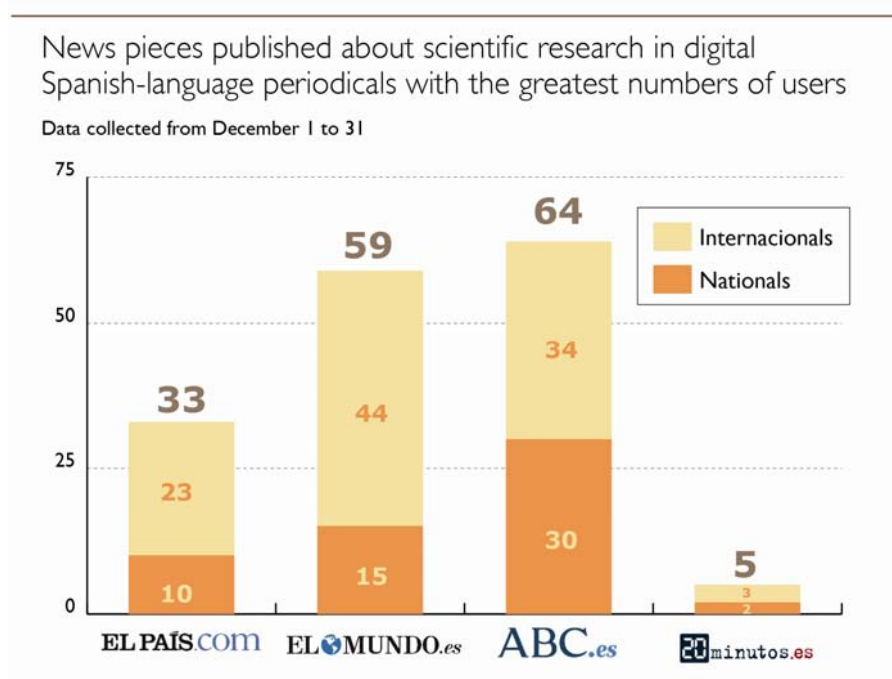


Figure 2. News pieces published about scientific research in digital Spanish-language periodicals with the greatest numbers of users.

Origins and Sources of Information. All four periodicals predominantly publish research results from international centers and universities: so much so that 64.5% of the news stories make reference to a foreign center or university as compared to 35.40% that mention scientific work developed in Spain.

Scientific journals are the primary source of information for the news. Fully 45.96% indicate a scientific journal as a source. In this respect, we must mention that of the 52 journals mentioned in the news pieces published by the four periodicals, not one is a Spanish-language publication. The journals with the most significant presence are: *Proceedings of the National Academy of Sciences*, *Nature*, *Science* and *British Medical Journal*. The European Space Agency (ESA) and the National Aeronautics and Space Administration (NSA) are the second most frequently appearing sources. Of the news stories analyzed, 12.42% refer to these two space agencies.

7. Conclusions

Public Spanish universities are making an effort to use the tools offered by Web 2.0 in order to make their research accessible to the entire public. The data confirm this effort, as 72.90% of the universities have specific channels on their websites for communicating their scientific projects.

The figures are lower when it comes to their presence on social networks, but they indicate the growing interest shown by academic institutions in Web 2.0 as a means of reversing the enrollment drop in science and the decrease of scientific vocations. Of the social networks, Facebook is in first place, with the presence of 35.4% of the centers analyzed.

On the other hand, it is noteworthy that a substantial percentage of the centers that use these communication channels are International Campuses of Excellence. This is a tendency to keep in mind and an item that gives rise to a new research hypothesis that links excellence, with apologies for the redundancy, with international campuses of excellence not only in terms of their research itself, but also in terms of dissemination.

As for the effectiveness of communication, the results indicate that, although the presence in Web 2.0 is significant, the incursion into this channel is relatively recent. None of the universities exceeds 3600 followers on the two most popular networks, Twitter and Facebook. The intensity is not high – an average of 10 pieces of information are published during the study period on each one of the channels studied – but it does reflect the general tendency to publish the results of their scientific projects. With respect to the areas with the greatest presence in this information, all channels display the same conclusion: medicine and biology lead the way, followed by physics and natural resources.

Regarding the analysis of the presence of Spanish science in the digital newspapers with the largest readerships, we can say that although Web 2.0 has permitted the establishment of specific sections on scientific information in digital media, it has not altered the handicap that Spanish science had to overcome in the print editions of these media sources in the late 1990s.

In this way, the results show that 45.96% of the news pieces analyzed name a scientific journal as a source. This result resembles the findings published by Carlos Elías (2008) in a study performed in 1998, which concluded that 45% of news stories stemmed from a scientific journal.

This same research observed the absence of Spanish journals in the news pieces analyzed, a reality that reappears in our analysis. The prevalence of three of the world's most prestigious science journals – *Science*, *Nature* and *The Lancet* – is another result obtained both by our analysis and the study conducted in 1998. That said, the data acquired by that study could be more precise, since, while these are the journals with the greatest presence, our study contains more heterogeneity in this sense by including 52 different scientific journals as information sources.

The strong presence of scientific journals in the published information is also reflected in the origins of more media-oriented research; strikingly, only 35.4% of newsworthy scientific results come from Spanish centers or researchers. The absence of news pieces about Spanish centers does not seem to result from a

lack of communication on the part of Spanish universities, since, during the study, they published 236 news stories as compared to the 57 that were allotted space in the four online periodicals analyzed.

Thus, with everything previously discussed here, we can say that Spanish universities are beginning to use Web 2.0 tools in order to bring research to society – but that this communication is still incipient and therefore not completely effective. As for digital media, while online periodicals include science in their agendas, they are rendering invisible the scientific work occurring in Spain due to the predominance of international information in their publications.

As an addition to these conclusions, we must also mention the homogeneity of the scientific information present in the media as a whole, which repeatedly turns to magazines like *Science*, *Nature* and *The Lancet* as sources of information.

All of these factors can contribute to the decrease both in vocations and in scientific culture in Spain: by conveying an unreachable image of science that only large international centers with prestige and diffusion can produce. This reality reflects the need for a change in how science is classified and discussed by the Spanish media.

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