



COMMENT




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Research agenda to engage citizens in science through social media communicative observations

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Social media has expanded the possibilities for citizens around the world to share knowledge and interact about scientific advancements, facilitating to raise public awareness of and interest in science. Amidst this context, scientists in all disciplines are intensifying the use of social media as a data source to capture what citizens express about their achievements, beyond dissemination purposes. Content analysis is the generalised method used by researchers to explore the interactions of citizens in social media about science. In this commentary paper, we explore the social media communicative observations as an emerging technique in the social media analytics to include the communicative dimension of science in the analysis of interactions between scientists and citizens. The implications to empower dialogically the social media communities interested in science are shared.

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Introduction

The expansion of the use of social media to communicate science has been incorporated by the scientific community in very diverse fields of knowledge (Al-Daihani et al., 2018; Buckarma et al., 2017; Osterrieder, 2013). For instance, in cardiovascular research, Lee et al. (2021) illustrate that Twitter can contribute to improve heart health and care, and the benefits of science dissemination for researchers. Furthermore, the research contributes to a more inclusive communication of science through social media, as it facilitates to reach audiences culturally and socially diverse, increasing the opportunities for vulnerable groups to have access to scientific results (FECYT, 2022).

The dissemination of research results through social media is very common but the increase of dialogue between scientists and social media users has pushed the design of research methodologies to capture the quantity and quality of interactions occurring between the world of science and citizens' realities. In this arena, the content analysis has been the generalised method to explore this dimension of the scientific activity. However, the existing interactions between scientists and social media users require new advancements to achieve real engagement of citizens in science (Pulido Rodriguez et al., 2021).

This commentary paper focuses on the social media communicative observations as an emerging technique in social media analytics to include the communicative dimension of science in the analysis of interactions between scientists and citizens. On the basis of the protocol on Social Media Analytics elaborated in the Allinteract project (Flecha and Pulido, 2021), the aim of this commentary paper is to provide guidance and concrete steps on how to develop social media communicative observations to reduce the gap between science and society.

Framework for social media communicative observations

The Allinteract Social Media Analytics Protocol is the framework that defines the steps to collect and analyse data for the successful design and implementation of social media communicative observations. It is important to highlight that the protocol is based on the following criteria: credibility, transferability, dependability, and confirmability (Korstjens and Moser, 2018), and its influence has reached international audiences (Flecha and Pulido, 2021; Puigvert et al., 2022, Pulido Rodriguez et al., 2021). Furthermore, one of the most relevant features of the protocol is the possibility for researchers to include the voices of social media users in an equalitarian dialogue that overcomes the hierarchies between scientists and citizens. The protocol integrates the communicative methodology of research (Flecha and Soler, 2014; Gómez et al., 2011), which has been developed seeking to move beyond traditional dualisms in social sciences research, such as subject/object or structure/individual. Thus, the communicative methodology allows the design and implementation of the analysis of social interactions, including the ones in social media. It enables research teams to build knowledge about research topics considering the contributions from the academia and the social agents.

Recommendations for a research agenda to capture interactions between researchers and social media users through social media communicative observations

The social media communicative observations can inspire researchers to capture how citizens are engaged in their scientific advancements. In this vein, the Allinteract project was selected by the European Commission (2020) with a twofold aim: to create new knowledge on how to transform potential citizen participation in science into actual engagement and to unveil new ways to

engage societal actors in science, including those who have traditionally been excluded from, like young citizens and vulnerable groups. The recommendations and steps shared in what follows are based on the novel contributions of the project.

Step 1. Selecting social media and keywords, with inclusion and exclusion criteria.

The use of social media can vary from country to country, but it is important to select the most appropriate ones considering the type of interactions that we, as researchers, want to explore. The social media communicative observations can be applied to any social media (Facebook, Twitter, Reddit, Instagram, TikTok...) and its selection depends on the target groups to explore. However, the initial recommendation for the social media communicative observations is to select Facebook and Reddit (subreddit), as they are platforms where dialogue and interactions instead of images or videos play a key role. For each social media, there is a selection of keywords to guide the search. Diverse criteria can be used to include or exclude Facebook and subreddit communities because not all segments of the population debate all social media. When selecting the groups, this aspect should be considered. For instance, if young people and vulnerable groups are at the core of our interest in the analysis of interactions between researchers and social media users, the selected Facebook public groups and subreddits may have these groups. Aspects such as the representation of diverse ages, genders, academic levels, or cultural backgrounds can also be added. The representation of different countries or the number of users/members in each social media can be also incorporated.

Step 2. Obtaining informed consents.

The responsible of the ethics committee contacts the administrators of the Facebook and subreddit groups to explain the objectives of the social media communicative observation. If a group administrator does not respond within a timeframe of 5 days, does not approve consent, or declines participation, the data collection and analysis cannot be developed. Then, the following group from a predefined list shall be selected and contacted and the process starts again. When the proposal for social media communicative observation is approved, the group administrators inform the members of the Facebook and subreddit groups and ask for their consent. The group administrator is not allowed to provide consent to the individual participants in the group. Prior to collecting data, researchers distribute consent forms to group members who express their willingness to participate in the social media communicative observation.

Step 3. Introducing scientific evidence.

The scientific evidence on the selected research topic shall be introduced in each group every week, ensuring that the language is understandable and written for a non-specialised audience. Therefore, the discussion is shared in the natural language of users to foster citizens' participation. The planning to share evidence implies that at least one statement of scientific evidence per week is included in each group, but if group members and the administrator agree, up to 3 statements per week may be shared. The role of the administrators is to avoid that offensive or sensitive messages are posted in the group, and corrective measures can be considered if researchers identify that the administrator is adopting the suggestions shared for skewing the results.

Step 4. Communicative observation of the interactions among users.

This is one of the crucial steps to achieve a successful analysis of social media communicative observations. It implies that researchers interact with users and enter discussions with them about the scientific evidence shared in the group. The role of the researchers implies the monitoring of how users' interactions change after having introduced scientific data (e.g., use of scientific arguments in the debate), as well as the correlation between

evidence mentioning and participation in scientific research (e.g., number of users participating in the debate).

Step 5. Extracting data.

The suggested programmes for the extraction of data are PYTHON and NVIVO. According to step 2, only interactions among users who have provided their consent are monitored and analysed.

Step 6. Anonymizing data.

Based on step 2, all data is anonymized to follow the corresponding General Data Protection Regulations and Terms and Conditions of each social network (Facebook and REDDIT).

Step 7. Data analysis.

The analysis of data can combine predefined categories with those categories that emerged during the process. The initial categories can emerge from concrete topics, for instance, the following ones:

- How citizens' benefit from scientific research.
- Citizen awareness of the impact of scientific research.
- Awareness-raising initiatives succeeding at engaging citizens in scientific participation, including the Open Access movement.
- Awareness-raising actions that foster the recruitment of new talent in sciences.
- Policies that promote awareness-raising actions and citizen engagement in science.
- A communicative analysis is conducted.

It is important to mention that new inductive categories may be introduced from the analysis, and they are defined through consensus among different researchers. During this process, the researcher proposes and shares the emerging categories with other researchers. Then, researchers analyse each message collaboratively and dialogically, building agreements to make the most of the identified interactions. An analysis of the correlation is then conducted between awareness of the social impact of research and engagement in science on the previous selection of individuals. This analysis can take as variables "citizen awareness of the social impact of research" and "citizen engagement in science". The correlation between both variables shall be crossed using R. Since both variables are nominal and dichotomic, Phi, Cramer's V, and the Contingency coefficient shall be selected. To observe directionality, Lambda, Goodman and Kruskal's Tau and the Uncertainty coefficient shall be used.

What's next?

The social media communicative observations contribute to define in a concrete and coherent manner how researchers can enter dialogue with social media users. The type of analysis using this procedure is in the initial stages but, in the coming years, it is expected to see an expansion of its use. This is coherent and aligned with the need for dialogue between science and society, which implies not just sharing research results but to include peoples' voices in social media research. In societies in which there are increasing claims to empower the communities in authentic dialogical processes (Flecha, 2022), science becomes an outstanding role model in the field.

As outlined in different scientific domains, research agendas require co-creation, deliberative processes, and dialogue between scientists and citizens (Foulds et al., 2022; Hilverda et al., 2021). In this vein, this research agenda to engage citizens in science through social media communicative observations has the inclusion of the voices of social media users into research as a principle. This principle will guide the future research process in social media communicative observations, creating and ensuring that dialogue underlines and features the data collection and

analysis. The research agenda to engage citizens in science through social media communicative observations is expected to generate analysis that strength the knowledge and insights about what citizens discuss regarding scientific evidence in social media. In the future, we expect to obtain an accurate analysis of the dialogues in social media beyond the ones obtained from big data. Recent investigations show that social media analysis use to focus on narrowed areas, for instance, the COVID-19 pandemic (Albrecht et al., 2022; Pulido et al., 2020). They provide insights related to the indicators of the Sustainable Development Goals defined by the United Nations (UN, 2017). In this vein, the areas of concern around the research on social media communicative observations will provide evidence of the main concerns of citizens, such as health, employment, or education. The Allinteract protocol focuses on gender and education but emerging topics of interest for citizens will merge.

The interest of citizens in science exists, the aim of researchers to reach diverse audiences also exists, and the emerging ways to enter into dialogue and interact about scientific evidence grow (Díez-Palomar et al., 2022; Pare Toe et al., 2022). The challenge is to think outside the box to achieve equalitarian dialogues and interactions to empower citizens and communities not only to participate in science but also to influence the solutions that researchers seek to achieve.

To finalise this commentary paper, we would like to bring back to our memories the words that Stanley Cohen told Rita Levi-Montalcini linked to their collaboration in science: "You and I are good, but together we are wonderful" (Levi-Montalcini R, 1988). They were both awarded the Nobel Prize in Physiology or Medicine in 1986 for the isolation of nerve growth factor and the discovery of epidermal growth factor. Some decades afterward, the challenge of engaging non-professionals in scientific research is aligned with the spirit of Cohen's words because researchers can co-create novel perspectives linked to social media research together with citizens in meaningful and "wonderful" ways. The inspiring advancements as the social media communicative observations can make a difference to further explore public involvement in research.

Data availability

Data sharing is not applicable to this research as no data were generated or analysed.

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The authors declare no competing interests.

Ethical approval

This comment does not contain any studies with human participants performed by any of the authors and ethical statements are not applicable.

Informed consent

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