■ ■ ■ Practice of Social Media Use In Science Communication

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Abstract. Social media refers to apps or websites that allow its users to connect and exchange data via the Internet. The rise of social media platforms has created great opportunities for open science, including exchanging scientific knowledge and communicating in more interactive ways between researchers and with the general population. Therefore, scientists are increasingly using multiple platforms of social media for communication in science. Through a content analysis of related articles published in academic journals, this paper would offer an overview of how scientists have been using various social media platforms for science communication purpose. A review of existing literature revealed that over the past decade, several social media platforms have been used to disseminate the research results outside of academia and increase public engagement. Besides, scientists also use social media to create scholarly connections, share and discuss their research findings and ideas with the scientific community across the globe, as well as to stay update with changes in science communication. Facebook*, Twitter, ResearchGate, Academia.edu, and blogs are the most commonly used platforms by scientists. The current paper can help better understand how scientists are currently using social media as a medium for communication inside and outside the scientific world.

Keywords: science communication, communication in science, communication in research, science information, social media

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Introduction. Social media is growing rapidly with billions of users worldwide and this number keeps on growing. According to the report of Statista, over 3.6 billion Internet users were using social media in 2020. In 2025, it is estimated that the number of social media users worldwide will increase to around 4.41 billion. On average, people spend 144 minutes per day on various social media platforms, up more than 30 minutes

* Recognized extremist and banned in Russia.

since 2015[1]. These statistics demonstrate social media has become a significant part of our lives.

Social media has changed many major areas of human activities, as well as the academic environment [Ngai et al.]. The research by Ecklund and co-authors reported that nearly half of all academic scientists were engaged in social media [Ecklund et al.]. Scientists are increasingly their use of social media as a tool to communicate both within and beyond the scholarly community. Scientists in particular use different social media platforms to search, organize, share ideas, resources, and support research communications.

Along with the numerous literature presents a broad picture of the current practice of science communication on social media, it is in this interest that this paper reviews and analyses relevant studies to provide a clearer understanding of how scientists are using social media to create scholarly connections, share research findings, and communicate with the public. To elucidate on this goal, the research question of this current paper is "How are scientists using social media for science communication?". This paper would benefit scientists and interested readers by adding to the general understanding of social media usage in science communication.

This paper's structure is as follows: first, the methodological approach is described. Then, the terms "social media" and "science communication" are clarified. Next, from the literature review conducted, the use of social media for science communication by scientists is presented. Finally, a conclusion is given.

Methodology. Based on research question, articles related to social media in scientific communication were identified and gathered from Google Scholar[2] – a specialized search engine, designed to locate scholarly literature available from academic publishers, professional societies, preprint repositories, and academic libraries, as well as scholarly articles available via the Internet [Reitz]. To offer an overview of related literature, the keywords of "social media" and each of the terms "Science communication", "Communication in science", "Communication in research" were used to search for related articles. Articles came up on the first five pages of a Google Scholar search results list were then read through to make sure they are relevance to the subject of this paper.

Review and analysis

The meaning of social media and science communication. It is worth clarifying the terms "social media" and "science communication" to proceed further. Social media was first known when Jim Ellis and Tom Truscott from Duke University created

[1] Statista (Jan 28, 2021). Number of global social network users 2017-2025 [el. source]: https://www.statista.com/statistics/278414/number-of-worldwide-social-network-users/ (accessed: 09.09.2021).

[2] Google Scholar [el. source]: https://scholar.google.com (accessed: 10.08.2022).

Usenet, a worldwide discussion system to post public messages, was created in 1979 [Edosomwan]. After that, the use of social media became prevalent soon after the advent of Web 2.0 [Kaplan, Haenlein]. Although there are several definitions of social media, there remains a lack of the formal definition [Weller]. The oft-cited definition by Kaplan and Haenlein, "Social media includes a different kind of Internet-based applications which build the ideological and technological foundations of Web 2.0, and allow user to create the content and exchange that with other people through the Internet" [Kaplan, Haenlein: 61]. This definition limits social media to digital technologies emphasizing content and engagement created by users. The primary advantages of social media are reaching out, spreading content, and interactivity between users. Social media can take the form of social networking site (e.g., Twitter, Facebook*, LinkedIn*), blog (e.g., Tumblr, Wordpress, Blogger), discussion forum, content sharing, video sharing (e.g., YouTube), social bookmarking (e.g., Digg, Reddit), podcasts, and wiki [Sharma, Verma]. Among them, social networking sites are now more popular than the others. Social networking sites allow its users to develop friendship environment and share a variety of information online [Boyd, Ellison]. The most widely used social networking sites are Facebook*, Twitter with millions monthly active users each[1]. With more than 2.9 billion monthly active users as of the second quarter of 2022, Facebook* is currently the largest social networking site worldwide[2]. Likewise, Twitter has become one of the most successful social networking site at the moment. In 2024, it is estimated that there will be around 340 million active users, up from 322 million in 2021[3]. Notably, social media when compared to traditional mass media is different in some aspects: firstly, social media involves all four prototypes of communication; secondly, now everybody can create and publish contents through social media; thirdly, the publication of information through social media can be done anytime [Jensen, Helles; Adornato]. These differences emphasize the right to produce and provide information for everyone on social media. To sum it up, Table 1 summaries the primary elements used to define social media.

Science communication is defined as "the use of appropriate skills, media, activities, and dialogue to produce one or more of the following personal responses to science: Awareness, Enjoyment, Interest, Opinion-forming, and Understanding" [Burns,

* Recognized extremist and banned in Russia.

[1] Statista (Sep 10, 2021). Most popular social networks worldwide as of July 2021, ranked by number of active users (in millions) [el. source]: https://www.statista.com/statistics/272014/global-social-networks-ranked-by-number-of-users/ (accessed: 14.09.2021).

[2] Statista (Aug 22, 2022). Number of monthly active Facebook users worldwide as of 2nd quarter 2022 (in millions) [el. source]: https://www.statista.com/statistics/264810/number-of-monthly-active-facebook-users-worldwide/ (accessed: 21.09.2022).

[3] Statista (Jul 27, 2022). Number of Twitter users worldwide from 2019 to 2024 (in millions) [el. source]: https://www.statista.com/statistics/303681/twitter-users-worldwide/ (accessed: 21.09.2022).

Table 1. The elements often used to define social media

Element	Explanation
Creation and dissemination of content	User can create and share content
Interactivity	User can make reaction, comment, and share posts
Convergence	Multimedia (posts include but not limited to texts, photos/images, videos, links, etc.)
Speed	Posts are accessed readily once uploading is complete
Cost	Mostly popular social media platforms can be used/ accessed free
Reach and numbers	Social media gets rid of geographical barriers. It connects people globally

O'Connor & Stocklmayer: 191]. Kulczycki classified two types of science communication by recipients groups [Kulczycki]. First, the "external communication science" is addressed primarily to non-scientists. The first type of science communication is explaining and disseminating scholarly research through the publication of popular science texts, the organization of science festivals, and the creative images of science and scientist. Second, the "internal communication science" is addressed mainly by professional researchers. The second type of science communication includes publishing research articles, scientific blogs, management, and social networking sites for scientists.

Social media is growing and the number of social media users is increasing as well. Importantly, social media provides scientists the optimal medium for sharing information, creating online scientific communities, engaging different groups of people, and a place for interactivity. Therefore, scientists have realized the importance of using social media in science communication [Habibi, Salim].

The current use of social media in science communication. Millions of Internet users around the world are constantly sharing knowledge and information on social media. Scientists also integrate with this trend. Communication via social media has become crucial and essential to distributing scientific information amongst researchers and the public. A survey of 3,748 American scientists conducted by the Pew Research Center in January 2015 reported that 47% of surveyed scientists discussed science or read about scientific developments through social media[1]. Another survey of 587 scientists from 31 countries found that Twitter, Facebook, and LinkedIn were the most widely used platforms by scientists, particularly by 88%, 82%, and 66%, respectively

[1] Rainie L., Funk C., Anderson M. How scientists engage the public. Pew Research Center (February 15, 2015) [el. source]: https://www.pewresearch.org/science/2015/02/15/how-scientists-engage-public/ (accessed: 14.09.2021).

[Collins et al.]. In addition, scientists were also increasingly interested in WordPress, ResearchGate, Tumblr, Blogger, Academia.edu, and more.

Use for communicating with the public. As mentioned above, science communication of the first type refers to activities in which scientists disseminate the results of their research outside of academia. The involvement of scientists in social media helps promote scientific achievements, increase the prestige of scientific activity, and strengthen the authority of scientists in society. Being good science communicators can help explain the importance of science, its impacts, and its uses in our lives more effectively. It also helps educate citizens concerned about threats facing people and the planet to better shape the direction of policymaking [Jucan M.S., Jucan C.N.].

Science communication researcher Mojarad emphasized that the job of a scientist in the social media age includes researching, teaching, and championing the messages of science [Mojarad: 1363]. Scientists need to be good at putting their ideas into writing and know how to post them on various social media platforms. There is no doubt that social media makes research results as widely available and accessible. In the past, science communication has been disseminated to the audience through traditional mass media such as books, newspapers, magazines, television, and radio. This process is 'one-to-many' communication – 'one' person (for example, the author of a book) simultaneously to many people (the audience). The commonality in traditional mass media tools is a barrier between scientists who disseminate ideas or information and their audience. Social media, meanwhile, allows different modes of communication (one-to-one, many-to-one, one-to-many, many-to-many) depending on how individuals wish to connect [Jensen, Helles]. Therefore, scientists will be more effective in bringing the scientific world to the masses by improving communication via online interactions.

Scientists choose multiple platforms such as Facebook, Twitter to reach a global audience. In addition, blogs play a significant role in increasing public understanding of science [Collins et al.]. Although there are different types of online discussions and shared content, scientists in various disciplines share published articles, exchanging scientific knowledge, posting updates from conferences, or circulating information about professional opportunities and upcoming events mainly via Facebook, Twitter, and blogs. For instance, Haustein analyzed 24 million tweets linking to scholarly documents and found that most tweets linking to articles appear shortly after publication in academic journals [Haustein]. Additionally, most tweets include hashtags, mention the title and a summary of the article that they refer to. Likewise, Facebook is used by many scientists to share science with personally connected or interested colleagues, friends, and family [Collins et al.]. It is noted that a formal style based on expert jargon may be difficult or even impossible to understand by non-experts. Less complicated and more informal, by contrast, can help readers better understand [Della Giusta et al.]. Thus, on social media, scientists explain the world of science in a language that can assist understanding by public members.

Furthermore, communication on social media is a two-way dialogue between scientists and the public. Therefore, scientists share research findings and learn about the public's opinions and needs based on their feedback.

Use for communication with the scientific community. In recent years, social media has become a part of the open science movement by creating scientific social communities called academic social networks, which refer to specialized platforms designed for researchers to communicate, disseminate, and exchange science-related information among the members involved [Elsayed]. Today, ResearchGate and Academia.edu are considered two of the most popular academic social networks. Both ResearchGate and Academia.edu are free of charge to use [Ovadia]. They allow members to upload their works and follow the network activity of other users. Besides, both sites provide publication analytics and facilitate the exchange of information. In particular, ResearchGate is going viral with more than 20 million members[1]. ResearchGate has an area for intra-institutional collaboration on projects used for document sharing and commenting; however, collaborators must be invited [Ovadia]. The role of academic social networks is not limited to sharing knowledge and exchanging experiences only. These networks help researchers know the value of their works by providing statistics concerning the use of uploaded papers and where researchers' profiles can be viewed [Elsayed]. Academia.edu tracks several metrics, showing users the number of times uploaded documents have been considered, the number of times the researcher's profile has been viewed, as well as the searches that led people to their profile [Ovadia].

Twitter also is one of the most popular tools regarding interaction with the scientific community. In a post restricted to 280 characters, Twitter users can share their thoughts and upload images or short videos. Twitter post (tweet) can include hashtags to indicate its topic, allowing people to find related tweets easily. Stillwell stated that Twitter is what scientists need to connect, learn, and celebrate together [Stillwell]. Virtual discussions can lead to social interactions in real life. Before meeting in person, conversations on Twitter can help scientists get closer in a workshop or conference setting. The scientist's impact can also be extended more widely in the research world through social media. Tweets from conferences can introduce scientists to valuable content and thus provide networking opportunities for users who actively post during meetings. Besides, Twitter works as an information filter for scientists so that it helps scientists keep up with new research developments [Bik, Goldstein]. For example, sharing research articles on Twitter can inform scientists to interesting papers they may not have seen (e.g., articles in journals tangential to their field or publications they usually do not read). Scientists who follow conference tweets may be further introduced to new researchers with relevant interests, especially early-career scientists and those new to Twitter. Thus,

[1] ResearchGate. About us [el. source]: https://www.researchgate.net/about (accessed: 10.09.2021).

conference tweets can enhance in-person networking opportunities by expanding these activities to online spaces.

Blogs focus on particular subjects written by scientists for scientists are becoming common and serve as places for the exchange of ideas. In addition, presentation sharing platforms (e.g., Slideshare) are commonly used to share presentations and documents at conferences or talks.

Conclusion. Social media is undoubtedly an effective way to disseminate information on science, discuss scientific reports, share personal experiences, and keep up to date with relevant literature. Social media supports the exchange of scientific information internally within the research communities and externally for outreach to engage the public as well. Realizing quite quickly advantages of social media, some popular platforms such as Facebook, Twitter, ResearhGate are being widely used by the scientific community to boost their professional profile and serve as a public voice for science. This paper is useful for those interested in the current practice of science communication on social media. Understanding how scientists are currently using social media may help further contextualize expectations for those who have not yet adopted the practice. However, the current paper has restricted concentrate on a review of how scientists use social media for science communication. In addition, the literature review is not exhaustive. Future studies can discuss difficulties or challenges that scientists may face with social media and how to overcome them. By doing this, we can see a clearer picture of social media usage in the academic environment.

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■ ■ ■ Социальные медиа как среда научной коммуникации

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Аннотация. Социальные медиа – приложения и веб-сайты – позволяют пользователям подключаться и обмениваться данными через Интернет. Рост популярности платформ социальных медиа создал большие возможности обмена научными знаниями и интерактивного взаимодействия между исследователями и пользователями, ученые все чаще используют социальные медиа. На основе контент-анализа статей, опубликованных в научных журналах, автор предлагает обзор сложившейся практики использования различных платформ социальных медиа для научных коммуникаций. Обзор существующей литературы показал, что за последнее десятилетие несколько платформ социальных медиа использовались для распространения результатов исследований за пределами академических кругов и привлечения внимания широкой аудитории. Кроме того, ученые также используют социальные медиа для создания научных связей, обмена и обсуждения результатов своих исследований и идей с научным сообществом по всему миру, а также для того, чтобы быть в курсе изменений в научной коммуникации. Facebook*, Twitter, ResearchGate, Academia.edu и блоги являются наиболее часто используемыми платформами. Эта статья поможет лучше понять, как ученые в настоящее время используют социальные медиа в качестве средства коммуникации внутри и за пределами научного мира.

Ключевые слова: научная коммуникация, коммуникация в науке, научная информация, социальные медиа

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