


Science journalism against disinformation: decalogue of good practices in the digital and transmedia environment

El periodismo científico ante la desinformación: decálogo de buenas prácticas en el entorno digital y transmedia

O jornalismo científico face à desinformação: um decálogo de boas práticas no ambiente digital e transmedia

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Abstract

In parallel to the impact of the Covid health pandemic, the fight against disinformation has become one of the main concerns of democratic societies and the media system itself due to its historical role as guarantor of the right to access to rigorous, contrasted, and quality information. The viralization of hoaxes, most of them through social networks, has led media and journalists to place verification processes as one of the cornerstones of their activity and to explore new narratives and publication strategies to reach audiences. In particular, the younger generations are increasingly disconnected from traditional communication environments. This context is revitalizing, redefining and placing science journalism in a strategic position: for what it implies in fact-checking processes and for the opportunity to improve engagement with the public. This research is structured on the basis of a solid corpus of interviews with academic and professional experts. The considerations and opinions of these specialists have made possible the elaboration of a decalogue of good practices oriented to the exploration of the transmedia ecosystem as a vehicle for innovation and promotion of media literacy.

Keywords: Science journalism; scientific literacy; misinformation; digital environment; fake news; transmedia narratives

Resumen

En paralelo al impacto de la pandemia sanitaria del Covid, la lucha contra la desinformación se ha convertido en una de las principales preocupaciones de las sociedades democráticas y del propio sistema mediático por su histórico papel como garante de libertades y derechos. La viralización de bulos, en su mayoría por redes sociales, ha hecho que medios y periodistas sitúen los procesos de verificación como uno de los ejes de su actividad y exploren nuevas narrativas y estrategias de publicación para llegar a las audiencias. En especial, a las generaciones de jóvenes cada vez más desconectadas de los entornos tradicionales de comunicación. Este contexto está revitalizando, redefiniendo y colocando al periodismo científico en una posición estratégica: por cuanto implica en los procesos de *fact-checking*, además de por la oportunidad de mejorar el *engagement* con el público. La presente investigación se construye a partir de un sólido corpus de entrevistas a expertos académicos y profesionales. Las consideraciones y opiniones de estos especialistas han posibilitado la elaboración de un decálogo de buenas prácticas orientado a la exploración del ecosistema transmedia como vehículo de innovación y fomento de la alfabetización mediática.

Palabras clave: Periodismo científico; alfabetización científica; desinformaciones; entorno digital; fake news; narrativas transmedia

Resumo

Paralelamente ao impacto da pandemia de saúde Covid, a luta contra a desinformação tornou-se uma das principais preocupações das sociedades democráticas e do próprio sistema de comunicação social, dado o seu papel histórico como garante do direito de

acesso a informação rigorosa, verificada e de qualidade. A viralização dos embustes, principalmente através de redes sociais, levou os meios de comunicação e os jornalistas a fazer dos processos de verificação uma das pedras angulares da sua actividade e a explorar novas narrativas e estratégias de publicação para chegar ao público. Em particular, as gerações mais jovens estão cada vez mais desligadas dos ambientes de comunicação tradicionais. Este contexto está a revitalizar, redefinindo e colocando o jornalismo científico numa posição estratégica: pelo que implica em processos de verificação de factos, bem como pela oportunidade de melhorar o envolvimento com o público. Esta investigação é construída sobre um sólido corpus de entrevistas com peritos e profissionais académicos. As considerações e opiniões destes especialistas permitiram a elaboração de um decálogo de boas práticas destinado a explorar o ecossistema transmedia como veículo de inovação e de promoção da literacia mediática.

Palavras-chave: Jornalismo científico; alfabetização científica; desinformação; ambiente digital; notícias falsas; narrativas transmedia

1. Introduction

The coronavirus pandemic has been an unprecedented challenge from the perspective of news with consequences for the practice of journalism and, in particular, media specializing in scientific dissemination. The need to communicate and update events in the field of healthcare and science has become quite a challenge in news processes. And that is not all; as the cases provoked by the virus increased, along with the need to provide appropriate information on what was occurring at sanitary level, the amount of misinformation distributed via analogue and digital means rose (Salaverría *et al.*, 2020), especially from social networks and instant messaging, the main platforms on which this type of false information is reproduced (Noain-Sánchez, 2021).

In light of this information crisis, the World Health Organization (WHO, 2020) determined that modern society is facing an “infodemic” as a result of the considerable increase in information circulating on the internet, driven by technology and the use of social networks, with the aim of creating “deliberate attempts to disseminate incorrect information to undermine the public health response and promote other interests of specific groups or persons” (WHO, 2020, par. 2).

Science journalism, understood as the discipline specializing in communicating and making the latest science content understandable for the public and in which the use of social networks and the digital environment is fundamental for the effective communication thereof (González-Pedraz & Campos-Domínguez, 2017; Vernal-Vilicic *et al.*, 2019; Calvo & Ufarte-Ruiz, 2021), is playing a central role in the public media agenda of modern-day society precisely because of its relevance for combating misinformation. Thus, in its mission to show the progress being made in the discipline and collaborate in

the field of fact-checking journalism (Hansen, 2016; Trillo-Domínguez & De-Moya-Anegón, 2022), science reporting has battled during this pandemic to contribute to explaining what is meant by “the truth, half-truths and misinformation” (Molina-Cañabate & Magallón-Rosa, 2020, p.12).

Considering the social duty of the profession, the responsibility to inform, educate and disseminate scientific knowledge and, all things considered, the importance of science for human life (Liskauskas *et al.*, 2019), it is imperative that strategies be developed that help to tackle the misinformation that is consumed via digital and analogue spaces. In this way it is made easier for society to acquire mechanisms that permit it to distinguish the lies or hoaxes that are generated, contributing towards the cultivation of scientific literacy on the part of citizens (Díaz Moreno, 2019).

1.1 Misinformation in times of pandemic

Fake news can be defined as a news story that has the purpose of intentionally misleading the audience that receives it (Catalina-García *et al.*, 2019). Nevertheless, for some authors, the problem of misinformation is so complex in the current media ecosystem that they advise against limiting it to this expression alone (Montemayor Rodríguez & García Jiménez, 2021). Thus, Salaverría *et al.* (2020) distinguish four types of hoaxes that are usually published: jokes, exaggerations, decontextualisations and deceptions. Generally, the two latter actions are the most serious, because they often take on a “greater level of falsehood and willingness in their spreading” (p.13).

As the technology has advanced, digital media and social networks have become the primary means for disseminating this type of misinformation, due to the immediacy and non-existence of geographical boundaries that occur through these channels (Gutiérrez-Coba *et al.*, 2020). Although social networks provide advantages for produced content to be distributed generally free of charge, quickly and to a mass audience (García-Galera *et al.*, 2020), the current media environment has favored the proliferation of this type of misinformative action, becoming fertile ground for the circulation of such fake content, strengthening its reach through the power of viralization held by social networks (López-Rico *et al.*, 2020; Massarani *et al.*, 2021). And it is on these platforms where misinformation has reached its greatest levels of dissemination, affecting young people in particular, who are those who most tend to use and trust these channels to get their information (Reuters Institute, 2021).

This problem reached its maximum level after the pandemic, with an exponential increase in misinformation via these networks. Conspiratorial stories on vaccinations (Pérez-DaSilva *et al.*, 2020), along with erroneous information associated with the consumption of coronavirus-curing chemicals (Álvarez-Daza *et al.*, 2020), formed part of the messages emitted on these applications. Situations such as the foregoing are just one

example of this surge of intoxication that had a bearing on citizens making bad decisions based on bad information (León *et al.*, 2022).

Fighting against this type of misinformation on social media was one of the great challenges during the management of the pandemic and a priority aim when informing about treatments (García-Marín & Salvat-Martinrey, 2022). However, the “infodemic” (WHO, 2020) that arose due to the abysmal quantity of sanitary information, without being able to know whether or not what was being read was true or simply fakes that prejudiced the well-being of citizens (Herrero-Diz & Pérez-Escolar, 2022), has not just had a direct impact on the public; it also tainted journalism and the media.

This is a potentially serious problem given that, generally speaking, the media are considered as responsible for educating their audiences on news consumption (González Clavero & Rodríguez Bazán, 2021) and providing citizens with the ability to inform themselves appropriately about what is happening around them (Califano, 2015). In this day and age, however, the media tend to prioritize immediacy over rigorous and contrasted work (Saavedra-Llamas *et al.*, 2019), putting their role as content filterers and educators of citizens with critical thinking to one side (Vernal-Vilicic *et al.*, 2019). Maybe because of this, and despite the pandemic bringing with it a considerable increase in the demand for science journalism and traditional media (Wormer, 2020; Post *et al.*, 2021), studies carried out in countries such as Spain and Portugal show that citizens are increasingly losing their trust in large media outlets (Pérez Escoda & Pedrero Esteban, 2021; Delicado *et al.*, 2021). Added to this weakness is the fact that the public perceive an ecosystem of politically ideological media, which favors space for misinformation and can come to negatively affect news quality (Vázquez-Herrero *et al.*, 2022).

1.2. Combating misinformation from the digital world

Taking into account the difficulties and crisis of confidence in which the media are currently embroiled, as well as the negative aspects brought by the social networks as regards affording visibility to trustworthy knowledge, journalism has sought new disruptive channels and innovating narratives to combat misinformation (Sanz-Hernando & Parejo-Cuéllar, 2021). This is how transmedia or gamified tools have positioned themselves in the digital environment as an approach in the face of fake informations. One example is that put forward by García-Ortega & García-Avilés (2021), who complied five types of games with a news focus created to educate the public against misinformation and, in a practical way, show how the verification of information works. Other multiplatform experiences are those developed by sites such as *Maldita Ciencia* [“Damned Science”] when using transmedia dynamics, where news forms part of a big narrative that employs diverse platforms and varying levels of depth in the processing of information to communicate and check the trustworthiness of a news story (Molina-Cañabate & Magallón-Rosa, 2020).

This is a key period, given that factchecking is increasingly positioning itself in the editorial departments of media outlets, developing as a line of professional specialization (Herrero & Herrera-Damas, 2021) and arises as a necessary tool for considering the credibility of a news story (Lobato *et al.*, 2021), permitting it to be checked whether it is true or false as it spreads over the social networks (Blanco-Alfonso *et al.*, 2021).

And it is here where the duty of science journalism has been revealed, especially due to its role as verifier of information in this age of media manipulation via the internet (Kitsa, 2021). A report from *European Cooperation in Science & Technology* (2021) revealed how there is now more than ever a need for effective science communication. Science journalists play a crucial role in raising awareness of the importance of the field in the turbulent times society is going through (Liskauskas *et al.*, 2019).

Starting out from the premise that playful and educational elements can be increasingly used to develop fact checking actions within science journalism, this study is set out taking into consideration the crisis of trust affecting journalism, especially content emerging online (Morales-Vargas *et al.*, 2021) and with the responsibility of professionals from the field to inform rigorously and with a critical eye (Cassany *et al.*, 2018).

The fundamental axis on which this work rests comprises the knowledge and experience of prominent specialists in journalism and communication. These experts have been consulted taking the horizon of innovations and challenges involved in transmedia narratives as an example. We propose in this way to explore and determine how to take advantage of the opportunities that the digital and transmedia environment can bring in order to combat misinformation. To this end, the following research questions are posed.

Q1. How is science journalism tackling the problem of misinformation in the digital realm?

Q2. What are the main strategies and challenges that should be considered by both science journalism and the users that consume it in the face of the misinformation problem?

Q3. What transmedia techniques have been employed in science journalism as tools for combating misinformation?

2. Methodology

To carry out this study a qualitative methodology has been applied based on the creation of a corpus of semi structured interviews (Díaz-Bravo *et al.*, 2013) aimed at prominent experts in journalism, with both academic and professional profiles. Despite the existence of different techniques that help to approach social phenomena, interviews with specialists occupy a relevant space. They have permitted the compiling of their opinions on the way in which science journalism has been developing in the digital realm, with special emphasis

on opportunities for dissemination on social media. Furthermore, they have facilitated the establishing of a dialogue wherein the interviewees have been able to express their opinions and put forward their proposals. Specifically, the following questions were asked: *i)* In your opinion, how should science journalism tackle the problem of misinformation in the digital realm? and *ii)* Which transmedia strategies can be used as fact-checking tools in science journalism?

In addition, the work presented here puts the spotlight on the notable international repercussion that Spanish research into communication has had over the last five years (Trabadela-Robles *et al.*, 2020; Trillo-Domínguez & De-Moya-Anegón, 2022). Thus, the interviewees were selected via judgmental sampling where “the variables that define the structural composition of the sample are defined theoretically by the researcher” (Mejía Navarrete, 2000, p. 169). The selection criteria for the sample were delimited to specialists of recognized standing, native to or working in Spain, and who furthermore fulfilled one of the following criteria: *i)* researchers or academics who have authored works that have had an impact published in the last 5 years on digital communication, be they on social networks, transmedia narratives or science journalism; *ii)* professionals with more than 5 years of professional experience in the area of digital, science or transmedia journalism.

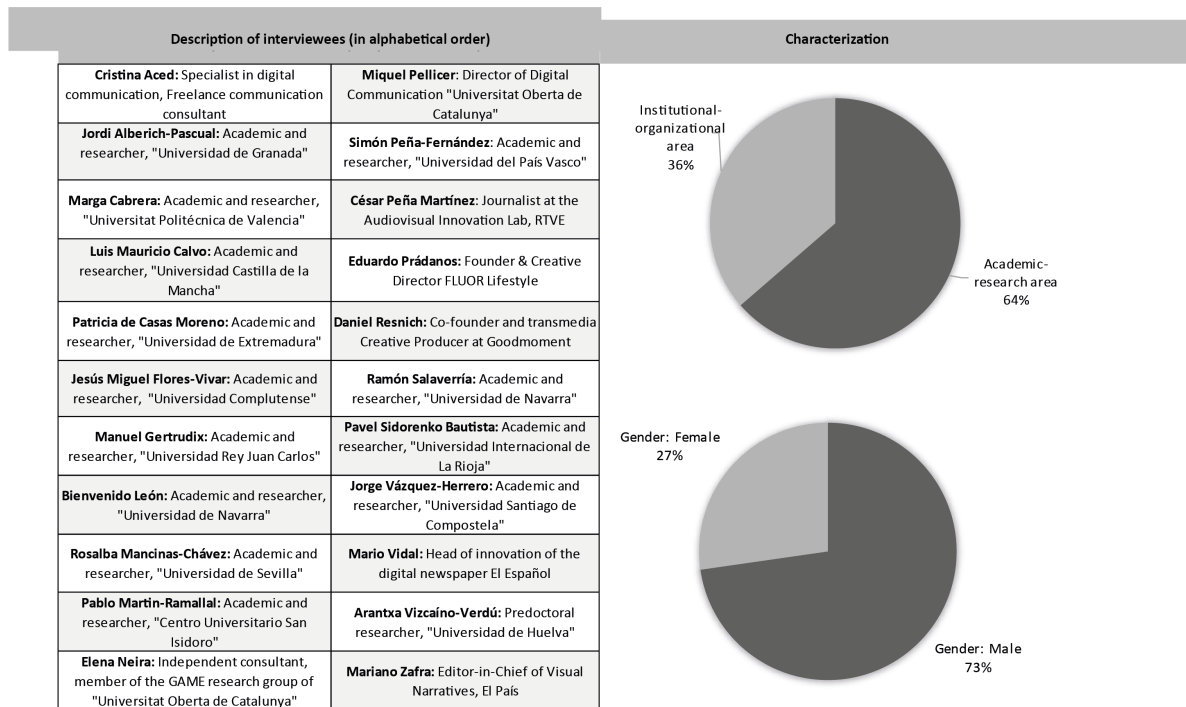
The interviews carried out respond to a global work, with two lines of research and complementary methodology, but with their own entity and development. These were a) The development of science journalism on TikTok and the transmedia board (Martin-Neira *et al.*, 2023) and b) how science journalism is tackling the problem of misinformation, which is the research material published in this study.

2.1 Collection and analysis of responses

The semi-structured interviews were carried out between March and April 2022. Firstly, potential participants were contacted by email, social networks, telephone and personal websites, which resulted in 55 professionals fulfilling the previously established requisites. It is worth drawing attention to the fact that, in this interviewee sample confirmation process, 60% of those contacted had a connection with the academic-university world and the other 40% were professionals linked to institutions, media outlets or were consultants in private organizations. A 42% of those contacted were women and 58%, men, to thus find the greatest possible gender parity as regards possible participants. However, of the total number of specialists who were initially asked to participate in the study, 33 (60% of the original proposal) were ruled out of the interview process, either because they openly stated it was impossible for them to participate in the study, or there was no feedback, or it was not possible to arrange a meeting, despite making contact on two separate occasions with one week between each attempt.

22 experts were eventually recruited to be part of the study (Figure 1). These interviews, the content of which was communicated in advance by the research team, were carried out online and recorded with the consent of the participants, having an average duration of 27 minutes. In some particular cases, and in order to adapt to the conditions of the participants' availability, it was necessary to either hold the interviews by telephone or the questions were responded to by email.

Figure 1. Characterization of the participants in the interviews



Source: Own creation

Taking into account the work by Vernal-Vilicic *et al.* (2019), in their study on perception and teaching of journalism in Chile, we decided to process the responses of their interviewees with the code "En", where the letter . is directly related to the name of the interviewee and . refers to a number randomly assigned by the research team, in order to observe their responses with agility and uniformity. The responses were processed using the program NVivo. In this way, we were able to identify the most frequently used words, enabling the creation of a word cloud, and applied a sentence analysis technique via a simple text query (Trigueros-Cervantes *et al.*, 2018), in order to highlight the main reflections of the experts in the sample.

The two branches of research can be appreciated in this word cloud (Figure 2). On the one hand, when speaking about how science journalism should tackle misinformation, the concepts they highlight are those associated with the value of education, along with the importance of the media and propriety of sources, all of which are relevant aspects

becomes viral". For this to occur, it is proposed that, as far as possible, the media outlet ensure that (E16) "all the news it publishes must go through a fact-checking process" and in order for this to happen it is crucial that sources be (E9) "of contrasted quality" and (E2) "extremely qualified".

However, a pattern that repeats in the responses of the interviewees is that the problem is not just related to journalism as a profession, rather that because it is (E3) "users who face misinformation", it is a task that must be carried out by "society in general" (E8). In the face of this, it is argued that the ideal situation is for there to be (E4) a digital literacy for citizens that in some way permits "teaching to read and contextualize information provided by journalists" and that, at the same time (E14), "it needs to be shown very early on that not everything that appears on social media is true". Therefore, the responsibility held by each user is fundamental, given it is often the case that (E18) "lies comfort us and are mechanisms for self-deception". That is why for this problem in general there is (E15) "probably 50% of individual responsibility and 50% correct verification and monitoring of accounts".

Another conflict detected by the interviewees is that social networks frequently fail to help in the task of combatting misinformation, as their algorithms are based on engagement and fact-checkers (E10) "(haven't) necessarily adapted to these networks in a narrative sense". Moreover, clarification does not achieve the same impact as a lie spread on social networks, stating that (E16) "dissemination of fake news is much greater than dissemination that clarifies or refutes it". Furthermore, there are networks such as Twitter that (E15) "don't carry out an exhaustive control of accounts and thus verify that certain media outlets fulfill their duty of informing and not falling for fake news". Regardless of this, some participants hope that not far from now, thanks to artificial intelligence, (E4) "good bots will appear that are able to counteract the harmfulness of the misinformation" appearing on social media.

In addition, and in relation to the other fundamental aspects on which they were asked to give their opinion, although the interviewees value the possibilities of transmedia as a tool to combat misinformation, some specialists could not recall specific experiences of this type and which sought to expose fake content or other actions that go against news reliability. Nevertheless, the journalists consulted made valuable contributions that can be seen as an interesting starting premise for driving the application of these types of fact-checking techniques. This is because, in the end (E13), "it is absolutely imperative that false narratives be counteracted with true ones", and in this way avoid their continued spread.

They point to the social networks, given they are (E6) "the most interesting point of convergence for creating and developing transmedia strategies for working on the verification of facts and news" and (E8) "to the extent you create pieces on Instagram, links to other platforms or Facebook buttons, in the end what you're doing is creating a strategy for fighting against misinformation following the transmedia logic on various channels". To achieve optimum transmedia communication it is crucial for the user to participate on

these channels. (E14) “One idea could be to involve users in scientific topics, where they can communicate doubts or solutions and in some way integrate them in a social network transmedia strategy”. In this sense, (E9) there is a value in “science information filtering clusters”, where a social network community acts as a “verifier of altered information, protecting and filtering from within this virtual community”.

In the face of other transmedia initiatives that serve as checking strategies, one of the specialists (E11) values the online documentary *Guerra a la mentira* [“War on Lies”] as a transmedia tool and one that helps fact-check information, as it “provides means for the public to understand verification with open sources”. Gamification is also taken as a reference (E18) as “there are games that specifically serve to unmask lies” Moreover, confidence is maintained in that in the future (E4) “artificial intelligence” will help to detect this type of fake informations via algorithms that facilitate tracking.

The specialists do however draw attention to the fact that care must be taken when a news story begins to be shared on different platforms and enters the transmedia world, given that (E3) “photographs or texts are often taken out of context and exaggerated and this leads to misinformation”, meaning that a user (E2) “may have fragmented access to part of the story and this can end up generating selective exposure”. Thus, (E20) “the ideal situation would be to undertake tracking in a transmedia sense, that is, via different channels, of how a news story endures and is modified, and what is the reality or otherwise”, explains one interviewee.

These examples follow the logic of citizen literacy mentioned by the specialists in the aforementioned topic and, in some way, it is highly important to draw attention to when carrying out these types of strategies in digital environments, provoking the situation where (E12) “people who connect to social media are aware when they are exposing themselves to truthful content and content that is untrue, and also know they cannot be participants at any stage of a misinformation process”.

As a way of uniting the recommendations of the interviewees about how science journalism should tackle misinformation in the digital realm and the transmedia board, we present the following guide to best professional practices (Figure 3). In addition, we include recommendations aimed at users to thus contribute towards orientating the ongoing process of scientific literacy society is going through.

Figure 3. Summary of recommendations for the development of science journalism in the digital realm

Guide for best science journalism practices in the digital and transmedia realm	
Science journalism must not follow the logic of immediacy. It must be ensured that everything published be verified	For the editing process, it is important to consult colleagues who help to validate the investigation or sources used
It is fundamental to rely, as a minimum, on three viable checked sources. Ideally it will be possible to contrast and reference these	As journalists or media outlets, do not redistribute dubious content Contrast images that may create doubts, for example using Google Images
It is important for both journalists and communications media to aim to achieve a reputation of quality and for both to be recognized as being a truthful information platform	Take into consideration that false narratives must be contrasted with true narratives, thus avoiding their spread on social networks. Maintain a position of protector of “the truth” in the face of fake information
You should not publish with ambitious or attention-seeking headlines with the pure logic of it “becoming viral” on social media	Contribute to supporting innovative actions that incorporate transmedia stories, artificial intelligence or information filtering clusters as tools against misinformation.
It is the duty of science journalism to clarify to citizens all concepts that may be difficult to understand. To this end, the ideal situation is to write with an abundance of specifications and nuances	Promote practices and spaces of interaction with users in order to in this way stimulate the reach of the scientific literacy of society.
Recommendations for users	
Identify the URL of the page to determine from where the information originates from	
Check whether the accounts from where posts are published have high rates of interaction or dissemination	
Identify media or journalists of reference to contrast information	
Compare the information that is presented in the news story with other similar information and check that the sources that publish them are reliable	
Be suspicious of the surprising headline: it frequently implies misinformation or that it is not completely true. Read and review all information and avoid merely settling on the photograph or headline	

Source: Own creation from results obtained

4. Discussion and conclusions

Spreading a hoax is relatively easy and inexpensive: lies, tricks and half-truths fly in the digital ecosystem, projected especially by scandal and false accounts on social networks. Dismantling fake information, along with combatting misinformation, is completely the opposite. It does not just involve immense effort and cost, but also the uncertainty of what version of reality will end up imposing itself when the auditing role of the media is blurred and new actors burst onto the scene who are not always subject to the ethical codes and social responsibility of what professional journalism has historically meant.

Although it may seem a paradox, the misinformation crisis that has become generalized in parallel with the expansion of the social networks, and which has intensified with the pandemic, has supposed a turning point in the media and a wake-up call for recovering credibility and reconnecting with audiences. In this challenge, science journalism, closely linked to combatting misinformation with fact checking techniques, may be considered as one of the lines of specialization and development with the greatest potential in the current digital ecosystem.

This is, at least, one of the main conclusions drawn from the study that concerns us and that is even presented as a space of opportunity from three complementary approaches: *a)* for professionals, to the extent that it is a commitment to innovation and journalism in capital letters; *b)* for the media system itself, due to the fact that it is its viability that is being questioned in the digital realm; and *c)* for audiences, the public, from the democratic aspiration of enjoying a good information diet. Rights and freedoms, but also duties.

In this game of challenges and stresses, shared between broadcasters and receivers in an unprecedented interactive and collaborative process of communication, science journalism takes on a relevant role for tackling misinformation. This is occurring in a markedly strategic manner in the digital environment and on the transmedia board, as the experts interviewed in our study warn in agreement with that indicated by the academic world about the “duty” of science journalism to combat the infodemic by “creating content with truthful and contrasted sources” and that can enable citizens to make decisions based on scientific information (Cassany et al., 2018; Elliott, 2019; Lobato-Martínez *et al.*, 2022).

As we have set out, the spreading of misinformation has increased as a result of COVID-19, with a worrying rise in misinformation that has expanded on the whole via the social networks, obliging science journalists, and media specializing in this field, to develop strategies and explore narratives in order to be able to counteract it (García-Marín & Merino-Ortego, 2022), especially through the use of fact-checking tools (López-García *et al.*, 2021).

Even so, we should warn that science journalism does not in itself suppose a lifeline. We are above all facing a challenge for journalists and media outlets, submerged in recent years in a crisis of trust before their audiences (Pérez Escoda & Pedrero Esteban, 2021; Vázquez-Herrero *et al.*, 2022), who demand an effort from within editorial departments as regards strategies of communication, style, narrative and formats. We cannot forget that the young public, the generations who will within a few years be pulling the strings in the new media ecosystems, are consuming less and less content from traditional communications media and get their information almost exclusively via social networks (Reuters Institute, 2021) with the complexity and peculiarities we have analyzed in this study. Considering this, it is important for science journalism to position itself on digital platforms to reach users in a more direct way with science news, avoiding headlines that provoke clickbait, prioritizing depth over immediacy, and not leaving space for misinformation in their content (Noain-Sánchez, 2021; Herrero-Diz *et al.*, 2022).

As indicated by some of the specialists in our study, it is a fact that fake information tends to spread more quickly and reach more people in comparison to that which occurs with content that is truthful (Vosoughi *et al.*, 2018). It is thus imperative to be constantly checking what is written and to generate news that can stand up to false information, with the final objective of taking advantage of this context of uncertainty as an opportunity to offer trustworthy content.

We therefore insist on the need for journalism, in general, to know how to use the advantages of the digital realm to create actions that contribute to the positioning of reliable information to the detriment of lies and hoaxes. As the interviewees in this study underline, little by little there are transmedia initiatives (with the social networks, surprisingly as a support weapon) together with techniques associated with immersive journalism (Blanco & Palomo, 2021) that help with this news checking process and offer tools for elaborating on the stories and combating the proliferation of fakes (Monteiro Borges & Rampazzo Gambarato, 2019). In the same way, gamified actions such as *newsgames* and *webdocs* have positioned themselves as instruments that unite the playful and the informative in order to combat false information (Herrero-Curiel & de la Maza, 2020).

The fact of building communities is a difficult task and knowing how best to achieve positive engagement with users has become a great challenge for digital journalism. For this reason, within the recommendations put forward, there is an indication of the importance of being able to create instances of interactivity with audiences and thus make them participants in the confirmation process for tackling the hoaxes circulating on the internet. This is how news content treatment actions on social networks and in which audiences play an active part in checking when sharing a story (Masip *et al.*, 2019), emerge as a starting point for striking up a positive dialogue with digital society. Likewise, the fact of seeing the story not just with a one-way development, but as a flowing and interactive process, increasingly personalized and with the participation of broadcasters and receivers with immediate response (Saavedra-Llamas *et al.*, 2019), may favor audience consolidation.

The process, moreover, goes beyond media outlets and journalists. In this study it is demonstrated that, together with the effort and attention that must be paid from the media system, it is necessary to start generating digital and scientific literacy in audiences, who often reveal a lack of culture as regards science and technology and do not necessarily know how to differentiate between news and dubious sources (Gutiérrez-Coba *et al.*, 2020; González Clavero & Rodríguez Bazán, 2021; Lobato-Martínez *et al.*, 2022). Journalism has a fundamental role to play when explaining and tackling all types of scientific controversies (Díaz Moreno, 2019), in the same way as it must help citizens to be able to understand and counter falsehoods via information literacy, creating users who are critical and who know how to discern reliable sources (López-Borrull *et al.*, 2018).

However, it is important to stress that this duty to educate in the face of disinformation does not just correspond to the world of journalism. On the contrary, it is a feat that requires the involvement of public and private institutions, educational bodies and all disciplines (Ferrerías Rodríguez, 2022). We face, therefore, a type of rejuvenation of journalism and scientific communication that transcends the field of specialization and demands a clearly transverse development, able to generate attitudes in the population in favor of science and thus increase the levels that allow citizens to believe and place value in these topics (Kappel & Holmen, 2019).

From a practical and professional point of view, as a future line of research it would be interesting to identify experiences on new narratives, initiatives linked to artificial intelligence and the application of communication techniques in the digital realm that are collaborating with science journalism and support the battle against misinformation. These original proposals would permit, by way of case studies, to also discover what the behavior is on the most emerging social networks, marked by live broadcasts and audiovisual language, and which tools are being used for enhancing information that has been proved to be true.

Authors' contribution

Juan-Ignacio Martin-Neira: Conceptualization, Methodology, Formal analysis, Investigation, Writing-original draft and Visualization. **Magdalena Trillo-Domínguez:** Conceptualization, Methodology, Validation, Writing-original draft, Writing - review and editing, Supervision and Visualization. **María-Dolores Olvera-Lobo:** Conceptualization, Validation, Resources, Writing-review and editing, Supervision and Visualization. All of the authors have read and accepted the published version of the manuscript. Conflicts of interest: The authors state they have no conflict of interest.

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References

- Álvarez-Daza, Nathaly., Pico-Valencia, Pablo., & Holgado-Terriza, Juan. (2020). Detection of Fake News in Social Networks Based on Machine and Deep Learning: A Brief Systematic Literature Review. *Revista Ibérica de Sistemas e Tecnologías de Información*, 41, 632–645. <https://bit.ly/3xp7P9C>
- Blanco-Alfonso, Ignacio., Chaparro-Domínguez, María., & Repiso, Rafael. (2021). Fact-checking as a global strategy to fight against disinformation. *Estudios Sobre el Mensaje Periodístico*, 27(3), 779–791. <https://doi.org/10.5209/ESMP.76189>
- Blanco, Sonia., & Palomo, Bella. (2021). Journalistic rigor and consistency the keys to the success of Spanish journalists on YouTube. *Estudios sobre el Mensaje Periodístico*, 27(4), 1043–1051. <https://doi.org/10.5209/esmp.78143>

- Califano, Bernadette. (2015). Los medios de comunicación, las noticias y su influencia sobre el sistema político. *Revista Mexicana de Opinión Pública*, 61–78. <https://bit.ly/3dY8yY4>
- Calvo, Luis., & Ufarte-Ruiz, María (2021). The academic training of iberoamerican journalists to communicate science and its relationship with investment in R&D. *Revista Prisma Social*, 32, 321–343. <https://bit.ly/3AQG0c6>
- Cassany, Roger., Cortiñas, Sergi., & Elduque, Albert. (2018). Communicating science: The profile of science journalists in Spain. *Comunicar*, 26(55), 9–17. <https://doi.org/10.3916/C55-2018-01>
- Catalina-García, Beatriz., Sousa, Jorge., & Cristina Silva Sousa, Li-Chang. (2019). Consumption of news and perception of fake news among Communication students from Brazil, Spain and Portugal. *Revista de Comunicación*, 18(2), 93–115. <https://doi.org/10.26441/rc18.2-2019-a5>
- Delicado, Ana., Rowland, Jussara., & Estevens, Joao. (2021). Bringing back the debate on mediated and unmediated science communication: the public's perspective. *Journal of Science Communication*, 20(03), 6. <https://doi.org/10.22323/2.20030210>
- Díaz-Bravo, Laura., Torruco-García, Uri., Martínez-Hernández, Mildred., & Varela-Ruiz, Margarita. (2013). La entrevista, recurso flexible y dinámico. *Investigación en Educación Médica*, 2(7), 162–167. <https://bit.ly/2CEAIAI>
- Díaz Moreno, Naira. (2019). Caracterizando controversias sociocientíficas en la prensa escrita. Una herramienta para el desarrollo de la alfabetización científica. *Revista Eureka*, 16(1), 1102. https://doi.org/10.25267/Rev_Eureka_ensen_divulg_cienc.2019.v16.i1.1102
- Elliott, Kevin (2019). Science Journalism, Value Judgments, and the Open Science Movement. *Frontiers in Communication*, 4, 1–10. <https://doi.org/10.3389/fcomm.2019.00071>
- European Cooperation in Science & Technology. (2021). *Communicating Science in Times of COVID-19: A selective overview of good practices*. <https://bit.ly/3xoQYU7>
- Ferreras Rodríguez, Eva. (2022). Más allá del fact-checking: organizaciones contra la desinformación. Identificación y análisis de proyectos internacionales. *Hipertext.net*, 24, 41–54. <https://doi.org/10.31009/hipertext.net.2022.i24.04>
- García-Galera, María del Carmen., Del-Hoyo-Hurtado, Mercedes., & Blanco-Alfonso, Ignacio. (2020). Disinformation and communicative intent: A proposal for fake news classification in professional journalistic environments. *Revista Mediterránea de Comunicación*, 11(2), 105–118. <https://doi.org/10.14198/MEDCOM2020.11.2.16>
- García-Marín, David., & Merino-Ortego, Marta. (2022). Desinformación anticientífica sobre la COVID-19 difundida en Twitter en Hispanoamérica. *Cuadernos.info*, 52, 24–46. <https://doi.org/10.7764/cdi.52.42795>
- García-Marín, David., & Salvat-Martinrey, Guiomar. (2022). Viralizing the truth: predictive factors of fact-checkers' engagement on TikTok. *Profesional De La información*, 1, 1–20. <https://doi.org/10.3145/epi.2022.mar.10>
- García-Ortega, Alba., & García-Avilés, José. (2021). Using ludic design to fight misinformation: How newsgames raise user awareness about fake news. *Revista ICONO 14. Revista Científica De Comunicación Y Tecnologías Emergentes*, 19(1), 179–204. <https://doi.org/10.7195/RI14.V19I1.1598>
- González Clavero, María., & Rodríguez Bazán, Grettel. (2021). Gestión informativa de la infodemia en medios digitales: experiencia de las agencias de noticias. *Revista Panamericana de Salud Pública*, 45(25), 1–5. <https://doi.org/10.26633/rpsp.2021.25>
- González-Pedraz, Cristina., & Campos-Domínguez, Eva. (2017). Science journalist professional practice: bibliographical review of the dysfunctions derived from the digital environment.

Revista Mediterránea de Comunicación, 8(2), 225–240. <https://doi.org/10.14198/medcom2017.8.2.14>

- Gutiérrez-Coba, Liliana., Coba-Gutiérrez, Patricia., & Gómez-Díaz, Javier. (2020). Fake news about Covid-19: A comparative analysis of six iberoamerican countries. *Revista Latina de Comunicación Social*, 78, 237–264. <https://doi.org/10.4185/RLCS-2020-1476>
- Hansen, Anders. (2016). The changing uses of accuracy in science communication. *Public Understanding of Science*, 25(7), 760–774. <https://doi.org/10.1177/0963662516636303>
- Herrero-Curiel, Eva., & de la Maza, Antonio. (2020). New journalistic narratives between information and playful simulation: Docuwebs and newsgames. *Palabra Clave*, 23(2), 1–26. <https://doi.org/10.5294/pacla.2020.23.2.5>
- Herrero-Diz, Paula., & Pérez-Escolar, Marta. (2022). Analysis of Hoaxes about COVID-19 Debunked by Maldita and Colombiacheck: Effects of the Infodemic on the Behavior of Society. *Palabra Clave*, 25(1), 1–36. <https://doi.org/10.5294/pacla.2022.25.1.7>
- Herrero-Diz, Paula., Pérez-Escolar, Marta., & Varona Aramburu, David. (2022). Fact-checking skills: a proposal for Communication studies. *Revista de Comunicación*, 21(1), 231–249. <https://doi.org/10.26441/rc21.1-2022-a12>
- Herrero, Esperanza., & Herrera-Damas, Susana. (2021). El fact-checker en español alrededor del mundo: Perfil, similitudes y diferencias entre verificadores hispanohablantes. *Revista de Comunicación de la SEECI*, 54, 49–77. <https://doi.org/10.15198/seeci.2021.54.e725>
- Kappel, Klemens., & Holmen, Sebastian. (2019). Why Science Communication , and Does It Work? A Taxonomy of Science Communication Aims and a Survey of the Empirical Evidence. *Frontiers in Communication*, 4, 1–12. <https://doi.org/10.3389/fcomm.2019.00055>
- Kitsa, Mariana. (2021). Media as a source of popular science information during COVID-19 pandemic. *International Journal of Media and Information Literacy*, 6(1), 119–128. <https://doi.org/10.13187/IJMIL.2021.1.119>
- León, Bienvenido., López-Goñi, Ignacio., & Salaverría, Ramón. (2022). The Covid-19 catastrophe#: A science communication mess? *Church, Communication and Culture*, 7(1), 6–22. <https://doi.org/10.1080/23753234.2022.2031236>
- Liskauskas, Suzana., Ribeiro, Mariana., & Vasconcelos, Sonia. (2019). Changing times for science and the public. *EMBO reports*, 20(4). <https://doi.org/10.15252/embr.201947906>
- Lobato-Martínez, Miguel., Monjas-Eleta, María., & Gómez-García, Salvador. (2022). Situación y perspectivas del periodismo científico en España. Investigación prospectiva a través del método Delphi. *Estudos em Comunicação*, 34, 66–80. <https://doi.org/10.25768/1646-4979n34-06>
- Lobato, Roberto., Velandia-Morales, Andrea., Sánchez-Rodríguez, Ángel., Montoya-Lozano, Mar., & García-Sánchez, Efraín. (2021). Fact-checking on twitter: An analysis of the hashtag #stopbulos. *Interamerican Journal of Psychology*, 55(2), 1–23. <https://doi.org/10.30849/ripijp.v55i2.1371>
- López-Borrull, Alexandre., Vives-Gràcia, Josep., & Badell, Joan. (2018). Fake news, threat or opportunity for information professionals? *Profesional De La Informacion*, 27(6), 1346–1356. <https://doi.org/10.3145/epi.2018.nov.17>
- López-García, Xosé., Costa-Sánchez, Carmen., & Vizoso, Ángel. (2021). Journalistic fact-checking of information in pandemic: Stakeholders, hoaxes, and strategies to fight disinformation during the covid-19 crisis in Spain. *International Journal of Environmental Research and Public Health*, 18(1227), 1–15. <https://doi.org/10.3390/ijerph18031227>

- López-Rico, Carmen-María., González-Esteban, Jose., & Hernández-Martínez, Alberto. (2020). Information consumption in social networks during the Covid-19's crisis in Spain. *Revista de Comunicación y Salud*, 10, 461–481. [https://doi.org/10.35669/rcys.2020.10\(2\).461-481](https://doi.org/10.35669/rcys.2020.10(2).461-481)
- Martin-Neira, Juan., Trillo-Domínguez, Magdalena., & Olvera-Lobo, María-Dolores. (2023). Comunicación científica tras la crisis del COVID-19#: estrategias de publicación en TikTok en el tablero transmedia. *Revista Latina de Comunicación Social*, 81, 109–132. <https://doi.org/10.4185/RLCS-2023-1841>
- Masip, Pere., Ruiz-Caballero, Carlos., & Suau, Jaume. (2019). Active audiences and social discussion on the digital public sphere. Review article. *Profesional De La información*, 28(2), 1–42. <https://doi.org/10.3145/epi.2019.mar.04>
- Massarani, Luisa., Waltz, Igor., Leal, Tatiane., & Modesto, Michelle. (2021). Narratives about vaccination in the age of fake news: a content analysis on social networks. *Saúde e Sociedade*, 30(2), 1–16. <https://doi.org/10.1590/s0104-12902021200317>
- Mejía Navarrete, Julio. (2000). El muestreo en la investigación cualitativa. *Investigaciones sociales*, 4(5), 165–180. <https://doi.org/10.15381/is.v4i5.6851>
- Molina-Cañabate, Juan-Pedro., & Magallón-Rosa, Raúl. (2020). Misinformation and scientific journalism. The case of Maldita Ciencia. *Revista Mediterranea de Comunicacion*, 11, 11–20. <https://doi.org/10.14198/MEDCOM2020.11.2.4>
- Monteiro Borges, Priscila., & Rampazzo Gambarato, Renira. (2019). The role of beliefs and behavior on Facebook: A semiotic approach to algorithms, fake news, and transmedia journalism. *International Journal of Communication*, 13, 603–618. <https://bit.ly/3wJgq63>
- Montemayor Rodríguez, Nancy., & García Jiménez, Antonio. (2021). Perception of journalists about disinformation and professional routines in the digital age. *Revista General de Información y Documentación*, 31(2), 601–619. <https://doi.org/10.5209/rgid.79460>
- Morales-Vargas, Alejandro., Pedraza-Jiménez, Rafael., & Codina, Lluís. (2021). Website quality in digital media: literature review on general evaluation methods and indicators and reliability attributes. *Revista Latina de Comunicación Social*, 80, 39–60. <https://doi.org/10.4185/rlcs-2022-1515>
- Noain-Sánchez, Amaya. (2021). Disinformation and Covid-19: Quantitative analysis through the hoaxes debunked in Latin America and Spain. *Estudios Sobre el Mensaje Periodístico*, 27(3), 879–892. <https://doi.org/10.5209/ESMP.72874>
- Organización Mundial de la Salud. (2020). *Gestión de la infodemia sobre la COVID-19: Promover comportamientos saludables y mitigar los daños derivados de la información incorrecta y falsa*. <https://bit.ly/3NDLQ44>
- Pérez-DaSilva, Jesús-Ángel., Meso-Ayerdí, Koldobika., & Mendiguren-Galdospín, Terese. (2020). Fake news and coronavirus: Detecting key players and trends through analysis of Twitter conversations. *Profesional De La información*, 29(3), 1–22. <https://doi.org/10.3145/epi.2020.may.08>
- Pérez Escoda, Ana., & Pedrero Esteban, Luis. (2021). Challenges for journalism facing social networks, fake news and the distrust of z generation. *Revista Latina de Comunicación Social*, 79, 67–85. <https://doi.org/10.4185/RLCS-2021-1519>
- Post, Senja., Bienzeisler, Nils., & Lohöfener, Mareike. (2021). A desire for authoritative science? How citizens' informational needs and epistemic beliefs shaped their views of science, news, and policymaking in the COVID-19 pandemic. *Public Understanding of Science*, 30(5), 496–514. <https://doi.org/10.1177/09636625211005334>

- Reuters Institute. (2021). *¿Cómo y por qué accede la audiencia a las noticias en redes sociales?* | Reuters Institute for the Study of Journalism. <https://bit.ly/3OTmXBB>
- Saavedra-Llamas, Marta., Herrero-de-la-Fuente, Mercedes., Rodríguez-Fernández, Leticia., & Jiménez-Narros, Carlos. (2019). Información de salud: fuentes periodísticas y desafíos profesionales. *Profesional De La información*, 28(2), 1–9. <https://doi.org/10.3145/epi.2019.mar.08>
- Salaverría, Ramón., Buslón, Nataly., López-Pan, Fernando., León, Bienvenido., López-Goñi, Ignacio., & Erviti, María-Carmen. (2020). Disinformation in times of pandemic: Typology of hoaxes on Covid-19. *Profesional De La información*, 29(3), 1–15. <https://doi.org/10.3145/epi.2020.may.15>
- Sanz-Hernando, Clara., & Parejo-Cuéllar, Macarena. (2021). Disruption in the communicative model of expert sources: the impact of COVID-19 on both cultural- scientific and innovation units. *Revista de Comunicación de la SEECI*, 54, 163–186. <https://doi.org/10.15198/seeci.2021.54.e697>
- Trabadela-Robles, Javier., Nuño-Moral, María., Guerrero-Bote, Vicente., & De-Moya-Anegón, Félix. (2020). Análisis de dominios científicos nacionales en Comunicación (Scopus, 2003-2018). *Profesional De La información*, 29(4), 1–13. <https://doi.org/10.3145/epi.2020.jul.18>
- Trigueros-Cervantes, Carmen., Rivera-García, Enrique., & Rivera-Trigueros, Irene. (2018). *Técnicas conversacionales y narrativas: Investigación cualitativa con Software NVivo*. Escuela Andaluza de Salud Pública/Universidad de Granada. <https://bit.ly/3y400oh>
- Trillo-Domínguez, Magdalena., & De-Moya-Anegón, Félix. (2022). Mapa de la investigación científica de Comunicación en España#: frentes de estudio y rankings de autores , publicaciones e instituciones. *Profesional De La información*, 31(1), 1–23. <https://doi.org/10.3145/epi.2022.ene.12>
- Vázquez-Herrero, Jorge., Negreira-Rey, María-Cruz., Silva-Rodríguez, Alba., & Rodríguez-Vázquez, Ana-Isabel. (2022). The news media through the lens of the Spanish audience: A matter of trust. *Estudios sobre el Mensaje Periodístico*, 28(2), 447–459. <https://doi.org/10.5209/esmp.77807> 1.
- Vernal-Vilicic, Teresa., Valderrama, Lorena., Contreras-Ovalle, Joaquín., & Arriola, Tamara. (2019). Perception of training and specialization of scientific journalism in Chile. *Cuadernos.info*, 45, 213–226. <https://doi.org/10.7764/cdi.45.1717>
- Vosoughi, Soroush., Roy, Deb., & Aral, Sinan. (2018). The spread of true and false news online. *Science*, 359(6380), 1146–1151. <https://doi.org/10.1126/science.aap9559>
- Wormer, Holger. (2020). German media and coronavirus: Exceptional communication—Or just a catalyst for existing tendencies? *Media and Communication*, 8(2), 467–470. <https://doi.org/10.17645/mac.v8i2.3242>