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# The Impact of Term Fake News on the Scientific Community. Scientific Performance and Mapping in Web of Science

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**Abstract:** Nowadays, multiple phenomena have promoted an impact on society, constituting in some cases, not only a contribution of benefits but also of risks. Among them, the fake news phenomenon is considered one of the most burning phenomena today due to the risk it poses to society. In view of this situation, the research community has carried out numerous studies that seek to address this issue from a multidisciplinary perspective. Based on this, the objective of this work was to analyze the productivity and, therefore, the impact of this topic in the research community. To this end, this work advocated a scientometric-type methodology, through scientometric laws, impact indicators, and scientific evolution of 640 publications of the web of science (WOS). The results showed the impact of the fake news discipline today, which is considered an emerging issue that is of interest to many knowledge disciplines around the world. Likewise, the results showed that the publications not only have a focus on analyzing the veracity or not of the news, but that it begins to vertebrate a new line of an investigation directed to the informational education and towards the prevention of the consumption of this type of news through the internet.

**Keywords:** fake news; disinformation; internet; scientometrics

## 1. Introduction

Today's society is in constant innovation and change. The arrival of information and communication technologies (ICT) has brought many benefits to the lives of citizens. Among them, the immediate access to information through different web portals allows society to keep up to date with the latest news and information developments worldwide (Kwak et al. 2018; Jamil et al. 2015).

However, the political, media, and social use of the concept of news has led to numerous exercises in information manipulation. The ease of publication on the digital network has meant that informative material can be distributed with minimal or no contrast of sources. Nowadays, these "informative scoops" are called fake news (Zhang and Ghorbani 2020).

The term fake news was chosen as the 2017 word of the year by the Collins dictionary, which defines it as: "false, often sensationalist, information intentionally disseminated under the guise of news". They are, therefore, mostly politically motivated news, aimed at manipulating citizens. It is, therefore, pertinent to distinguish between the concept of fake news and news that is biased and, therefore, unintentionally does not tell the truth (Tamul et al. 2019).

This idea is linked to one of the most important events in which the term fake news was most relevant. In 2016, with Donald Trump's victory in the US elections, several investigations confirmed that

a total of 115 false news items were produced in favor of the current US President during the election campaign period. These news items were shared through Facebook 30 million times, compared to 41 fake news in benefit of Hillary Clinton shared in 7.6 million occasions (Valero and Oliveira 2018; Allen and McAleer 2018; Allcott and Gentzkow 2017).

It is significant to address the origin of fake news and why it is written and shared through social media. It is pertinent to differentiate their origin, between those that are not created by humans and those that are. In the first case, these are social bots and cyborgs that are designed to present human-like behavior and automatically produce content and interact with humans in social media (Ferrara et al. 2016; Zaboski and Therriault 2019). On the other hand, there are the human-designed and distributed fake news, which becomes news propagators through the web. It is especially common for fake news to be distributed through social groups on social networks, generating a blushing echo among the digital community (Shu et al. 2017).

Since then, the increase in fake news on the digital network has been such that in the latest Eurobarometer survey, 83% of respondents stated that they were concerned about deliberate misinformation, especially in order to target and influence future polling days. This is a phenomenon that has been gaining prominence and whose arrival has had a negative impact on various spheres of life by producing a distortion of reality. This action, in turn, has led to a controversial social atmosphere and a feeling of confusion among citizens (Ricoy et al. 2019).

As a result, the study of fake news has proliferated in recent years. Research on identifying false news can be discerned in different directions. Firstly, there are those who claim to cover the detection of fake news through the creation of technological models, mostly of artificial intelligence, that allow the revision of texts and check for any false news (Ricoy et al. 2019; Yavary et al. 2020).

On the other hand, some important international proposals stand out, such as the Cairncross review: prepared by the British government on information sustainability or the European Commission's report on online misinformation, among whose measures it includes a code of good practice to fight this dangerous phenomenon (Keenan and Dillenburger 2018; European Commission 2018).

In short, another challenge facing the research community in this discipline is to prepare the public for the mass circulation of fake news. Among the main focuses of its broadcast, social networks are the main sources of distribution of fake news today, especially on Twitter and Instagram, which have proved to be true engines of political dissemination (Guess et al. 2019; Vosoughi et al. 2018; Wineburg and McGrew 2019). In essence, fake news is news whose headlines are usually shocking and eye-catching so that the user can access it: it is the clickbait phenomenon ("cyber-shooting") (Himma-Kadakas 2017). In this line, there are many investigations that aim to identify and stop the "information hoaxes" that are promoted through social networks. This is a study that works on the development of models that analyze the combinations of lexicon, syntax, and semantic information of the text to determine the veracity of the news (Kapusta and Obonya 2020; Barton 2019; Zakharov et al. 2019; Conroy et al. 2015).

Therefore, and in relation to the above, one of the challenges proposed by the research community with the arrival of the fake news is to carry out training in citizens to enable them to detect fake news. To achieve this objective, the development of digital competence, more specifically, in information and information literacy, is the main training challenge to face the information society in which we live. Specifically, it is essential that from an early age, young people become familiar with strategies for searching for reliable information, differentiating truthful sites from those that are not, as well as knowing some of the characteristics that make up false information (Trujillo-Torres et al. 2020; McDougall et al. 2019). In line with this idea, the Cost report (Vraga and Tully 2019) on digital literacy in Europe, whose conclusions were oriented towards the need to promote education based on digital skills, aims that the education system should promote the training of future citizens capable of surviving in a digital and information-saturated society. To this end, it is recommended that this procedure should begin, especially at an early age, with the aim of establishing solid and quality teaching standards (González-Fernández et al. 2016).

In parallel, other experts add media literacy as a social need, understood as the ability to access and analyze the media according to different ways of presenting information (European Commission 2018; Aguaded Gómez et al. 2015; McNair 2018; Harsin 2018; Marda and Milan 2018). This is a field that encompasses different dimensions: language; technology; the processes of interaction, production, and dissemination; the critical analysis of information and aesthetics (Claire and Derakhshan 2017).

We must bear in mind the psychosocial impact that fake news can have on the population. When we talk about psychosocial aspects, we refer to the relationship that an individual has with his social environment (López and Aguaded 2015). Therefore, when we refer to the psychosocial impact, we are referring to the impact generated by one individual, or several individuals, a fact generated in the social environment (Anderson and Clarke 2019). This can lead to a series of psychosocial risks, understood as the aspects of the social environment that can cause the individual psychological, social, or physical harm (Saxby et al. 2019).

In short, it is a problem at a global level and whose repercussions are alarming. In view of this situation, the arrival of fake news has begun to be a trend in publications of impact in recent years on the research scene. For this reason, this paper aimed to measure the existing scientific production of impact on fake news, in order to analyze the psychosocial impact of the subject on the scientific community.

## 2. Research Objectives

As this is a recent issue, this paper sought to establish a state of play on the existing scientific productivity of fake news in the research community. To this end, some objectives that were solved in this work are raised below:

- Determine the academic performance of the fake news theme in the web of science database.
- Establish the source of fake news research in the web of science database.
- Know the scientific evolution of the fake news topic in the years of scientific production.
- Determine the most relevant topics in the research developed on fake news in the web of science.
- Identify the specific contribution pattern of authors who research on fake news.
- Know the distribution pattern of scientific documents in the research journals that publish on the fake news topic.

## 3. Methodology

This study followed the guidelines set by scientometric studies in the field of education (Maciag et al. 2019; López Belmonte et al. 2019). Likewise, the premises on document tracking and analysis of scientometric analyses of contrasted documents were followed to guarantee the optimum development of the research (Guerrero 2019; Cobo et al. 2011). The reason why this research technique was used was due to the potential of scientometrics in aspects concerning the quantification, evaluation, and estimation of the evolution of a field of knowledge in question (Martínez et al. 2015).

### 3.1. Procedure

First, the search descriptors, extracted from the Eric Thesaurus related to the main theme, were established. In this way, the following search equation was established: "fake news". The use of a single descriptor is to identify the study by the scientific community in the "fake news" concept (Rodríguez-García et al. 2019). The search was established by title, abstract, and keywords.

The literature search took place in the database with the greatest international impact: web of sciences (WOS), considered an online service of scientific information, developed by Clarivate, being the reference base for Journal Citation Reports (JCR), which collects documents of impact in the field of social sciences. The main criteria for inclusion were the scientific journals since they are the ones that set the best quality standards due to the fact that they go through exhaustive editing and reviewing process (Moreno-Guerrero et al. 2020). The search took place in December 2019.

The flow chart following the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) declaration shows the refining process until the final sample of documents was obtained (Figure 1).
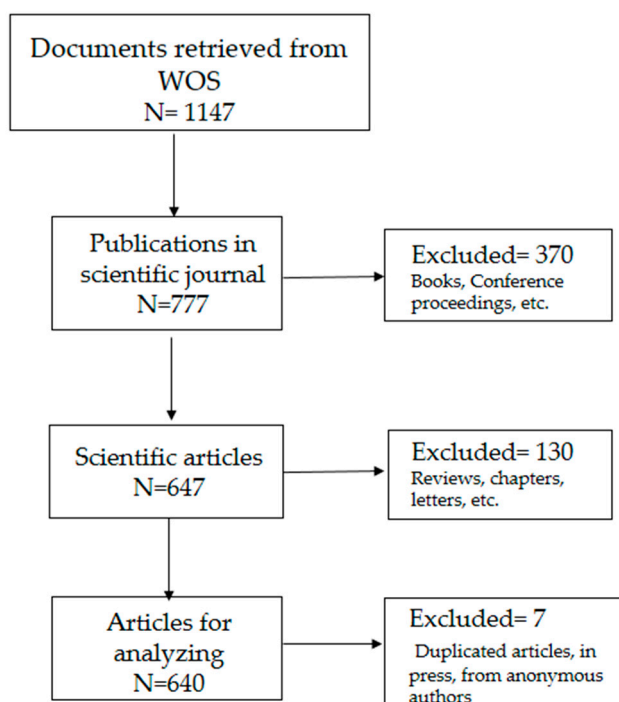


**Figure 1.** Flow chart of the refining process according to the PRISMA declaration. Own elaboration.

After the application of the inclusion and exclusion criteria, a sample of 640 articles ($n = 640$) was obtained for analysis. Therefore, through the research questions previously drafted, the objectives of the research were established, and scientometric indicators were associated with them to provide answers (Table 1).

**Table 1.** Objectives, research questions, and scientometric indicators that provide answers.

| Objetive | Question | Indicator |
|---|---|---|
| Evolution of scientific productivity (A) | When did the investigative treatment of fake news in education originate? How has the fake news evolved in the scientific community? | A1. Number of articles and years of publication A2. Diachronic productivity and price law |
| Characteristics of journals and dispersion of scientific production (B) | What are the main magazines that publish about fake news? How are the articles distributed in the total number of producing magazines? | B1. Most productive magazines about fake news. B2. Bradford law. |
| Author productivity and more prolific institutions (C) | Who are the most prolific authors? What are their citation level and the impact rate? What are the most productive institutions? Does the level of contribution of the authors follow a certain pattern? | C1. List of journals plus producers about fake news. C2. List of the most prolific institutions. C3. List of authors with higher productivity on fake news. Lotka's law. |
| Relationship between key concepts of the analyzed sample (D) | What is the scientific evolution of fake news in the years of scientific production? What topics are most influential in the fake news concept? | D1. Map of connection between key descriptors D2. Analysis of fake news' thematic performance |

### 3.2. Data Analysis

The data analysis was carried out from the information collected from the web of sciences (WoS), and the processing and management of the data were done through Excel and SciMAT. Finally, the mapping of key descriptors was carried out through VosViewer. First, diachronic productivity was ascertained, in order to observe the trend of productivity, on the subject over the years. At the same time, we started from the premise dictated by Price's law to check if the distribution of publications on fake news responds to exponential growth (Price 1986).

Later, Bradford's law was used to establish a quantitative relationship between the journals and the scientific articles contained in the collected bibliography (Brookes 1977). After this, we investigated the most prolific authors, institutions, and journals on the subject, in order to find out the publication focuses on the fake news' research. In relation to this question, the Lotka law was advocated, with the aim of establishing binding relationships between authors and journals, and to be able to bring together the authors who contribute most to the development of the line of research (Macroberts and Macroberts 1982).

Finally, the research was directed towards the analysis of keywords, through the development of a map of key descriptors with VosViewer, which allowed to find out the terms most used by the authors when directing their scientific work on fake news (Van Eck and Waltman 2010). Finally, structural and dynamic development was analyzed through a co-word study (Zupic and Čater 2015), taking into account as main indicators the h-index and the number of citations (Asemi and Ebrahimi 2020) to elaborate scientific maps where parameters, such as yield and location, are collected, and conceptual subdomains are established, to identify thematic development (Hirsch 2005). In addition, other indicators, such as the g-index, h-g-index, and q2-index, were used to further complete the information presented. The program used to carry out this analysis was SciMAT (Cobo et al. 2011), which was developed in four phases:

- Recognition: It consisted of analyzing the keywords provided by the scientific literature ($n = 2415$) and elaborating on a co-occurrence map by means of nodes, generating a standardized network of co-words, thus obtaining the main themes ($n = 2373$). The clustering algorithm defined the topics, as well as the concepts with more attraction between them.
- Reproduction: With the previous data, a strategic diagram and thematic network were generated based on the principles of centrality and density. The graphic representation was configured in four sectors: (1) Upper-right = motor and relevant themes; (2) Upper-left = consolidated but isolated themes; (3) Lower-left = themes in development or in disappearance; (4) Lower-right: transversal themes with little development.
- Determination: The study periods were then established, in this case, three (I1 = 2005–2017; I2 = 2018; I3 = 2019), to classify and analyze the generated topics. The periods were established, having as a criterion the equity of documents, trying at all times to maintain an even number of documents in the generated periods.
- Performance: Finally, the connections were obtained, both of the generated topics and of the keywords. This was done, thanks to the unit of analysis that determined the unit of evaluation containing the keywords established by the authors in the documents, the keywords established by WoS, and the keywords of the authors in different publications. Another indicator—the frequency threshold—was used to determine the minimum frequency of the intervals. The type of network allowed the elaboration of a network of co-occurrence of keywords and authors (co-words). The coincidence union value allowed to articulate the established intervals. The normalization measure determined the binding threshold, revealing the minimum connection of the occurrence. To normalize the connections, the equivalence index $e_{ij} = c_{ij}2/\text{Root} (c_i - c_j)$ was performed. The clustering algorithm, by means of simple centers, was used to make the map of themes and related sub-networks. The evolutionary measure, through the Jaccard Index, was used to

determine the similarity measure that produced the evolutionary map and the transition map through the inclusion rate (Table 2).

**Table 2.** Production indicators and inclusion criteria.

| Configuration | Values |
|---|---|
| Analysis unit | Keywords authors, keywords WoS |
| Frequency threshold | Keywords: $I_1 = (2)$, $I_2 = (2)$, $I_3 = (2)$ |
| Network type | Co-occurrence |
| Co-occurrence union value threshold | Keywords: $I_1 = (1)$, $I_2 = (1)$, $I_3 = (2)$ |
| Normalization measure | Equivalence index |
| Clustering algorithm | Maximum size: 9; Minimum size: 3 |
| Evolutionary measure | Jaccard index |
| Overlapping measure | Inclusion rate |

Note: $I_1$: The period from 2005 to 2017; $I_2$: the period from 2018; $I_3$: the period from 2019.

## 4. Results

### 4.1. Evolution of Scientific Productivity

In relation to scientific production, the diachronic sequence was elaborated in which it was visualized that the theme of the fake news has existed since the last years (Figure 2). Its first publication as a scientific article in the web of science took place in 2005. However, the development of articles did not obtain a growing trend until 2017 when there was exponential growth, from 57 articles to 215 in 2018. In 2019, the production of publications increased slightly to 224 articles.
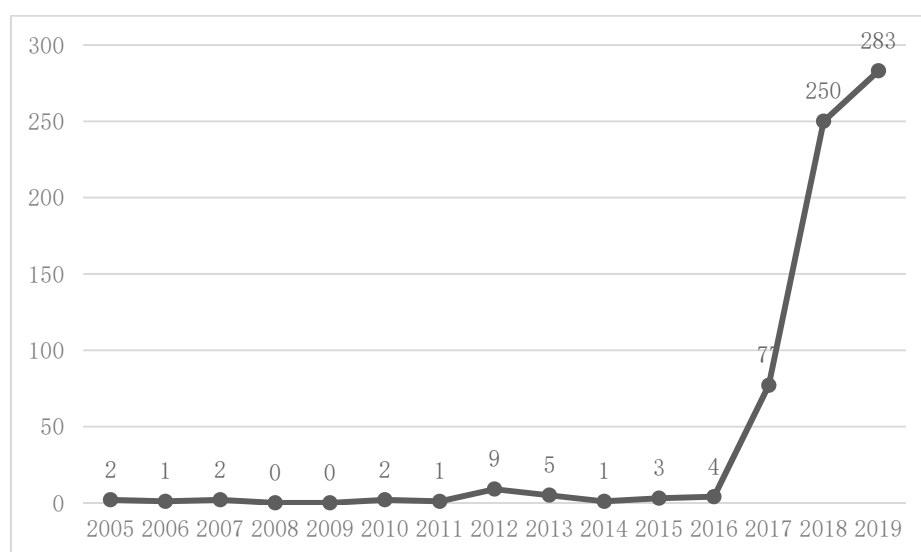


**Figure 2.** Diachronic productivity of fake news in the web of sciences database.

In this sense, if we started from Price's law on the growth of scientific information, it was visualized that in the case of fake news and its productivity, this premise was fulfilled. Despite not being exact, it showed how, after 10 years of the existence of fake news in the scientific panorama, exponential growth in productivity was produced. Likewise, the data for 2019, which expressed a slight increase, allowed us to elucidate the idea that the subject matter is in a phase of linear growth.

### 4.2. Characteristics of Journals and Dispersion of Scientific Production

In order to analyze the dispersion among the articles and how they are grouped in the journals in which they have been published, Bradford's law was used. This premise indicated that a few journals

that made up the core concentrated the same or a similar number of articles as would be found grouped in the rest of the areas (Brookes 1977). Thus, Figure 3 shows the three zones (core, zone 1, and zone 2) established according to this law. As could be seen, the nucleus was made up of only 29 journals that contained a similar number of articles to those in zones 1 and 2, with much higher numbers of journals.
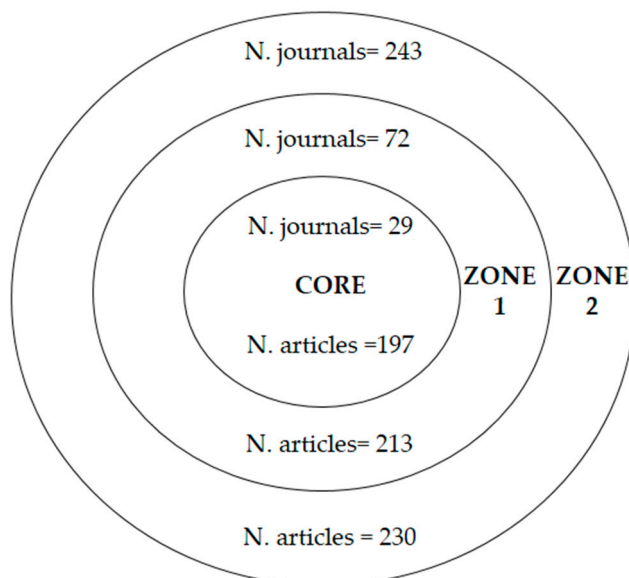


**Figure 3.** Areas of Bradford, where fake news articles and magazines are distributed produced in-house.

### 4.3. Author Productivity and Most Prolific Institutions

In recent years, the productivity of fake news has been gaining prominence in different magazines, institutions, countries, and authors from many different backgrounds. Firstly, we analyzed which journals have the largest number of publications on fake news. A distinction was made between the ten journals that contained the largest number of articles on fake news, in addition to the citations they received and their impact rate (Table 3).

**Table 3.** Journals with the most scientific articles on fake news.

| Journal | N°doc | % | Cites | Impact Index (I) | Publisher |
|---|---|---|---|---|---|
| Profesional de la información | 19 | 2.94 | 16 | 0.842 | Taylor and Francis |
| Journal of American Folklore | 13 | 2.16 | 56 | 4.31 | American Folklore Society |
| International Journal of Communication | 11 | 1.70 | 11 | 1 | University of South California Annenberg Press |
| Cultura y Educación | 7 | 1.08 | 0 | 0 | Taylor and Francis |
| Digital Journalism | 7 | 1.082 | 132 | 18.86 | Taylor and Francis |
| Public Integrity | 7 | 1.802 | 2 | 0.29 | Taylor and Francis |
| Computers in Human Behavior | 6 | 0.927 | 35 | 5.83 | Elsevier |
| Journalism Practice | 6 | 0.927 | 62 | 10.33 | Taylor and Francis |
| El Profesional de la Información | 6 | 0.927 | 14 | 2.33 | Editorial UOC |
| Journal of Media Law Ethics and Policy | 6 | 0.927 | 1 | 0.16 | Taylor and Francis |

Thus, three journals were detected: Information Professional with 19 articles, Journal of American Folklore with 13, and International Journal of Communication with 11 contributions. The rest of the journals contained a similar amount of scientific articles. However, when analyzing the impact index of the documents, it was observed that the Digital Journalism and Journalism Practice journals were those whose articles received the highest number of citations.

The institution that developed more scientific production on the subject of "fake news" was the University of Texas. In sum, it was visualized that there were several institutions that accumulated a considerable number of scientific documents on the subject of interest. Likewise, all the contributions had been cited, although, in particular, those from New York University, whose impact rate was the highest on the list (Table 4). Finally, it is worth noting the wide presence of institutions from the United States (five in total), followed by the United Kingdom, Australia, and Spain.

**Table 4.** Most prolific institutions on fake news.

| Institution | N°doc | % | Cites | Impact Index (I) | Country |
|---|---|---|---|---|---|
| University of Texas System | 10 | 1.546 | 30 | 3 | United States |
| Harvard University | 8 | 1.236 | 36 | 4.5 | United States |
| Nayang Technological University | 8 | 1.236 | 120 | 15 | Singapore |
| New York University | 8 | 1.236 | 372 | 46.5 | United States |
| University of California System | 7 | 1.082 | 20 | 2.86 | United States |
| University of Oxford | 7 | 1.802 | 12 | 1.71 | United Kingdom |
| California State University System | 6 | 0.927 | 10 | 1.67 | United States |
| Deakin University | 6 | 0.927 | 15 | 2.5 | Australia |
| Universidad de Londres | 6 | 0.927 | 12 | 2 | United Kingdom |
| UNED | 6 | 0.927 | 2 | 0.34 | Spain |

Finally, with regard to the most prolific authors (Table 5), the analysis carried out revealed that most of the authors had not produced a large number of articles on the subject. In particular, Pennycook and Tandoc stood out with four contributions each. With regard to the number of citations and, therefore, the impact index of their publications, the publications of Allcot and Tandoc stood out, especially as their impact index was considerable.

**Table 5.** Most prolific authors, publishing articles on fake news.

| Author | N°doc | % | Cites | Impact Index (I) | University |
|---|---|---|---|---|---|
| Pennycook, G. | 4 | 0.618 | 41 | 10.25 | United States |
| Tandoc, E.C. | 4 | 0.618 | 110 | 27.5 | United States |
| Rand, D.G. | 3 | 0.464 | 41 | 13.67 | Singapore |
| Reilly, I. | 3 | 0.464 | 16 | 5.33 | United States |
| Romero-Rodríguez, L.M. | 3 | 0.464 | 4 | 1.33 | United States |
| Baxter, G. | 2 | 0.309 | 1 | 0.50 | United Kingdom |
| Ahiaga-Dagbui, D. | 2 | 0.309 | 12 | 6 | United States |
| Al-Rawi, A. | 2 | 0.309 | 1 | 0.50 | Australia |
| Allcott, H. | 2 | 0.309 | 337 | 168.50 | United Kingdom |
| Amazeen, M.A. | 2 | 0.309 | 29 | 14.50 | Spain |

In addition, we used the Lotka's law, referring to the productivity of authors on a scientific subject, in which it is stated that there is a small group of experts who carry out a greater scientific production and that the rest make a minimal contribution to the field of knowledge in question (Macroberts and Macroberts 1982). In this case, the premise was verified by finding a minimum group of authors with more than one publication on fake news. The rest, out of the total of 542 authors analyzed, had only produced one article on the subject. This was confirmed by the logarithmic regression elaborated from the data distribution, whose R coefficient corroborated its adequacy (Figure 4).
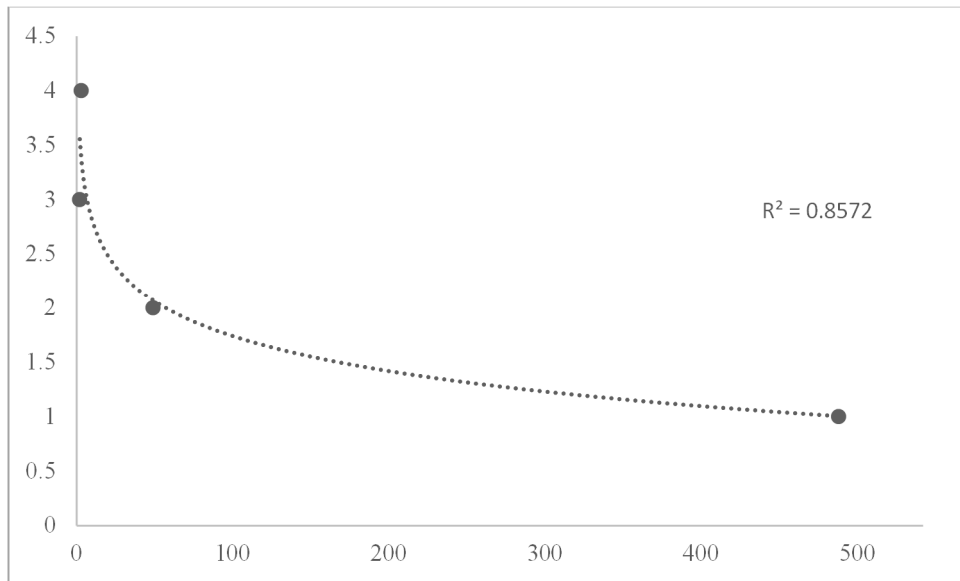
**Figure 4.** Representation of article contribution by author and logarithmic trend of the data.

*4.4. Relationship between Key Concepts of the Analyzed Sample*

4.4.1. Map of Connection between Descriptors

Lastly, a map of key descriptors was drawn up using the VosViewer software, which made it possible to establish the links between all the keywords in the different abstracts of the 640 articles analyzed (Figure 5). The results of the analysis elucidated the existence of four clusters of key descriptors. Firstly, there was the set of green descriptors, which was the one that contained the largest number of descriptors, the most prominent being the concept "news", followed by "social medium", "journalist", or "user". Consequently, it was followed by the red cluster, in which outstanding concepts, such as "truth", "society", and "journalism", were elucidated. This was followed by the blue cluster, in which the words "information", "source", "student", or "education" were highlighted. Finally, a small group of key concepts was shown in yellow, in which descriptors, such as "credibility" or "effect", were found.
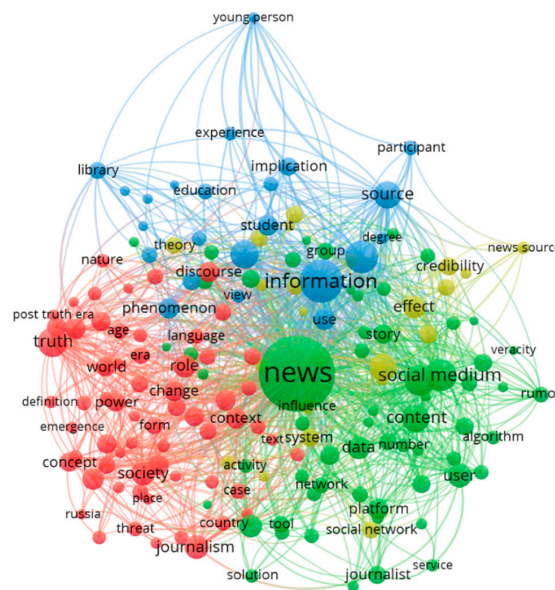


**Figure 5.** Map of key descriptors about fake news.

### 4.4.2. Analysis of the Evolution of Key Concepts

The results shown in Figure 6 showed the evolution of keywords in the three periods analyzed, providing information on the words that come out of a certain period, those that are included as new, and those that coincide between the established time intervals. In this case, we could see an evolution in the number of keywords, which was increasing over time. In addition, the percentage of coincidence was between 25% and 30%, which showed a stable line of research, but which marked new trends and new fields of research on fake news.
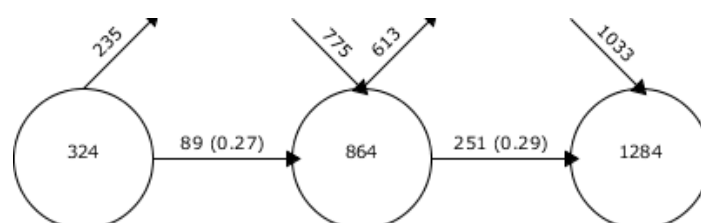


**Figure 6.** Continuity of keywords between contiguous intervals.

The thematic performance in the three established time intervals showed the keywords with the highest scientometric indicators in each of them. In all three periods, the "fake news" theme had the highest scientometric indicators (Table 6).

**Table 6.** Thematic performance in fake news.

| Interval 2005–2017 | | | | | |
|---|---|---|---|---|---|
| **Denomination** | **Works** | **h-Index** | **g-Index** | **Hg-Index** | **$q^2$-Index** | **Cites** |
| Literacy | 5 | 3 | 5 | 3.87 | 7.14 | 49 |
| Parody | 2 | 2 | 2 | 2 | 6.78 | 40 |
| Fake news | 17 | 6 | 14 | 9.17 | 16.06 | 292 |
| Science | 8 | 5 | 7 | 5.92 | 9.49 | 566 |
| Jon-Stewart | 4 | 4 | 4 | 4 | 8.94 | 261 |
| Accounts | 2 | 2 | 2 | 2 | 2 | 4 |

| Interval 2018 | | | | | |
|---|---|---|---|---|---|
| **Denomination** | **Works** | **h-Index** | **g-Index** | **Hg-Index** | **$q^2$-Index** | **Cites** |
| Impact | 4 | 2 | 3 | 2.45 | 5.83 | 24 |
| Community | 2 | 1 | 1 | 1 | 2 | 4 |
| Skills | 5 | 1 | 1 | 1 | 1.41 | 4 |
| Digital health | 7 | 2 | 3 | 2.45 | 3.46 | 11 |
| Social networks | 4 | 2 | 3 | 2.45 | 3.16 | 9 |
| Verification | 11 | 5 | 9 | 6.71 | 8.06 | 88 |
| Politics | 6 | 2 | 3 | 2.45 | 3.16 | 11 |
| Fake news | 74 | 14 | 22 | 17.55 | 16.73 | 568 |
| Rumors | 5 | 3 | 4 | 3.46 | 3.87 | 25 |
| Science | 5 | 3 | 3 | 3 | 3 | 12 |
| Performance | 6 | 2 | 4 | 2.83 | 4.9 | 20 |
| Twitter | 10 | 3 | 5 | 3.87 | 4.24 | 29 |
| Populism | 5 | 2 | 4 | 2.83 | 7.35 | 32 |
| Media literacy | 4 | 2 | 3 | 2.45 | 6 | 22 |
| Exposure | 2 | 1 | 1 | 1 | 1 | 1 |
| Political satire | 2 | 2 | 2 | 2 | 3.46 | 8 |
| Mass media | 2 | 0 | 0 | 0 | 0 | 0 |

**Table 6.** *Cont.*

| | | | Interval 2019 | | | |
|---|---|---|---|---|---|---|
| **Denomination** | **Works** | **h-Index** | **g-Index** | **Hg-Index** | **q²-Index** | **Cites** |
| Web | 10 | 1 | 2 | 1.41 | 1.73 | 6 |
| BIAS | 11 | 3 | 5 | 3.87 | 4.9 | 35 |
| Fake news | 154 | 6 | 11 | 8.12 | 10.39 | 193 |
| Political communication | 12 | 1 | 2 | 1.41 | 1.73 | 5 |
| Information | 12 | 2 | 3 | 2.45 | 4 | 17 |
| Media literacy | 11 | 2 | 2 | 2 | 2.45 | 7 |
| Trust | 8 | 2 | 2 | 2 | 2.83 | 7 |
| Social network | 6 | 1 | 1 | 1 | 1 | 1 |
| Sales | 2 | 1 | 1 | 1 | 2 | 4 |
| Perspective | 3 | 0 | 0 | 0 | 0 | 0 |
| Russia | 3 | 1 | 1 | 1 | 1.41 | 2 |
| Persuasion | 3 | 1 | 1 | 1 | 1.41 | 2 |
| Science | 4 | 2 | 3 | 2.45 | 3.46 | 9 |

The three diagrams, based on the three periods generated (Figure 7), provided information on the relevance and importance of the themes analyzed in each of the periods analyzed. In the first period, the driving themes were "parody" and "literacy", while "fake news", which had the highest h-index, was positioned as the basic and transversal theme. In the second period, the number of driving topics increased, in this case, being "impact", "social networks", "skills", "verification", and "digital health". Similar to the first period, "fake news", although it had a higher h-index, was positioned as a basic and transversal theme. In the last and third periods, the driving themes were "BIAS", "political communication", "web", and "fake news".
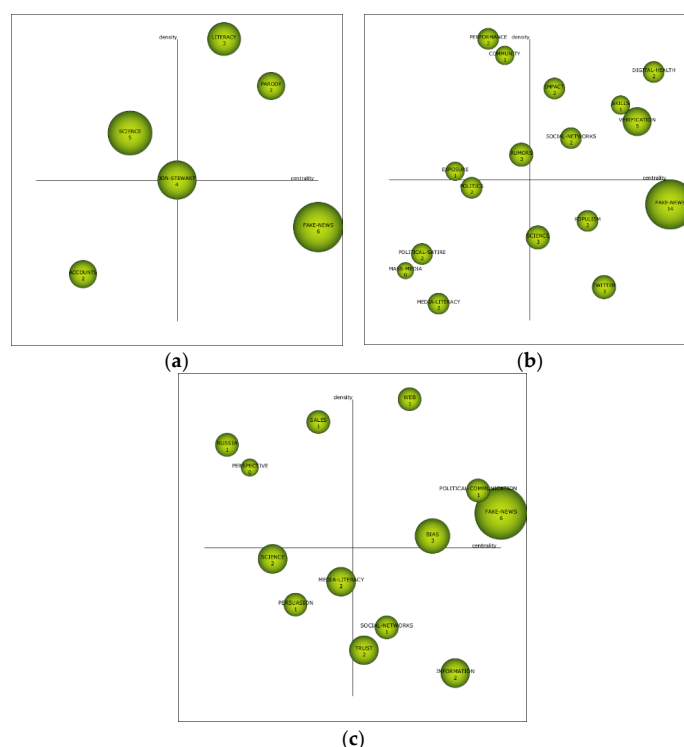


**Figure 7.** Strategic diagram by fake news' h-index. Note: (**a**) Interval 2005–2017; (**b**) Interval 2018; (**c**) Interval 2019.

The thematic evolution presented us with the strength of association given between the generated themes and the different established intervals, having, in this case, the Jaccard index as a reference. The evolution of a theme is established when they share keywords with the previous or subsequent periods. The more keywords or themes have the themes in common, the greater the relationship between them. The two types of connections that can be generated are by keywords, which are represented by discontinuous lines, and by themes, which are shown as continuous lines. The greater the strength of the relationship, the greater the thickness of the line.

Taking into account the results obtained in Figure 8, it could be seen that there was thematic continuity between the intervals analyzed, given that "fake news" was repeated in all three periods, by means of a thematic connection, with the connection between the second and third period being the one that presented the greatest strength. The connections given between the first and second periods were mainly through keywords, while between the second and third periods, the relations were mainly thematic. It was relevant that in the second period, themes, such as "media literacy" and "social network", were based on time. In this case, the research moved from an analysis of events and facts about "fake news" to re-education of values about the use and consequences marked by this theme.
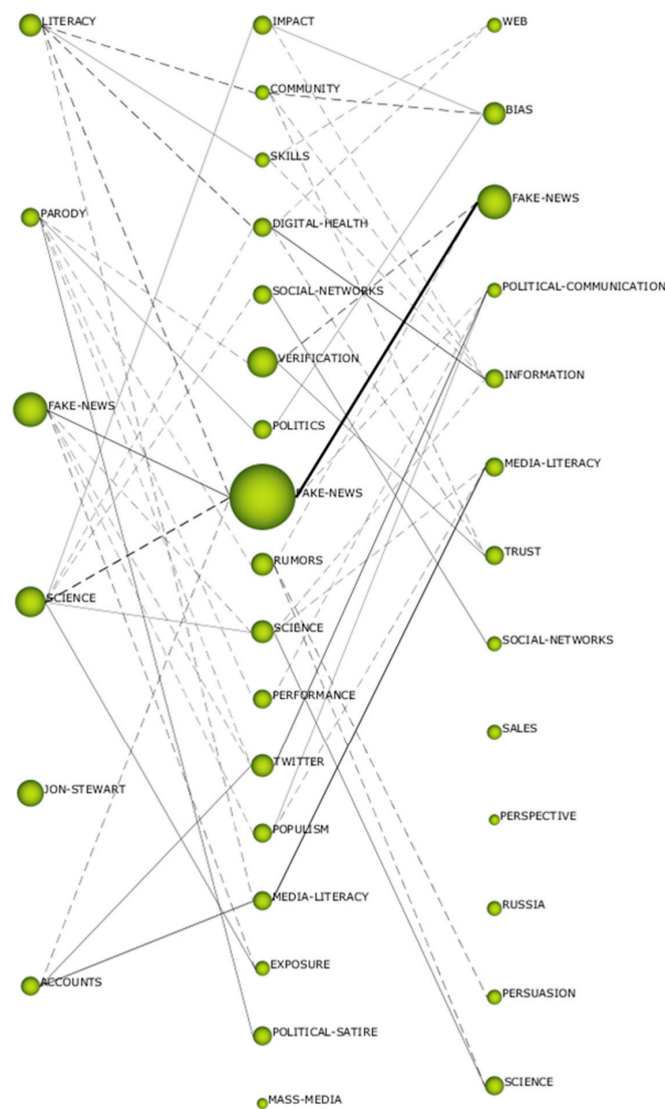


**Figure 8.** Thematic evolution by h-index.

## 5. Discussion

The appearance of the fake news phenomenon has burst into the scientific community in a dizzying way. The proliferation of this disinformative phenomenon has led many researchers to focus their work on analyzing different aspects of the subject (Jamil et al. 2015).

The aim of this study was to establish a state-of-the-art based on scientometrics that would determine the current status of the fake news research line in the most prestigious database at present: web of sciences (WoS). Specifically, the aim was to indicate how it has evolved as a subject and to locate the main focuses of publication. The large percentage of manuscripts found belonged mainly to the journalistic area, linked to the importance of knowing the risk of this phenomenon and how to identify this type of news. However, an emerging number was also found concerning the educational branch, which allowed us to see that fake news is beginning to be a concern considered by the educational community in order to establish preventive measures that citizens are aware of (Zhang and Ghorbani 2020).

Firstly, the analysis of diachronic productivity allowed us to analyze that productivity on fake news suffered an exponential growth since its first publication. In just two years, its performance has increased considerably to date, which continues in this upward phase. As Price's law indicates, productivity is expected to continue to increase until it reaches a phase of linear growth (Price 1986). This corroborates that the social impact that the fake news phenomenon has had on the scientific community is both existing and current and that this is confirmed by the increase in publications on this subject (Tamul et al. 2019; Allcott and Gentzkow 2017).

In this sense, the study of Bradford's law provided an overview of how the articles in the study sample were distributed in relation to existing journals. The results made it clear that a small number of journals, which could be considered to specialize in the subject matter, accumulated a similar number to the rest of the group of journals in which articles on fake news were published, which contained a very small number (Brookes 1977). Thus, after investigating this idea, we analyzed the most prolific magazines, authors, and institutions in the field of fake news. In the case of the articles, it was found that the journals that publish articles on this subject reached more than a considerable number of citations, thus obtaining a high level of impact. This data allowed us to infer that publications on fake news are of interest to the scientific community, and they take these works as references when carrying out their projects (Valero and Oliveira 2018).

On the other hand, the co-word analysis provided the descriptors with the highest academic performance over the years on fake news, in addition to being able to visualize what the evolution of the topic has been over the years. The term fake news has contemplated publications from its origin to the present, but the adjacent descriptors have suffered changes over the years. Firstly, the first one differentiated descriptors, such as "fake news" "parody", "science", "accounts", or "political satire" from 2005 to 2017; "verification", "populism", "media literacy", or "politics"; the current period of 2019 with descriptors, such as "political communication" or "BIAS". As shown, there was a transformation in the descriptors that accompany "fake news". In the first place, the term alluded to the news that expressed in a parodic and comical way some events, which included political terms. However, nowadays, the phenomenon of fake news is associated with populist messages, mostly related to the political sphere, as previous studies have also stated (Allen and McAleer 2018; Ricoy et al. 2019; Zakharov et al. 2019). Likewise, the presence of descriptors, such as "Twitter" and "web", in the current interval corroborates the idea that the channel through which fake news is sent is social networks and, in general, the internet (Allcott and Gentzkow 2017). In short, the term "literacy" or "verification" can be found in all three periods considered, which means that the previous idea that there is a line of publications that covers the need for information literacy among citizens, as well as the need to combat this disinformative phenomenon through continuous training, can be corroborated (López and Aguaded 2015).

Finally, the analysis of the thematic evolution presented some strong links between the themes generated in the different time intervals. Thus, links, such as "accounts-media literacy-media-literacy",

"accounts-twitter-political communication", were distinguished, which could allude to the importance of having an information literacy that allows distinguishing whether the origin of the information is an official account or a fake one, as argued by authors in previous research (Trujillo-Torres et al. 2020). In addition, links between descriptors, such as "Parody-politics-BIAS", "Science-Impact-BIAS", confirmed, on the one hand, the importance of the concept of fake news, understood as news that parodies certain events, but which has the intention of influencing the population on a certain perception or idea (Kwak et al. 2018).

## 6. Conclusions

The emergence of fake news has had a considerable impact on society, causing a feeling of blushing and confusion about the information coming from the digital network. Its spread through the internet has made it one of the most alarming phenomena and concerns in society today. Research on this subject has become a reason for interest in the scientific panorama. Without a doubt, the threat that this phenomenon entails has caused researchers and, therefore, institutions all over the world to begin to study this subject in depth.

In this way, and based on the initial objective of the research, this work has determined the importance of the subject in the field of social sciences through the establishment of a systematic mapping in the most important database at the international level, the web of sciences (WoS). Likewise, the results of this work have allowed us to know that this is a line of research whose ascent is emerging but, at the same time, vertiginous.

Regarding the limitations of the study, it is found that the search for documents was only carried out on the web of sciences, being able to expand in more databases of international prestige, such as the case of Scopus. Similarly, the inclusion criteria when scrutinizing the sample of documents were chosen by the authors. With respect to future lines of research, the need to continue promoting research that evaluates the suitability of the news circulating on the network is advocated, as well as promoting an appropriate educational practice that warns students at different stages about this dangerous phenomenon.

In conclusion, the idea of continuing on the path of promoting healthy living habits with respect to digital health, especially when surfing the internet and consulting information, is stressed. To this end, it will be necessary for research on topics, such as fake news, to continue on a path that combines the eradication of the phenomenon, as well as education for the prevention of its consumption.

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