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Evolution of the Field of Social Media Research through Science Maps (2008-2017)

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Abstract

The objectives of this work were to discover the main points of interest in the field of research on Social Media, within the scientific area of Communication, and to analyse how it has evolved. A methodology based on the analysis of co-words and visualisation techniques was applied. The data was obtained from scientific publications indexed in the Web of Science (WoS) database, during the periods 2008-2012 and 2013-2017. The resulting maps showed that, during the period 2008-2012, the main areas of interest were web 2.0 and the internet in terms of social networking sites. However, during the period 2013-2017, there was a strong upward trend in the impact of social networks and platforms, especially *Twitter* and *Facebook*, in many areas (such as social movements, public relations and publicity, distribution of content, crisis communication, participatory journalism, political communication, or the configuration of public identities through social platforms, with special emphasis on youth). Finally, new scientific challenges were found in automatic analysis of content and management of big data. In conclusion, it was possible to transform a complex, underlying, dynamic and multidimensional reality into visible representations that could help experts in the field to better understand the evolution of research on Social Media.

Keywords
Social Media, communication, co-words analysis, knowledge domain visualisation methods.

1. Introduction

Social Media is considered an evolution in communication systems, linked to the technological revolution that emerged with web 2.0. With them, new forms of relationships between users appear, based on more open, horizontal, collaborative, participatory and bidirectional communications. Web 2.0 represents a set of technological platforms that allow users to interact through the creation and exchange of information. In web 1.0 the user only had access to information on static pages, without the possibility of participating in the creation of content. In web 2.0 the user can interact with the contents of dynamic pages, whether it be commenting, expressing opinions or receiving information from other users. The web 2.0 version has become an instrument for collaborative projects, such as blogs, microblogs, virtual communities and social networks, all united under the concept of Social Media.

Social Media represent a communication model in which a diverse range of users produce and share information, proving themselves to be an increasingly important part of the internet. Initially, the mass media were meant to inform and entertain the public that had access to them, being unidirectional channels of communication; but, with the arrival of the internet it was possible to democratise and facilitate access to information and communication. The term *Social Media* (grassroots media) is used in contrast with the term *mass media* (mainstream media). Henry Jenkins (2006) analysed the changes that were taking place in both, and concluded that the power of the mainstream media was in the amplification of information, while that of grassroots media was in its diversification. The Social Media revolution has penetrated organisations around the world due to the incredible speed with which it has entered into all fields of social and economic life, as well as almost every other aspect of daily life. Social Media have permanently changed communications, marketing, advertising, journalism and many other areas. With the success of Social Media, new jobs which implement new strategies in the workplace have emerged, such as Social Media manager or community manager.

The irruption of Social Media has awakened the interest of many researchers from a bibliometric perspective (Peng *et al*., 2012; Coursaris & Van Osch, 2014; Van Noorden, 2014; Wang *et al*., 2014; Costas *et al*., 2015; Haustein *et al*., 2015). Bibliometric approaches and techniques are particularly useful for analysing scientific areas and revealing the dynamics of their evolution. Bibliometrics, scientometrics, webometrics and altmetrics are disciplines, often difficult to distinguish, aimed at analysing, quantifying and measuring communication phenomena in order to build accurate formal representations of their behaviour for explanatory and evaluation purposes (De Bellis, 2009). Bibliometric analysis provides information on growth of literature and knowledge flow within a specific field over a period of time, through the analysis of information collected in databases, such as citations, authors, or keywords. The bibliometric approach, in combination with graphic representation techniques, achieves not only an adequate visualisation of the information, but also makes it possible to measure underlying phenomena. The visualisation of information aims to transform abstract data and complex relationships into visible messages, giving rise to what is considered a new science of visual communication called *schematics* (Costa, 1998). It is an area that studies the graphic language of schemes as messages, and schematisation as a procedure for visualisation of difficult to distinguish information. But schemes also have their own qualities as a communication language: the ability to transmit knowledge (Costa, 1998), and within these schemes would be integrated science maps, also called *maps of knowledge,* or *scienciograms* (Small, 2006).

Previous studies have dealt with the evolution of research topics in the field of communication (Peng *et al.,* 2012; Günther & Domahidi, 2017). However, no work has been done from a bibliometric perspective that is capable of responding to the following general questions: how is the conceptual and thematic structure of the field of Social Media research configured within the area of scientific communication? What specialties and sub-specialties are found at the heart of the field? How has research in this field evolved in the last decade? What are the emerging research fronts and future challenges?

2. Theoretical framework

2.1. *Research in Social Media*

Social Media are defined as integrated internet-based applications that are built on the basis of social networks and the technological foundations of web 2.0, which encourage the creation and exchange of user-generated content (Kaplan & Haenlein, 2010). The different definitions of Social Media are condensed into three basic characteristics (Obar & Wildman, 2015): they are applications based on web 2.0, they primarily contain user generated content (UGC), and

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they are services that facilitate the development of online social networks by connecting profiles with those of other people and groups. Based on web 2.0 applications and on the different types referred to in the literature (O`Reilly, 2007; Kaplan & Haenlein, 2010; Merodio, 2012), this article establishes a categorisation of Social Media, consisting on the following main platforms:

a) Social network sites. On these platforms, users use web 2.0 applications to communicate informally with others, find people and share similar interests. Examples of these sites are *Facebook*, *Tuenti*, *Google+* or *LinkedIn*.

b) Self-publication websites, or blogs. A blog is a web 2.0 tool in which opinions, stories, articles or links to other websites are collected, and in which the author is free to publish what they think is appropriate. Blogs, on platforms such as *Wordpress* and *Blogger,* have become a global communication tool that is radically transforming journalism and traditional media.

c) Microblogging. These services allow the publication and submission of short written texts through web 2.0 tools that are specifically designed for this purpose, such as *Twitter* and *Tumblr*.

d) Participatory journalism, or citizen journalism. These platforms, built around a web 2.0 site, allow citizens themselves to become sources of information, allowing them to communicate news, and to criticise, deny, enrich or clarify information published in other media.

e) Collaborative projects, or wikis. A wiki is a web 2.0 platform designed for easy and automatic creation, exchange and reviewing of information. Users of a wiki can generate, modify and delete the same text that they share with other users, an example being *Wikipedia*.

f) Multimedia Social Media. These web 2.0 platforms facilitate the exchange of photographic and audiovisual materials. Examples are *Flickr*, *Youtube*, *Vimeo*, *Dailymotion* and *Periscope*.

g) Discussion forums. A forum is a web 2.0 application that supports online discussions. Companies that have a presence on forums do so in order to find out the opinions of direct users.

h) Crowdsourcing: a type of participatory online activity in which a person, institution, organisation or company promotes or requests to a group of individuals, through an open call, the voluntary completion of a task. In creative industries these platforms are increasingly used for collaborative networking, such as *Kickstarter*, *Innocentive* or *Seedquick*.

i) Electronic word-of-mouth (eWOM) communication. This consists of the exchange of information through written comments on the internet about an organisation's product or service.

j) Social bookmarking. The user can store and classify internet entries that are of interest to him on these web 2.0 platforms. As these favourite links are online, it can become a fundamental tool for blogs and corporate websites to achieve better online positioning. Examples can be found on *Slashdot, Delicious* or *Google Bookmarks*.

Given the diversity and continuous evolution of 2.0 platforms, there has been a revolution within the traditional communication model, with the model being transformed in favour of network structures where each node can transmit information and become a communicator (Freire & Gutiérrez -Rubí, 2010). The impact of this phenomenon, linked to the new digital culture and online interactive digital tools, has been investigated in numerous works (Boyd & Ellison, 2007; O`Reilly, 2007; Flores, 2009; Kaplan & Haenlein, 2010; Noguera, 2010; Cardoso, 2011; Said Hung *et al*., 2013; Georgescua & Popescula, 2015; Gupta *et al*., 2015; Knoll, 2016).

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2.2. *Bibliometric research based on co-word analysis*

Bibliometric research uses quantitative analysis of statistical data in published literature to study publication patterns within a scientific field (De Bellis, 2009). In general, bibliometric studies can be divided into two broad categories (Soos *et al*., 2013): *evaluative bibliometric studies* (designed to measure the impact of research with the purpose of evaluating science through the use of quantitative indicators), and *structural bibliometric studies* (through the use of relational indicators based on the co-occurrence of certain units of analysis, such as citations, authors or keywords). Another classification, proposed by Van Raan (2005), is based on bibliometric indicators or statistical data derived from scientific publications: one classification being *one-dimensional indicators* (based on univariate statistical techniques, dedicated to analysing or measuring a single characteristic of published documents, without considering any link that may exist between them) and the other being *multidimensional indicators* (based on multivariate statistical techniques, dedicated to analysing or simultaneously measuring different characteristics or variables, or multiple interrelations that could be observed in the published documents). Such relational structures can be represented graphically with bibliometric maps, or science maps, which offer revealing data about the relationships between the analysed units.

Co-word analysis, used in this work, is included within the classification of structural bibliometric studies in which relational and multidimensional indicators are applied. Co-word analysis is the study of co-occurrences of two terms in a given text, in order to identify the conceptual and thematic structure of a scientific domain (Callon *et al*., 1986; Leydesdorff & Welbers, 2011). In the co-words analysis method, the terms to be processed are selected from a set of documents that represent field's scientific production. Firstly, co-occurrence matrices are constructed, then networks of co-words with which different types of analysis are developed, in such a way that the measurement of the link between two words will be proportional to the co-occurrence of those two words in the sample documents. Once co-occurrence matrices are obtained, measures of similarity are calculated. These measures serve as input to different classes of multivariate analysis, such as clustering analysis and dimensional reduction analysis, or *multidimensional scaling* (MDS). The clustering analysis consists on deconstructing the analysis units into groups of similar and interconnected items. It would then be possible to assimilate the groups of words obtained into the thematic lines of the scientific fields. In turn, the statistical techniques of multivariate analysis and dimensional reduction allow the visualisation of selected units in science maps (Small, 2006; Noyons *et al*., 1999; Van Eck, 2011). Another approach is to study and visualise word co-occurrence networks by calculating their structural properties using social network analysis techniques (Wasserman & Faust, 1994).

Co-word analysis and its representation in science maps is one of the most effective methods to investigate the morphology of a field of research and discovering trends or emerging issues within that scientific domain. This methodology has been applied successfully to multiple subjects and disciplines (Braam *et al*., 1991; Ding *et al.,* 2001; Kostoff *et al.,* 2006; Leydesdorff & Welbers, 2011; Hu & Zhang, 2015; Ravikumar *et al.,* 2015; Gan & Wang, 2015; Leung *et al.,* 2017).

3. Objectives

From a bibliometric approach based on co-word analysis and the application of visualisation techniques, the objectives of this work are the following:

- Identify, from scientific publications compiled in scientific databases, the main concepts and focuses of research on Social Media.
- Visualise the conceptual and thematic structure of research on Social Media.
- Identify the specialties or sub-specialties that are found at the heart of the discipline.

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– Show how it has evolved in the last ten years by analysing the periods between 2008 and 2012 and between 2013 and 2017.

4. Methodology

The procedure for performing the co-word analysis consisted of several stages (Börner *et al.,* 2003): data collection; selection of the units of analysis; obtaining the frequencies of each unit of analysis; calculation of co-occurrences; application of clustering techniques; positioning and visualisation of the analysis units in two-dimensional (2D) maps; interpretation of the resulting visual representations. For treatment of units of analysis and to eliminate any duplication, the *BibExcel* tool was used (Persson, 2011). For construction and visualisation of science maps, we took advantage of the *VOSviewer* tool (Van Eck & Waltman, 2010).

4.1. *Data collection*

The Web of Science (WoS) platform was used to retrieve the data, where the Science Citation Index Expanded (SCIE), Social Sciences Citation Index (SSCI) and Arts & Humanities Citation Index (A & HCI) databases were accessed. The search strategy used was to search the WC field (Web of Science Categories) for the term 'WC = Communication'; the field TP (type of document) for the term 'TP = Article', limiting the time period to between 2008 and 2017; the field TS for 'TS=("Social Media", "social networking", "social networking site", "SNS", "web 2.0", "user generated content", "user-generated content", "Twitter", "Facebook", "participatory journalism", "citizen journalism", "blog", "microblog", "microblogging", "blogger", "Wordpress", "online community", "online communities", "virtual community", "discussion forums", "internet forum", "wiki", "online review", "cocreation", "big data", "YouTube", "Flickr", "Vimeo", "DailyMotion", "Periscope", "Tumblr", "LinkedIn", "Instagram", "Pinterest", "Myspace", "video sharing site", "crowdsourcing", "social bookmarking", "bookmarking", "electronic word-of-mouth" and "eWOM")' (looking for topic terms in the following fields within a record: Title, Abstract, Author Keywords and KeyWords Plus). Because the term 'Social Media' may not have a unique meaning, it was decided to look in addition for other terms related to this concept. These topic terms probably do not exhaust the semantic spectrum linked to Social Media, but we consider that they are thorough enough to identify most of the research related to this field.

Only original articles were selected (discarding editorial material, letters or reviews), because it was considered that this type of publications is the ones that accurately reflect the proven results of research in a scientific field. As a result, a total of 3,480 research articles related to Social Media (Table 1), published in 86 journals, were obtained. These documents were downloaded directly in plain text format for later analysis.

Table 1: Selection of the first 20 journals in the analysed sample, ordered according to the number of published articles.

Journals	Number of articles
New Media & Society	349
Information Communication & Society	335
International Journal of Communication	244
Public Relations Review	241
Journal of Computer-Mediated Communication	150
Media Culture & Society	98
Media International Australia	90
Journal of Broadcasting & Electronic Media	87
Journal of Communication	79
Comunicar	75
Convergence-the International Journal of Research into New Media	74
Journal of Health Communication	73
Television & New Media	73

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Journalism	67
Health Communication	67
Journalism Studies	64
Discourse Context & Media	63
Continuum-Journal of Media & Cultural Studies	57
Journalism & Mass Communication Quarterly	56
Asian Journal of Communication	55
Others	1.377
Total	3.480

4.2. *Selection and processing of analysis units*

The units of analysis selected were keywords from which the scientific productionis indexed in WoS. In this database, records include two types of keywords: Author Keywords, provided by the authors themselves, and KeyWords Plus, generated base d onhow frequently the words appear in the titles of articles cited as references. For bibliometric analysis, the keywords extracted automatically are less specific and understandable than the keywords provided by the authors (Zhang *et al*., 2016). For this reason, Author Keywords were selected for this work.

To simplify the complex information structures, only keywords that exceeded a high threshold of occurrences were considered. Thus, only those keywords whose frequency was ≥4 were selected (a lower threshold would have resulted in a long list of keywords and complex maps that were difficult to visualise and interpret). Furthermore, before constructing science maps, keywords that were too general were eliminated, and the term 'Social Media' was also deleted (for later representation on the maps), because it was found to be related to most of the keywords. After the pre-processing, 111 keywords corresponding to the period 2008-2012 were obtained, and 528 corresponding to the period 2013-2017.

With the selected keywords, square matrices of N x N elements, or co-occurrence matrices between pairs of keywords, were constructed. The frequency with which two keywords appeared simultaneously in the same document was calculated. Using the *BibExcel* tool, keywords were pre-processed to eliminate any duplication, and two matrices were constructed: 111 x 111 keywords (2008-2012 period), and 519 x 519 (2013-2017 period).

4.3. *Positioning and visualisation of keywords in science maps*

Co-occurrence networks of generated keywords were loaded into the *VOSviewer* tool. In the procedure for creating network visualisations, the steps detailed below were carried out (Van Eck & Waltman, 2014):

1) Normalisation: in a bibliometric network, there are big differences between the number of links that some nodes have with others. In order to normalise co-occurrence values between keywords, the similarity index, or the so-called Association Strength (AS) measure was applied (Van & Walkman, 2007). The AS index is based on the normalisation of the associations of keyword pairs. With its application, the significance of each keyword is obtained (in such a way that greater significance was given to the words with low frequency, but with a high frequency of co-occurrence, while a lower value was given to high-frequency words with low frequency of co-occurrence).

2) Mapping: the next step was to position the nodes in a two-dimensional space; strongly related nodes were positioned nearby, and weakly related nodes were positioned far away. For this purpose, the technique of visualisation of similarities (VOS) was applied (Van Eck & Walkman, 2010). The VOS mapping technique allowed the use of different clustering algorithms in order to position and classify the keywords in similar groups, comparable to thematic groups. The *VOSviewer* clustering algorithm includes different resolution parameters, depending on the value that is provided to configure it, in order to obtain different levels of grouping. A cluster is a set of closely related nodes, and each

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node in a network is assigned to just one cluster. The number of clusters was determined by the applied resolution parameter. Several tests were carried out introducing different values into the parameter, and it was decided to select a value of 3 to obtain consistent thematic clusters. It was also decided that the clusters should contain a minimum of 40 keywords, thus guaranteeing a series of consistent thematic groups.

Finally, groups of keywords were represented in two types of two-dimensional (2D) bibliometric maps:

a) The *label view*, in which the visualisation of the network generated an image in which keywords were represented by a circle, and identified by a label. The greater the significance of the node, the larger the circle and the label. The random colour of the nodes was determined by the cluster to which each keyword belongs. The lines between the elements represented the links. The stronger these relationships were, the more they were interpreted as constituting a coherent set of research topics.

b) The *density view*, in which the visualisation of the network generated an image in which each zone had a colour that indicated the density of the relationships between the keywords at that point. By default, the colours vary between yellow, green or blue. The greater the number of elements connected to a point and the greater the significance of the neighbouring elements, the closer the colour of the point will be to yellow. Conversely, the smaller the number of interconnected elements of a point, the closer the colour will be to blue.

After positioning the nodes of the keyword bibliometric network in two-dimensional maps and grouping them in clusters, the network was visualised using various techniques which allowed them to be designed in the best possible way. To ensure that the labels of the nodes did not overlap each other, only a selection of all the labels was shown. This selection was determined by the decision to display as many labels as possible, although the nodes with more links took precedence over the labels of the less important ones. In addition, maps could be explored using functions such as zooming and panning (scrolling), to be able to examine different areas.

5. Results

5.1. *Maps for the period 2008-2012*

As a result of the label view that corresponds to the period 2008-2012 (Figure 1), four major categories of keywords that formed the main focuses of interest in Social Media research during this period, were obtained. Next, the four main thematic groups (*G*) obtained, and a selection of the terms with greater significance within each grouping, are detailed. The denomination of each thematic group was headed by a summary based on the most important keywords:

- *G1* (red): "Social network sites". It included 40 keywords, the most significant being 'social network sites', 'Facebook', 'culture', 'activism', 'political participation', 'youth', 'social capital', 'political communication', 'community', 'professionalism', and 'privacy'.
- *G2* (green): "New media". It included 30 keywords, the most significant being 'new media', 'blogs', 'citizen journalism', 'user-generated content', 'participatory journalism', 'youtube, blogging', 'public sphere',' 'ict', 'virtual community', 'narrative', 'discourse', 'online journalism', 'online news', and 'newspapers'.
- *G3* (blue): "Web 2.0". It included 22 keywords, the most significant being 'web 2.0', 'computer-mediated communication', 'identity', 'social networking', 'online community', 'digital culture', 'media studies', 'politics', 'sociology', 'cyberculture', 'communication studies', and 'participatory culture'.

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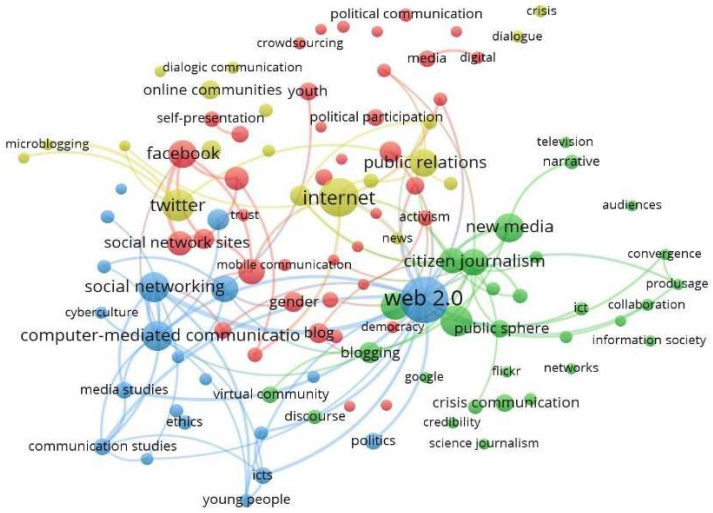
– *G4* (yellow): "Internet and Twitter". It grouped 19 keywords, the most significant being 'internet', 'Twitter', 'public relations', 'content analysis', 'audience, journalism', 'online communities', 'dialogue', 'news', and 'online'.

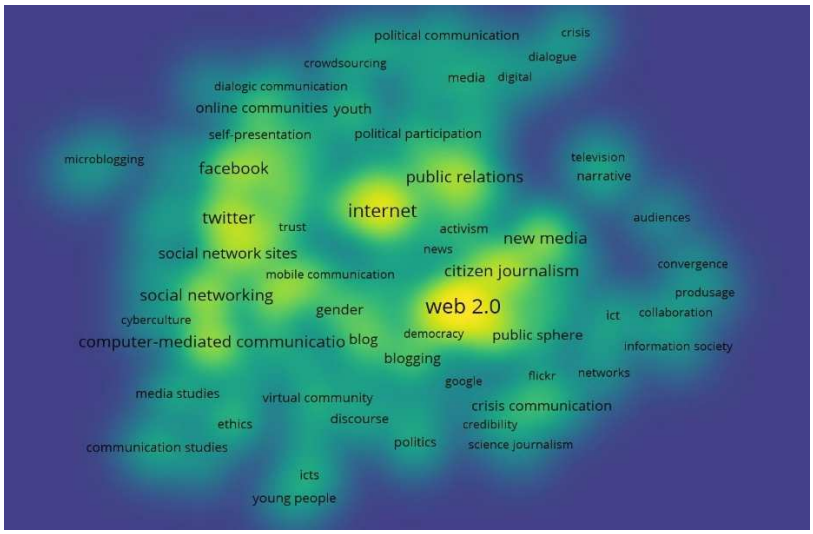
Figure 1: The label view (2008-2012) with different thematic groups distinguished with a random colour.



When it comes to the density view for the period 2008-2012 (Figure 2), the different areas with greater and lesser interrelation of keywords were visualised. The following focal points of density were highlighted:

– High density areas (yellow). In this area the keywords'web 2.0' and 'internet' were located.
– Medium density areas (green). In this area were located the keywords 'Twitter', 'social network sites', 'user-generated content', 'computer-mediated communication', 'public relations', 'new media', 'youtube', 'facebook', 'culture', 'interactivity', 'blog', 'citizen journalism', and 'online journalism'.
– Low density areas (blue). In this area were located 'political communication', 'political participation', 'crisis communication', 'digital culture', 'communication studies', 'online communities', 'television', and 'crowdsourcing'.

Figure 2: The density view (2008-2012) with the areas of greatest interconnection of keywords (shown in yellow).



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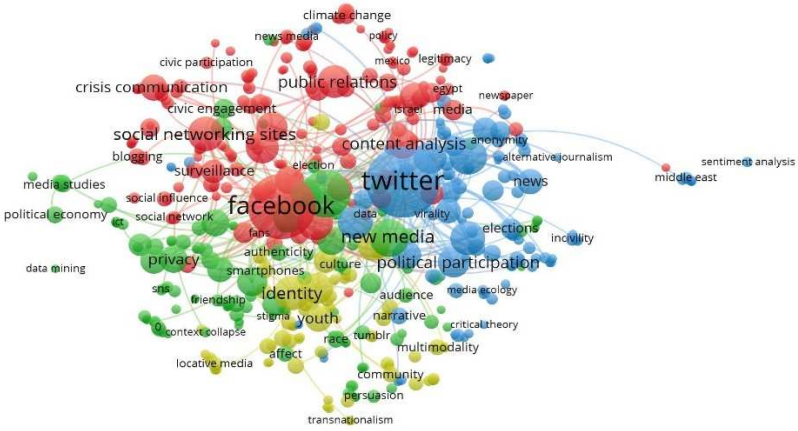
5.2. *Maps for the period 2013-2017*

As a result of the label view that corresponds to the period 2013-2018 (Figure 3), four major categorisations of keywords were obtained, corresponding to the period's main focuses of research on Social Media. Next, the four main thematic groups (*G*) obtained are detailed, headed by the keywords with greater significance within each grouping:

- *G1* (red): "Social networks sites, public relations and social movements". It included 174 keywords, the most significant being 'social networking sites', 'Facebook', 'content analysis', 'public relations', 'China', 'crisis communication', 'social movements', 'surveillance', 'activism', 'user-generated content', 'television', 'blogs', 'discourse analysis', 'participatory culture', 'arab spring', and 'alternative media'.
- *G2* (green): "New media on the internet". It included 137 keywords, the most significant being 'internet', 'new media', 'social networks', 'politics', 'privacy', 'digital divide', 'online communities', 'social networking', 'computer-mediated communication', 'social capital', 'discourse', 'civic engagement', 'ict','audience', and 'authenticity'.
- *G3* (blue): "Twitter, journalism and political communication". It included 121 keywords, the most significant being 'Twitter', 'journalism', 'big data', 'political communication', 'citizen journalism', 'digital media', 'political participation', 'public sphere', ' news', 'interactivity', 'online news', 'participatory journalism', 'democracy', 'gatekeeping', and 'elections'.
- *G4* (yellow): "Digital identity and young people". It included 87 keywords, the most significant being 'identity', 'youth', 'participation', 'sexuality', 'gender', 'queer', 'citizenship', 'mobile communication', 'mobile phones', 'mobile media', 'ethnography', and 'instagram'.

Figure 3: The label view (2013-2017) with different thematic groups differentiated by a random colour.



Regarding the density view for the period 2013-2017 (Figure 4), the different zones with greater and lesser intensity of keywords were visualised. The following density cores were shown:

- High density areas (yellow). In this area were located the keywords 'Twitter' and 'Facebook'.
- Medium density areas (green). In this area were located the keywords 'Internet', 'new media', 'journalism', 'identity', 'youtube', 'content analysis', 'participation', 'gender', 'social networking sites', 'big data', 'social networks', 'political communication', 'China', 'politics', 'youth', 'citizen journalism', 'social movements', 'digital media', 'social network sites', 'public relations', 'surveillance', 'activism', 'political participation', 'public sphere', and 'user-generated content'.

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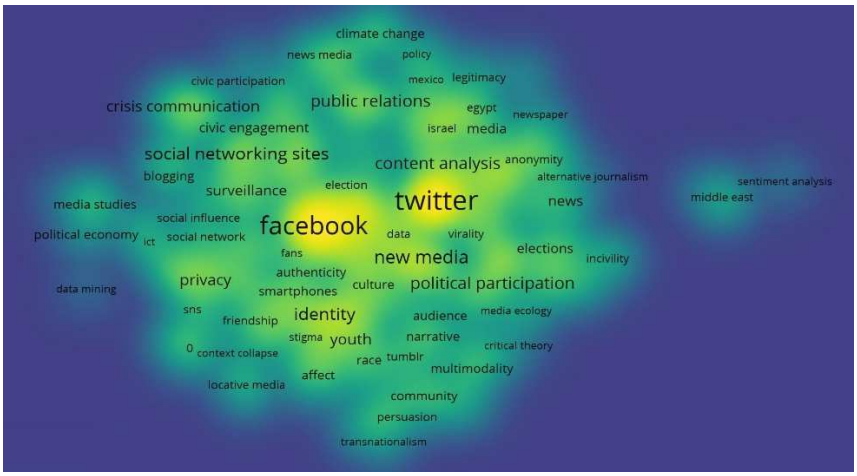
– Low density areas (blue). In this area were located the keywords 'web 2.0', 'privacy', 'online communities', 'interactivity', 'computer-mediated communication', 'television', 'online news', 'discourse', 'blogs', 'digital divide', 'social capital', 'civic engagement', and 'democracy'.

Figure 4: The density view (2013-2017) with the areas of greatest interconnection of keywords (shown in yellow).



5.3. *Evolution of Social Media research in the last decade*

Studies on Social Media, within the WoS Communication category, have increased exponentially in the last decade (Figure 5), showing a more rapid change in the 2013-2017 period. To analyse the evolution of this field of research, we first considered the main differences in the number of occurrences, or frequencies, of keywords in the analysed periods 2008-2012 and 2013-2017 (Table 3). The resulting maps of both periods were then compared (Figure 6).

Figure 5: Distribution by year of publication on Social Media, within the Communication category of Web of Science (WoS).

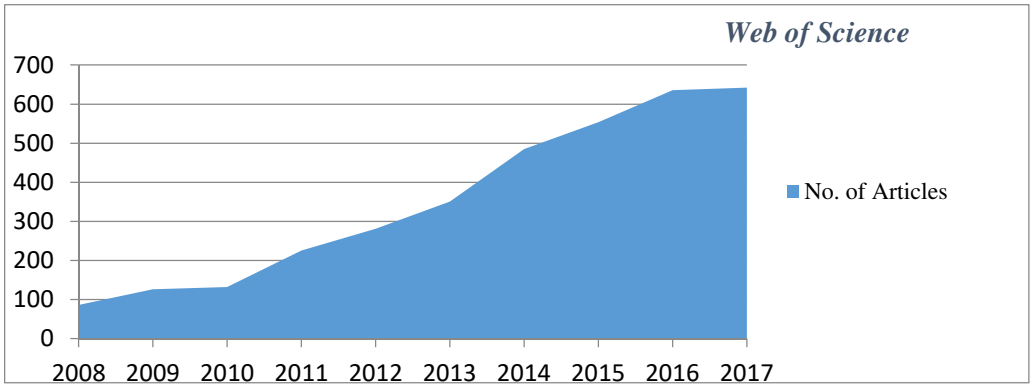


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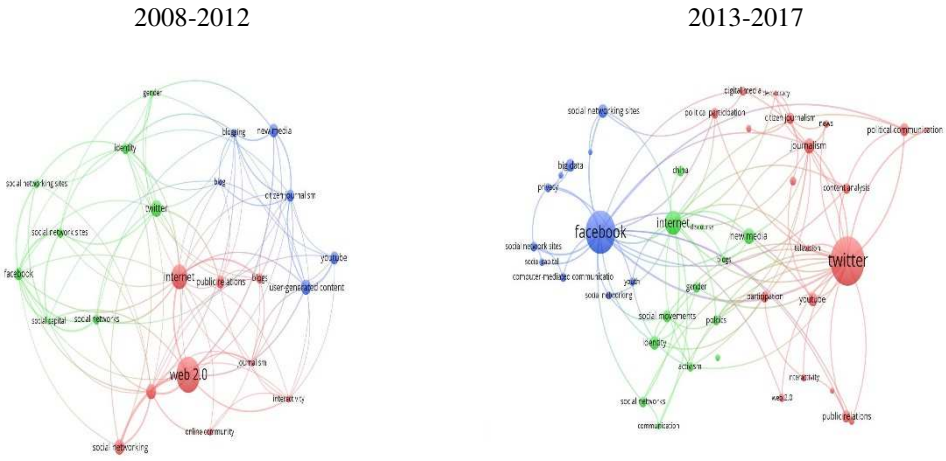
Table 3: The top 25 keywords with the greatest relative increase in the number of occurrences between the two analysed time periods.

	Number of ocurrences	
Keywords	2008-2012	2013-2017
Social Media	98	859
Twitter	33	259
Facebook	25	223
Internet	47	117
Youth	0	77
New media	26	72
Journalism	13	71
Identity	22	62
Social networking sites	36	61
Political communication	6	58
Public relations	25	56
Television	0	56
Social movements	9	53
Political participation	9	49
China	0	46
Crisis communication	10	37
Gender	1	30
Activism	4	29
Content analysis	4	25
YouTube	4	22
Social networks	8	20
Computer-mediated-communication	7	20
Arab spring	1	19
Big data	1	17
Interactivity	0	15
Digital divide	0	15

Figure 6: Zooming into the most densely connected nodes in the two analysed periods.



6. Discussion

In the interpretation of the label view, the number of keywords within each thematic group, the number of occurrences of each keyword, their interrelation, and their spatial location were all taken into account. The size of the labels and the diameter of the circles were proportional to the frequency and strength of the connections of the respective keywords. In

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general, the thematic groups (*G*) located at the centre of the maps indicated the thematic areas of greatest scientific activity. On the other hand, in the interpretation of the density view, it was the colour of the groupings that were taken into account, which represented the areas with the highest degree of interrelation between keywords. The density view was especially useful to identify core-terms in each time period and to obtain a global view of the areas of greatest research activity.

Analysis of the results from the period 2008-2012 revealed that the main trends in research were marked mainly by the irruption of web 2.0 into the media and by changes brought by new platforms on the internet. The maps reflected the following focuses of interest:

1) The impact of the transition from unidirectional to bidirectional communication, in which the user is able to generate content and is involved in editing, publication and exchange of information.

2) In this new technological environment, and as a consequence of the resulting connections, the incipient 2.0 communication platforms emerged that allowed users to communicate through networks such as *Twitter* and *Facebook*.

3) Another thematic group, although of lesser importance, was dedicated to computer-mediated communication (CMC) and its contribution to social communication, where the developing interest in a new kind of journalism could be appreciated –the so-called citizen journalism in which members of the public who are not media professionals come together on a website to share news, or add to information published in the media.

4) Also as a consequence of this new digital environment, the first attempts at adapting traditional public relations to the communicative tendencies of web 2.0 were experienced – thus facilitating the interactive communication of an organisation with its public via the internet.

The analysis of the results of the maps corresponding to the period 2013-2017 revealed the strong impulse for, and consolidation of, research on social networks such as *Facebook* or *Twitter* in the media. The maps reflected the following focuses of interest:

1) The interconnection of Social Media, especially *Twitter*, with journalism and political communication. A high density area was distinguished in this thematic category, and it was possible to appreciate the fundamental change taking place within the information landscape –a change that allowed for an increased ability to generate news and share them with, and receive them from citizens, and that is also causing a breakage of the traditional mass media's monopoly on information.

2) The widespread use of collaborative environments for corporate and marketing communication, and the new landscape of public relations, thus causing the inclusion of Social Media in communication strategies, which has meant a change in the typical communication model.

3) The contribution of social networks to political activism and social movements during this period was visualised in the relevance of social networks in transforming the communicative dimension of social movements and political participation. Keywords such as 'arab spring' or political activism in 'China' were clear examples of this phenomenon.

4) The configuration of a new form of digital identity and social relations in processes of socialisation, with special emphasis on shaping the identity of young people and adolescents.

5) The use of new communication management strategies (partly in order to minimise the negative impact of the shift in the typical communication model), which represented a significant change in the tackling of crises, and in which the use of social networks played a fundamental role.

6) Other properties that occupied a significant area of the maps were those related to new media and the processes linked to privacy, immediacy, interaction, connectivity, or new ways of watching television.

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Relevant changes were observed in the evolution of studies on Social Media in the last decade by comparing keywords that had the greatest relative increase in the number of occurrences between the two periods analysed. Communication researchers' growing interest in new media and changes in the ways of producing, distributing and consuming information in the context of digital platforms was verified. Specifically, the keyword 'Social Media' went from 89 occurrences during the period 2008-2012 to 859 during the period 2013-2017. Another significant increase was seen in the growth of the frequencies of the keywords '*Twitter*' and '*Facebook*', indicative of the transformation processes caused by the internet and social networks. There was also important growth in the frequency of terms related to journalism and to the multiple innovations that Social Media generated in favour of the consolidation of citizen journalism and new ways of promoting these initiatives. Data also revealed the growth, during the 2013-2017 period, of keywords related to the ability of social networks to transform political communication and participation, (such as 'political communication' or 'political participation'), and their ability to become tools to influence political processes as well as instruments for measuring social movements and public opinion. Also, and as a consequence of the revolution of these new platforms, researchers focused on the tendencies of organisations to pay more attention to social networks during crisis management and to minimise the effects that this new context would be having, as was indicated by the increase in the number of occurrences of the keyword 'crisis communication'.

Comparison of the maps did also generate relevant data. Between 2008 and 2012, the main centres of interest are predominantly focused on the emergence of internet technologies and tools that promote collaborative work. The most relevant nodes during this period corresponded to the keywords 'internet' and 'web 2.0'. In this incipient phase, interest was focused on the new challenges that were being posed in the field of media, with the birth of the new digital environment that was causing citizens to become producers of information, through forums, blogs and social networks. During both periods, an impact of the internet on democratisation and social movements was observed. However, during the 2013-2017 period, interest in the impact of internet use on political activism increased. In the same 2013-2017 period, maps showed that research on web 2.0 was already over, and the most relevant nodes corresponded to the keywords *'Twitter'* and '*Facebook*'. In this most recent stage, the upward trend of research on social networks was observed, particularly the *Twitter* media orientation network and its strong link with journalism, public relations, corporate and political communication, and the influence of social network comments on television content. Finally, in the 2013-2017 period, researchers began using keywords that reflected a new field of interest in Social Media research: that which related to data. These challenges were manifested in the use of keywords related to the user-generated content on social networks, or the use of big data technology, aimed at managing the great amount of data that is generated in social networks and that can potentially be extracted in order to obtain relevant information.

7. Conclusions

In this work, we have mapped, explored and analysed the evolution of research on Social Media during the periods of 2008-2012 and 2013-2017 through the analysis of co-words, in combination with visualisation techniques, which proved to be an effective procedure for examining the main multidimensional and changing trends in this scientific field. From the co-occurrence of the keywords detected in the scientific production indexed in the WoS Communication category, the quantitative methodology used allowed for the identification of thematic groups of keywords, which were represented in science maps. From the analysis and interpretation of the resulting images, a series of conclusions were drawn.

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A downward trend in research on web 2.0 was detected in the period 2013-2017, and it was found that these studies seem to be resolved. There was also an emerging trend due to the enormous magnitude and potential of social networks in multiple sectors of the media, especially of *Twitter* and *Facebook* –such as the dissemination of content to increase audience sizes, activism and political transformations, public relations, management of crisis communication, publicity, participatory journalism, political communication, or the configuration of digital identity with special emphasis on adolescents. The maps also showed an upward trend in work on transformation and digital convergence, fostered by the use of the internet and digital telecommunications technologies in which the audience became a medium of social communication capable of influencing public opinion. Finally, an emerging development was found that was aimed at managing big data, together with the use of social networks, and which was interpreted as a shift in the management of communication. The foundations of this innovation focused on the application of big data and automatic content analysis, public relations between agencies and clients, or new forms of content distribution within organisations through influencers and engagement with networks. Although the challenges of Social Media are unknown, the analysis of the data could mark a future trend in this field of research.

As a general conclusion, this work has made possible to convert data extracted from textual information in scientific publications that could not be directly perceived, into visual information. The analysis made it possible to observe the data in a different, global way, by providing reduced representations of reality in order to achieve a better perception and understanding of the research on Social Media carried out by experts in the field.

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