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Science communication objectives and actual practices of science news websites as a showcase for gaps between theory and practice

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Abstract

This study contributes to the growing body of science communication research showing gaps between theory and practice objectives, focusing on one particular understudied and emerging science communication innovation.The objectives and practices of four Israeli science news websites were analyzed considering three science communication models: *Dissemination*, *Dialogue*, and *Participation.* Using concurrent parallel mixed methods, we examined the perspectives of website administrators (n=8) and readers (n=20) through interviews, a content analysis of news items (n=298), discussion threads (n=507), and reader questionnaires (n=89). Findings indicate limited adoption of two-way communication about how science is applied in society. The scant implementation of the dialogue model suggests its promises are not concretized in practice on these science news websites.

Keywords

Popularization of science and technology; Public engagement with science and technology; Science communication: theory and models

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The continuous reevaluations over the past few decades of the relationships between science, the media, and the public have challenged the traditional science communication approach that aims to transfer scientific knowledge or persuade audiences of science's benefits [Bucchi & Trench, 2021]. Instead, they promote a more interactive and deliberative communication that actively engages the public [Davies et al., 2021]. These reevaluations have shifted the emphasis from a *public understanding of science* toward a *public engagement with science* that involves sharing and exchanging knowledge, perspectives, and preferences between or among groups with varying expertise, power, and values [Jensen & Holliman, 2015]. Science communication is thus seen as critical, dialogic, and participatory, aiming to enable diverse publics to have more significant influence in collectively shaping the impact of science on society [Fahy & Nisbet, 2011]. However, studies point to gaps between the stated aspirations of science communication in theory and its actual practice [e.g., Brossard & Lewenstein, 2009; Kappel & Holmen, 2019; Metcalfe, 2019]. While theory stresses the importance of interactive and deliberative science communication that actively engages the public, much of the practice still appears to be centered on disseminating scientific knowledge and educating the public [Metcalfe, 2019].

Differences in approaches to communicating science affect the public's attitudes, opinions, and engagement [National Academies of Sciences Engineering and Medicine, 2017]; therefore, exploring the objectives and practices of those directly involved in science communication is paramount. This study examined how the theoretical shift toward dialogue and participation might be realized in practice in the context of online science-related engagement activity, specifically – science news websites.

Science news websites (SNWs) are "peripheral journalism actors" that publish science news by integrating scientific expertise with journalism. Their writers usually hold advanced degrees in science, and some are practicing scientists. They follow some journalistic practices and work as an editorial team despite not being professional journalists [Ginosar, Zimmerman & Tal, 2022]. Typically, these entities operate independently and produce original content primarily focusing on popular science, similar to contents produced by "Scientific American". They rarely engage in commentary-style initiatives like those undertaken by "The Conversation".

SNWs can be an interesting context for comparing science communication theory with practice. First, science news is a prevalent way for the public to engage with science, with 54% of Americans regularly consuming science news from news outlets [Funk, Gottfried & Mitchell, 2017] and 48% of Israelis [Israel Ministry of Science and Technology, 2015]. SNWs distribute their original content to social media, as well as to general media outlets, potentially reaching broader audiences compared with only science enthusiasts. Second, SNWs enable reader comments – technically allowing discussion between readers and between readers and authors. Hence, they may promote diverse science communication objectives beyond dissemination, such as dialogue and policy advocacy.

We compared the science communication objectives and actual practices of four Israeli SNWs with the objectives implicit in the three most widely discussed theoretical science communication models: *Dissemination*, *Dialogue*, and *Participation* put forward by Lewenstein [2003] and refined by Brossard and Lewenstein [2009] and Bucchi and Trench [2021]. These models describe the relationship between science communicators and the public on a continuum of increasing interactivity from limited to substantial, representing one-way, two-way, and multi-way communication models [Trench, 2008]. Each model reflects different objectives, summarized in Table 1. According to the *Dissemination model*, also commonly referred to as the "Deficit-model", science is disseminated by experts to less knowledgeable publics. Its objectives are to inform the public about science and make reliable science content accessible. The *Dialogue model* focuses on Interactive bidirectional communication that seeks to engage publics in science-related discourse, enabling people to talk back and share their opinions and experiences. The *Participation model* involves multidirectional communication between experts and the public. Its objectives include public participation in shaping science policymaking and co-creation of new scientific knowledge. These models are far from trichotomies, and the literature has pointed to their coexistence and blurred boundaries, as evidenced in science engagement activities [Metcalfe, 2019]. Contemporary models of science communication, stemming from societal and political aspects, address the discourse surrounding science, as well as the ethical, societal, and political questions that arise from its practical applications. These models have emerged in response to the ever-evolving information landscape and the emergence of new scientific challenges [Akin & Scheufele, 2017], and may involve diverse actors outside science who function not just as recipients of science communication but also as communicators [Faehnrich, 2021]. However, for this study, which focuses on assessing the disparity between the envisioned science communication objectives and their actual implementation, the three most discussed models of science communication are the most appropriate. They provide a practical conceptual framework for examining different objectives for science communication activities with significant ongoing infrastructures.

Table 1. Analytical framework for analyzing the websites' science communication objectives.

PCST models [Bucchi & Trench, 2021; Trench, 2008]			Science communication objectives [Metcalfe, 2019; Scheufele, Krause, Freiling & Brossard, 2021]
	Sci-comm applications	*Science orientation to public*	
Dissemination	Education	They are ignorant	Enhance the public's scientific literacy to be able to make informed decisions
	Defense	They are hostile	Contradict science misinformation, disinformation, and fake news
	Popularization	They need to be informed	Inform the public about science and distribute scientific content
			Make scientific content accessible
	Promotion	They can be persuaded	Excite the public about science and increase appreciation for science
			Gain the public's support and government funding for science
	Contextualization	They have diverse needs	Tailor messages to specific audiences
Dialogue	Consultation	They talk back and we find out their views	Find out the public opinion and needs to better communicate science
	Engagement	They take on the issue	Encourage the public to be involved in public science discourse, express concerns and raise questions that stem from science and its applications
Participation	Deliberation	They and we shape the issue and set the science agenda	Foster the public to help set the agenda for science by actively deliberate in public debates on the "why" and "why not" of science, as part of democratic policymaking
	Critique	They and we negotiate meanings	Enable responsible innovations – Acknowledge the public critique on the science research enterprise priority list, and strive to maximize possible societal returns from investments in science for the larger social good
	Collaboration	They and we co-create	Encourage the public to participate in research endeavors with scientists, encompassing the real-life experiences of non-experts and their socially informed scientific knowledge as part of the collaborative knowledge creation process

Obviously, SNWs serve as platforms for distributing scientific news, aligning with various goals encompassed within the dissemination model. However, as these websites permit readers to post comments over an extended period, they also potentially establish a realm for trust-building engagement, including interactive discussions and critique about how science is applied in society – objectives associated with the dialogic and participatory models. Nevertheless, it remains uncertain whether these opportunities are seized by the SNW staff. To explore this, we ask:

RQ1. What are the objectives of SNWs in communicating science to the public, and which science communication model do they reflect?

RQ2. How are SNWs' objectives manifested in their practice?

We posit that SNWs inherently prioritize the objectives of the dissemination model to a great extent while only minimally emphasizing those of the participation model, such as collaboration and co-creation of knowledge. The pivotal and crucial question revolves around whether they promote dialogic objectives.

SNWs' objectives were analyzed based on interviews with their administrators. Actual practices were determined through content analysis of their publications as well as their associated discussion threads, interviews with website readers, and a reader questionnaire.

Here, we provide comprehensive insights into the editorial practices of SNWs and the perspectives of actors on both their production and audience sides. The significance of this study rests in its capacity to focus on the potential ramifications stemming from the prioritization of objectives within science communication and in introducing a novel framework for categorizing the science communication objectives based on practitioners' reasoning.

The evolving landscape of science communication via online media

Science communication through the media reflects both the traditional and the dialogic perspectives: it plays pragmatic and cultural roles related to science and society, including the promotion and marketing of science, critiquing it, and drawing attention to social issues [Davies, 2020]. It also simplifies scientific information and relates it to real-world phenomena, events, and issues that concern daily life, thus fulfilling the critical task of making scientific knowledge understandable and accessible to the public at large, potentially leading to changes in attitudes, beliefs, and intentions about science [Dunwoody, 2021].

With the internet becoming the primary source of scientific content [National Science Foundation, 2020], the exclusive position of legacy media (i.e., print and broadcast) as the absolute channel through which scientific information gets to the public has been deprived in favor of digital media [Dunwoody, 2021]. Digital media affordances, encompassing features like hypertextuality, multimodality, and interactivity, have significantly shaped information societies and dialogical journalism [Deuze, 2003]. New media and Web 2.0 opened up opportunities for greater interactive public engagement with popular forms of science [Brossard, 2013]. The contemporary online media ecosystem has enabled the rise in prominence of other online actors, facilitating multi-way communications between individuals and groups and providing spaces for a deliberative public sphere, thus dispossessing, to some level, science journalists from their traditional roles as gatekeepers and watchdogs [Fahy & Nisbet, 2011]. It allows different levels of interactivity, from one-click activities, such as adding emojis and sharing, to generating and publishing original content by users [Oh, Bellur & Sundar, 2015]. Posting comments is subsumed to the latter since users generate unique content by self-expressing thoughts, beliefs, and feelings [Taddicken & Krämer, 2021]. Interactive and discursive practices may empower citizens beyond one-way science communication [Lewenstein, 2015], potentially resulting in high levels of public involvement, such as reshaping framing [Laslo, Baram-Tsabari & Lewenstein, 2011], supporting knowledge construction [Dubovi & Tabak, 2020], and providing a foundation for greater public engagement in bioethics [Laslo & Baram-Tsabari, 2019].

The interplay between traditional actors at the core and non-traditional players at the periphery shapes the manner in which it is no longer possible to draw clear lines between what journalism is and what it is not [Tandoc Jr., 2019]. Amid these trends, science experts are now able to engage with and have an impact on the broader public via novel interfaces in science communication, such as "The Conversation", acting as amplifier platforms directly linked to mainstream and social media [Guenther & Joubert, 2021]. However, the positioning of SNWs is different than that of science journalism. SNWs might be more geared toward affirmative and uncritical science writing than science journalism, designed for republishing content in general media and easily sharing articles on social media [Riedlinger et al., 2023]. Therefore, our analysis used a science communication rather than a science journalism perspective.

Methods

Quantitative and qualitative data were independently collected using a concurrent parallel mixed methods approach to achieve greater complementarity and development [Creswell & Creswell, 2018]. The study involved interviews with the websites' administrators[1] and an analysis of their homepages to define their science communication objectives. It also included a content analysis of website items and their discussion threads, interviews with website readers, and a reader questionnaire to examine the practices employed by the websites to achieve their objectives.

Research field

Four leading Israeli SNWs were included in this study. To preserve the anonymity of the interviewees, the sites are denoted by the letters *A* to *D*. The four websites met three pre-determined inclusion criteria: (1) coverage of various science topics, (2) a publishing frequency of at least four times a week, and (3) cultural prominence confirmed by a mention in a chapter on Israeli science communication [Baram-Tsabari et al., 2020]. The websites exhibit a similar essence to peripheral journalism entities, as Ginosar et al. [2022] pointed out. They display both commonalities and distinctions in their characteristics: *A* and *B* are operated by renowned organizations, a research institute, and a scientific association that provides financial support, whereas volunteers operate the others. *B* primarily focuses on environmental sciences and ecology, whereas the other three websites present a more comprehensive range of science topics; *A*, *B*, and *C* are operated by

[1]The websites' administrators write and edit science news, moderate reader comments, and manage the website and Facebook page.

science-trained staff, whereas *D* is operated mainly by one person, an ex-journalist. In addition to original texts, *A* and *D* also post press releases from research institutions and universities (8% and 43% of the websites' content, respectively). The four websites are active on several social networks, but primarily Facebook (see appendix A). Two of the websites provide their items at no cost to general media outlets.

SNW readers.

Demographic data were gathered through a short online demographic questionnaire posted on the Facebook page of each website and one website's homepage. Respondents (N=515) were asked to indicate their gender, age, education, and internet browsing frequency. Of the respondents, 63% were males, 76% had an academic degree, and 60% worked or studied in STEM[2] fields. They ranged widely in age,[3] and half of the respondents said they keep up with science news by using other online sources as well, such as blogs and forums. SNWs' readers greatly differ from the Israeli general public in several demographic parameters: males are overrepresented, relatively younger, possess higher levels of education, display a greater inclination towards scientific pursuits, and identify themselves as (see appendix B). This is not unique to Israel; similar demographics were demonstrated among science blog readers [Jarreau & Porter, 2017]. According to the Pew Research Center report [2017], active science news consumers who seek out science news and consume it at least a few times a week are more likely to be male college graduates. Since the participants in this study fit that description, they likely represent typical active consumers of scientific information. However, this type of audience is still considered non-expert to some degree, despite being educated and science-minded, due to the high degree of differentiation and specialized nature of scientific disciplines [Summ & Volpers, 2016]. That said, it is critical to reiterate that two SNWs republish their items on general media platforms with broad distribution, potentially reaching a more extensive and diverse audience than on SNW platforms.[4]

Data Collection and Analysis

Interviews with website administrators. Eight semi-structured interviews were conducted with website-leading staff members to understand better the websites' objectives and modes of communicating scientific knowledge to the public. The interviewees were explicitly asked to describe the website's objectives and were encouraged to elaborate on their relationships with their readership and other media agents. Four other interviews with the lead administrators of each website (out of the first eight interviewees) were conducted via Zoom for more information. The interviewees were presented with the literature-based list of 12 science communication objectives shown in Table 1 and were asked to rank them from 1 to 6 in terms of importance from the website's perspective. The interviewees were not

[2] STEM – Science (Biology, Physics, Earth Sciences), Technology, Engineering, and Mathematics.

[3] 20% (n=103) aged 18–24, 39% (n=201) aged 25–39, 23% (n=118) aged 40–54, 18% (n=93) aged 55–80.

[4] The number of visits to the leading general media site that published content from SNW A and B was 56,800,000 (February 2022) compared to an average of 202,000 visits per month to SNW A-D (SimilarWeb data).

aware of the origins or classification of the objectives regarding the three theoretical models. To assess the extent to which the administrators assigned the same ratings, we calculated an Intraclass Correlation Coefficient (ICC) using an absolute agreement, 2-way random effects model. The ICC value was 0.891, and the 95% confidence interval ranged from 0.74 to 0.97, indicating good reliability. This list of 12 objectives was also used as a framework for analyzing the unstructured speech of the interviewees (n=8). To identify emerging themes, interviewees' statements were further analyzed using thematic analysis driven by insights gained through interaction with the data [Braun & Clarke, 2006]. All the interviews lasted about an hour, were recorded, and transcribed. Example quotes were selected to demonstrate the shared attitude and state of mind of administrators.

Website homepage. Additional information was retrieved from each website's "about us" section to understand better the websites' aims and how they describe themselves (e.g., their mode of operation and the staff's academic and professional experience).

The news items. All the news items published by the websites during the last quarter of 2019 were collected (N=298): 118 by *A*, 51 by *B*, 62 by *C*, and 67 by *D*. We chose this period because it encompassed the most recent period before COVID-19 dramatically changed scientific coverage, aiming to examine a routine type of coverage. The number of published items on each website during this period was within the standard deviation for all quarters of 2018 and 2019. To assess the practices of the objective of "making scientific content accessible", we analyzed the items to identify and quantify the accessibility strategies used by the websites. Accessibility strategies are design elements and key attributes incorporated into the text to provide a context, make the message more understandable, and appeal to the audience [McTigue & Slough, 2010]. The analysis employed a coding scheme drawn from the accessibility approaches outlined by the websites' administrators. This scheme was reinforced by insights from the literature regarding methods to enhance text accessibility in general and scientific contexts. The initial reference was the analytical structure Baram-Tsabari and Lewenstein [2012] proposed, intended for scientists communicating science with the public. This framework was tailored to align with the specific objectives of the present study, encompassing thirteen accessibility strategies, categorized into four clusters denoted Clarity, Visualization, Relevance, and Style (Table 2). Each of these clusters centered on a distinct facet of accessibility.

The items were additionally sorted by subject into one or two science field categories: Medicine & Health, Life Sciences, Environmental Sciences, Technology & Space, or the Physical Sciences (i.e., Physics, Chemistry, and Math). The codebook underwent a process of face validation involving evaluation by five science communication researchers. It was tested and refined through multiple iterations until a comprehensive and precise version was attained. The initial author and a trained research assistant collaborated on coding the items. To establish intercoder reliability, they individually coded a subset comprising 20% of the items (n=61). Cohen's kappa coefficient was computed for each criterion to confirm satisfactory levels of intercoder reliability (Table 2). Any disparities in coding were deliberated upon until a consensus was achieved before their incorporation into the analysis.

Table 2. Coding scheme for the accessibility strategies used in the science news websites' news items.

Cluster	Accessibility strategy	Operationalization	Variable values	Percentage	Intercoder reliability[1]
Clarity	Item length	The word count per item, excluding the title and captions	Low < 450	9%	1
			Medium 451-850	65%	
			High > 851	26%	
	Jargon	The count of jargon-terms[2] (e.g., zygote, endothelium, hydrolysis). Each term was coded only once, regardless of its frequency in the text	Light: 3 terms or less	48%	0.74
			Moderate: 4-6 terms	34%	
			Heavy: 7 terms or more	18%	
	Explanations	A clarification offered after the utilization of an unfamiliar scientific term	Yes/No	66%	0.80
	Examples	A concrete case to elucidate a broader scientific concept	Yes/No	42%	0.75
	Analogies	A commonly understood and straightforward notion presented to clarify a less familiar and more intricate concept	Yes/No	7%	0.81
Visualization	Pictures	An image, a photograph, or an illustration incorporated into the text	Yes/No	94%	1
	Diagrams	A chart, a flow diagram, or a mathematical formula included alongside the text	Yes/No	8%	0.92
	Videos	A video clip linked within the text	Yes/No	26%	1
Relevance	Current affairs	The item reported a contemporary scientific occurrence (such as a scientist receiving an award or a recent climate conference) or offered a scientific perspective on ongoing current affairs	Yes/No	29%	0.74
	Local aspects	The item showcased an event or a matter with potential implications for Israel or Israelis. For instance, the launch of "Beresheet," the robotic lunar lander and lunar probe developed by Israel Aerospace Industries	Yes/No	22%	0.92
	Socio-scientific issues (SSIs)	The item introduced a scientific issue eliciting public debate that has societal implications (such as genetically modified organisms or biofuels)	Yes/No	8%	0.62
	Applications	The item presented technological breakthrough that adds value to individuals or society	Yes/No	16%	0.65
Style	Narrative	The item adopted a storytelling style, involving one or multiple characters, or conveyed a series of events	Yes/No	8%	0.80

[1] To achieve intercoder reliability, the first author and a trained research assistant independently coded a sub-sample of 20% of the items (n=61). Cohen's kappa coefficient was calculated for each criterion to ensure acceptable levels of intercoder reliability.

[2] The jargon terms identified by the two coders were corroborated in two steps by eight science educators, of whom three have a PhD. The experts first independently identified jargon words in 10 articles. Then jargon words that were identified by at least five of the eight experts (> 63%) were compared to those identified by the coders. An agreement of 89% was achieved.

Discussion threads. All the comments corresponding to each of the 298 items were collected chronologically from the website and Facebook platforms;[5] 3137 of the comments were generated by readers (range per news item 0–74; Median=3; IQR[6] =11.5) and 477 by SNW administrators (range per news item 0–17; Median=0; IQR=2). These statistics indicate that most items were only followed by a few comments. To examine dialogical practices, the interactions between readers and administrators were explored. Interactions between participants in online communication are best understood as a series of mutually responsive messages that should be weighed against the overall message of the discussion thread [Lucas, Gunawardena & Moreira, 2014]. The multi-directional nature of online communication often launches various threads of discussion in response to a single item; hence, we defined a discussion thread as one comment or a series of comments with the same context. Based on this definition, the comments were further grouped into 507 threads (range per news item 1–9; Median=1.5; IQR=2), 89 of which (18%) were single comments. In each discussion thread, only the first four questions were documented. The analysis of the discussion threads focused on examining the websites' practices related to dissemination and dialogue objectives, as detailed in Table 1. Specifically, it recorded whether readers or administrators participated in the discussion, whether a question raised by a reader was answered and by whom, and whether a reader's comment was challenged if it contained misinformation. The discussion thread analysis also examined whether asymmetrical or symmetrical communication occurred between the readers and the administrators. *Asymmetrical communication* addresses knowledge deficits and seeks more effective public persuasion, whereas *symmetrical communication* involves exchanging information to find mutually beneficial solutions [Trench, 2008]. In *asymmetrical communication*, the administrator retains primary control over scientific knowledge by using the answers to fill the apparent deficits of the reader's knowledge, whereas in *symmetrical communication*, the exchange of scientific knowledge is more balanced. However, it is worth noting that different initial reader comments may elicit different responses. For example, if a reader asks for clarification or more information, this clearly constitutes a request for knowledge. Here, we simply differentiated between the two types of communication. To achieve intercoder reliability, the first author and two trained coders independently coded a sub-sample of 10% of the discussion threads (n=51). Cohen's kappa coefficient values ranged from 0.74 to 0.91 (Table 3). Coding discrepancies were discussed until a consensus was reached before they were included in the analysis. Table 3 depicts the thread coding scheme and selected examples to illustrate (i) a reader's question, (ii) a website administrator's attempt to counter misinformation, and (iii) the two types of communication between administrators and readers.

[5]On the website and the Facebook platforms, discussion threads related to the same item were documented separately.

[6]IQR — Interquartile range.

Table 3: Coding scheme for discussion threads to news items, and their distribution (n=507).

Categories	Operationalization	Percentage	Selected examples	Intercoder reliability
Participants	A reader – a single comment without follow-up comments (n=89)	18%		-
	Dialogues between readers and administrators (n=215)	42%		
	Dialogues between readers (n=203)	40%		
A science-related question[1] raised by a reader (n=306)	Addressed by the administrators (n=174)	57%	Reader: *"Why would the material coalesce in threads rather than balls?"* Administrator: *"Normally, matter collapses into "balls" (galaxies) at first, but as the universe expands, the "balls" stretch out and form threads."* *(D7TH435, October 2019)*	0.74–0.89
	Addressed by other readers (n=37)	12%		
	Addressed both by the administrators and the readers (n=34)	11%		
	Not addressed (n=61)	20%		
Misrepresented science posted by a reader (n=25)	Administrators' attempt to contradict the misinformation (n=7)	28%	Reader: *The use of genetic engineering to improve genes has led to the creation of toxic strains harmful to humans.* Administrator: *Both physicians and scientists have determined that genetic engineering is safe and is, in fact, crucial to providing food in underdeveloped areas. The position you cite is primarily based on Facebook messages written by people without any scientific background. These people tend to oppose genetic engineering. My preference is to believe in someone with expertise in the field.* *(C28TH331, November 2019)*	0.79
	Reader attempts to contradict the misinformation (n=2)	8%		
	No attempt to contradict the misinformation (n=16)	64%		
Dialogue types between administrators and readers (n=215)	Asymmetrical communication (n=92)	43%	Reader: *"Is it possible that the same mutations develop in both the southern and northern hemispheres?"* Administrator: *"Southern hemisphere mutations differ from northern hemisphere mutations. Health organizations check which strains are common in the southern hemisphere before the winter here begins because they are likely to reach us, and before the winter in the southern hemisphere begins, the health organizations check which strains have developed in the northern hemisphere."* *(A7TH105, November 2019)*	0.91

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Table 3: *Continued from the previous page.*

Categories	Operationalization	Percentage	Selected examples	Intercoder reliability
	Symmetrical communication (n=81)	38%	Reader: *"You wrote that the Helium particle inside the balloon occasionally finds itself outside. However, Helium particles outside the balloon can also find themselves inside. If they had simply exited the balloon according to the laws of entropy, it would have taken much longer. This means that a strong force actively pushes the Helium particles out of the balloon."* Administrator: *"That's interesting. Would you be able to present the calculation you did to prove that entropy considerations lead to a slower process? What is the typical time for each function? By the way, entropy dominates even when there are no pressure differences..."* Reader: *"Let's consider an imaginary environment where a Helium particle is close to the microscopic hole in a balloon and the forces exerted on it [....] "* Administrator: *"Yes, but because Helium is an ideal gas, the repulsive forces between its atoms are negligible, and the square of the distance..."* The discussion continues... *(C7TH185, October 2019)*	
	Other (n=42)	19%	Reader: *"The word temperature is spelled incorrectly."* Administrator: *"Thanks for pointing this out. I fixed it."* *(A65TH26, October 2019)*	

[1] The first four reader questions in a single thread were analyzed.

[2] To achieve intercoder reliability, the first author and two trained coders independently coded a sub-sample of 10% of the discussion threads (n=51). Cohen's kappa coefficient was calculated for each criterion to ensure acceptable levels of intercoder reliability.

Reader questionnaire. An online questionnaire was emailed to 164 SNW readers out of the 515 who filled in the demographic questionnaire and left their contact information; 89 complete questionnaires were received (54%). The questionnaire aimed to quantitatively assess the extent to which the websites fulfill the 12 science communication objectives detailed in Table 1 from the readers' perspective. The instructions read: *Assume that the following twelve statements describe the science news websites' objectives. To what extent are these objectives met in the items they write and publish and in their reactions to reader comments?* The respondents rated each objective on a 6-point Likert scale ranging from 1 (very little) to 6 (very much). To assess the extent to which the readers assigned the same ratings, we calculated an Intraclass Correlation Coefficient (ICC) using an absolute agreement, 2-way random effects model. The ICC value was 0.976, and the 95% confidence interval ranged from 0.95 to 0.99, indicating excellent reliability.

Interviews with the readers. Twenty semi-structured interviews with website readers were conducted via Zoom to provide insights into these readers' perceptions of the websites' efforts to fulfill the 12 science communication objectives. Fourteen interviewees (70%) were male, and 16 (80%) held a college degree. They ranged in age[7] from 18 to 80. A purposive sampling technique [Patton, 2015] was used to recruit these interviewees. Priority was given to readers who reported on the questionnaire that they were inclined to write comments or read those written by others. The interviewees were asked to elaborate on the ways the websites met each science communication objective they rated on the online questionnaire and to ground their explanations by providing examples. The interviews lasted about an hour, were recorded, and then transcribed. The interviewees are denoted by numbers (#1, #2, etc.) attached to their illustrative quotes.

Statistical analysis. Statistics were calculated using SPSS statistical package version 28 (SPSS Inc, Chicago, IL).

Ethics. This study was approved by the university Institutional Review Board (approval No. 2021-010). All participants filled in a consent form, and they were all volunteers.

Results

SNWs' objectives

Bridging the gap between the scientific community and the general public was a shared fundamental goal that was clearly expressed in the "about us" section on all the websites we studied. Even though administrators (n=8) explicitly stated in their interviews that they targeted the general public, the actual readership of the SNWs was narrower and unrepresentative of the general public: it was made of more educated science-oriented young males than the general population. However, republishing the science items on general media platforms that offer large distribution to multiple publics increases the reach to the general audience. Therefore, this objective is not entirely detached from practice, which targets broad audiences.

Scrutinizing more nuanced science communication objectives (Table 1) was done based on administrators' prioritization (n=4) and free speech quotes (n=8). Table 4 shows that the objectives related to the dissemination model were ranked the highest by the administrators, and many were spontaneously mentioned. Objectives related to the dialogue model were perceived as relevant but less central. Administrators of three websites clearly expressed that, given additional resources, their priority would be to allocate them towards publishing more content rather than initiating discussions with the audience. Some objectives related to the participation model were not prioritized at all by two of the four websites.

SNWs' practices

Table 4 indicates that the readers perceived many of the objectives related to the dissemination model as manifested in the work of the SNWs, whereas the objectives associated with the dialogue model as less actively pursued by the websites' administrators. The objectives related to the participation model were ranked last. Appendix D provides illustrative quotes from readers.

[7] 15% (n=3) aged 18–24, 25% (n=5) aged 25–39, 30% (n=6) aged 40–54, 30% (n=6) aged 55–80.

Table 4. Administrators' ratings of the science communication objectives by their importance to the websites, and readers' ratings of the extent to which they perceive the websites' effort to pursue these objectives.

Science communication objectives by PCST models		Administrators' Ratings[1] (n=4)					Readers' ratings[2] (n=89)
		A	B	C	D	Estimated average	Estimated average
Dissemination	Enhance the public's scientific literacy to be able to make informed decisions	*	*				
	Contradict science misinformation, disinformation, and fake news	*		*	*		
	Inform the public about science and distribute scientific content	*	*	*	*		
	Make scientific content accessible	*	*	*	*		
	Excite the public about science and increase appreciation for science	*		*	*		
	Gain the public's support and government funding for science						
	Tailor messages to specific audiences	*	*				
Dialogue	Find out the public opinion and needs to better communicate science						
	Encourage the public to be involved in public science discourse, express concerns and raise questions that stem from science and its applications			*			
Participation	Foster the public to help set the agenda for science by actively deliberate in public debates on the "why" and "why not" of science, as part of democratic policymaking		*				
	Enable responsible innovations – Acknowledge the public critique of the science research enterprise priority list, and strive to maximize possible societal returns from investments in science for the larger social good						
	Encourage the public to participate in research endeavors with scientists, encompassing the real-life experiences of non-experts and their socially informed scientific knowledge as part of the collaborative knowledge creation process						

[1] Administrators' ratings: the importance administrators ascribe to the objective ranging from 1 (very little) to 6 (very much).

[2] Readers' ratings: the extent to which readers perceive the websites' effort to pursue the objective ranging from 1 (very little) to 6 (very much).

Notes: (1) The four websites are denoted by the letters A to D. (2) The interviewees were not aware of the origins or classification of the objectives regarding the three theoretical science communication models. (3) Darker shading signifies an elevated priority of the objective for the websites. (4) An asterisk (*) denotes objectives that were mentioned spontaneously by the administrators.

The administrators' ranking of their science communication objectives and the readers' ratings of what was prioritized, illustrated in Table 4, were very similar, exhibiting a pronounced alignment between the importance assigned to each objective by the administrators and how readers perceived the websites' actual efforts in achieving them. The ICC value was 0.894, and the 95% confidence interval ranged from 0.63 to 0.97, indicating moderate to excellent reliability. This result suggests that the importance the administrators attribute to each objective was evident in their efforts to promote it.

The fulfillment of three leading dissemination objectives and one dialogic objective was then examined in greater depth using content analysis of the news items and their associated discussion threads in conjunction with the interviews and questionnaires (appendix C depicts the complete list of research instruments for each analysis).

Inform the public about science and distribute scientific content. This objective topped both the administrators' and the readers' lists. Analysis[8] showed that the

[8] The items were classified into one or two science fields; therefore, the percentages exceed 100%.

websites inform the public about various science topics, with 30% of the news items addressing Medicine & Health issues, 20% Life Sciences, 25% Environmental Sciences, 29% Technology & Space, and 19% Physical Sciences. About half of the news items discuss recent science and research breakthroughs, and the remainder discuss more familiar science topics, such as why photosynthesis is vital to living organisms. Administrators keep their items available constantly so that they can serve as a searchable archive and not only a news source: *"The website offers its readers a comprehensive stockpile of scientific content" (D)*; *"We maintain a content-rich site that is always accessible to everyone, anywhere and at any time" (A)*.

In terms of distribution, the websites are active on social networks: *"It is a channel for spreading and reverberating our messages…delivering science to more people" (A); "It is a marketplace where you can stand on a crate where you can present your manifesto publicly and out loud" (B).* The number of their followers on social media platforms is growing, primarily on Facebook (appendix A), though only 66% of all items published by the SNWs were posted on their Facebook pages. Another critical distribution channel is the mainstream media. Websites *A* and *B* offer their news items exclusively and at no cost to specific general online news outlets,[9] defining themselves as news agencies.

Overall, it was clear from the breakdown of the websites' practices that the objective of informing the public about science and distributing scientific content was vigorously pursued. The readers' ratings also confirmed this. It is worth noting that the administrators pointed out that SNWs' effectiveness is assessed based on metrics such as Google Analytics views.

Make scientific content accessible. There was a consensus among administrators as to the centrality of this objective, and the readers perceived it similarly. Content analysis of the news items presents the prevalence of the 13 accessibility strategies implemented by the websites (Table 2). It demonstrates that specific clusters were more prominent than others. For instance, clarity received more emphasis than either relevance or narrative style. Within the clusters, some strategies were employed more frequently than others: explanation (66%) and examples (42%) were used much more frequently than analogies (7%). Three websites reported that their items are routinely language-edited as part of the production process to reduce jargon and enhance clarity. In the relevance cluster, 29% of items dealt with current events, which aligns with administrators' claims *"We make efforts to connect our items to current affairs, rather than be divorced from the reality we live in" (C)*. A similar picture was found for local aspects (22%): *"Whenever a global issue comes up, we ask ourselves: is this taking place in Israel too? Does it somehow affect Israel?" (B)*. Socio-scientific issues (SSIs), however, were addressed only to a limited extent (8%), although readers wanted these issues to be addressed: *"I expect them to write about issues affecting my day-to-day life, such as getting vaccinated or not being vaccinated. For example, part of the decision I made over the years was not to have more than two children…sincerely, part of it is due to what I read about issues related to the environment here and elsewhere" (#16)*. Limited use of narrative writing style (8%) was demonstrated as well.

[9]To better situate the distribution of general news outlets vs. SNWs: the number of visits to *Ynet*, which is the most popular general news outlet in Israel, as of February 2022 was 56,800,000 compared to an average number of 202,000 visits on the four SNWs.
https://www.similarweb.com/website/ynet.co.il/#overview.

Table 5 presents the differences in the use of accessibility strategies across five science fields to indicate whether the items addressing different fields of science made science equally accessible. In the Physical Sciences, many more items included explanations (71%), examples (50%), analogies (19%), diagrams (22%) and relatively more narrative style (17%). Items classified as Environmental Sciences, on the other hand, addressed much more local aspects (46%) and SSIs (30%) than the other fields, and Technology & Space items referred to more current affairs (41%) and applications (38%).

Overall, the websites employed various strategies to make scientific content accessible, and the readers highly rated their efforts. However, some critical accessibility strategies were underutilized, including those that addressed SSIs.

Counteract scientific misinformation. The administrators prioritized this objective, and three of them mentioned it spontaneously: *"We must adapt in a world awash with misinformation…from time to time our items address science-related issues that people are irrationally bothered by…we refute them by providing the scientific side" (A)*. They also stated that they responded to readers' comments that are inconsistent with scientific knowledge: *"We will always respond to such comments…we understand that a great many other people see what is written…so whenever we challenge incorrect scientific information, we are actually addressing not only the person who wrote the comment but also all those who are unsure what think they know, and those who want to know" (C)*. To determine how this objective was achieved, a content analysis of the discussion threads was conducted (Table 3). Only 5% of the threads (n=25) contained information that did not align with current scientific knowledge. This small number might be the result of active removal of these comments by the administrators to handle misrepresented science on the part of readers: *"Whenever we see comments with links to science deniers' sites, we immediately remove them. We inform them we only accept fact-based discussions that rely on peer-reviewed scientific papers" (C)*. Alternatively, SNW readers, who overrepresent a science-minded and educated audience, could also account for this situation. An analysis of the 25 threads showed that in most cases (64%), there was no attempt to contradict the information presented. In 28%, it was contested by the administrators, and the remaining 8% by other readers. The small number of refutations may be related to earlier failures: *"Trolls on the internet want to stir the pot and get attention; it probably gives them some satisfaction. We try not to fall into these traps, so we often choose to ignore them" (B)*.

Thus, the websites did not completely combat misinformation related to science, possibly because it relies on administrators actively engaging in conversations with readers.

Stimulate the public to be involved in public science discourse. This dialogic objective was perceived very differently by the SNW administrators. Whereas website *C* prioritized it and mentioned it spontaneously, *B* did not see it as one of the website's objectives (Table 4). Content analysis of reader discussion threads showed that in 42% of the threads (n=215), the discussions involved an administrator and a reader (either one or more), and 43% of these (n=92) reflected an asymmetrical communication that addressed readers' knowledge deficits. Another 38% (n=81) reflected a symmetrical communication that involved

Table 5. Accessibility strategies by science field (%).

Science field	Accessibility strategies																	
	Clarity									Visualization			Relevance				Style
	Item length			Jargon			Explanation	Example	Analogy	Picture	Diagram	Video	Current affairs	Local aspect	SSI	Application	Narrative
	S[1]	M[2]	L[3]	L[4]	M[5]	H[6]											
Medicine & Health (n=88)	8	76	16	40	41	19	84	39	6	85	7	10	19	16	3	14	6
Life Sciences (n=60)	10	65	25	63	32	5	68	53	5	98	3	22	17	20	3	8	7
Environmental Sciences (n=74)	0	43	57	62	30	8	57	43	7	97	1	57	35	46	30	16	7
Technology & Space (n=87)	13	57	30	37	31	32	49	33	5	97	12	25	41	18	0	38	8
Physical Sciences (n=58)	14	67	19	36	28	26	71	50	19	95	22	28	28	10	0	26	17
Total (N=298)	9	56	26	48	34	18	66	42	7	94	8	26	29	22	8	16	8

[1] Short, [2] Medium, [3] Long, [4] Low, [5] Moderate, [6] Heavy

Notes: The items were classified into one or two science fields; therefore, the percentages exceed 100%. Statistical significance was not calculated since the assumption of independence was violated.

exchanging information between the readers and the administrators (Table 3). In 40% of the threads, readers discussed among themselves, and in 18%, a single reader comment remained without any follow-up. The administrators stated, *"We do not intend to take an interactive approach... our expertise is to generate and provide content" (C)*. In addition, 306 questions were raised by readers, of which 57% (n=174) were addressed by the administrators, 12% (n=37) by other readers, and 11% (n=34) by both; however, 20% (n=61) did not receive a response. The administrators justified this by saying, *"We try to respond to reader comments, but we cannot consider the large number of comments ... frankly, we prefer to focus on creating new content than answering questions" (A)*.

Overall, the websites were more concerned with generating more content than engaging readers.

Derived from interviews with administrators, a novel framework featuring three key themes surfaced for classifying science communication objectives by the logic of SNWs: (i) Operational objectives, referring to the extent to which SNW practice encompasses and excludes, e.g., *"This is what we do 98% of the time" (C) or "This is something we do not do" (A)*; (ii) The desired impact on the public they wish to have, *e.g., "We strive to excite the public about science through our writing" (C)*; and, (iii) Endpoints and more general downstream goals for science communication, e.g., *"The ultimate goal is for individuals to be able to make science-related decisions based on evidence" (A)*. By delving into the practitioner rationale, it becomes evident that concretizing any of the operational objectives, regardless of the model it corresponds to, holds the potential to generate the desired impact on the public. In turn, it can contribute to achieving the ultimate goals. Figure 1 illustrates the reorganization of science communication objectives from the literature into these three overarching themes and the interdependent progression from one to the next. See appendix E for administrator illustrative quotes.

Discussion

This study illustrates the complex relations between theory and practice, illuminating the cyclical process in which theoretical viewpoints steer, to some extent, practical implementation, while at the same time may be further shaped through empirical analysis of real-world application. Findings indicate that while allowing their readers to comment, potentially advancing dialogic objectives, the SNWs view themselves primarily as content generators rather than moderators of interactive public discourse. Stimulating the public to be involved in science discourse was not highly prioritized by the websites (Table 4). Moreover, administrators explicitly stated that if they had more resources, they would direct them to publish additional items rather than engage in dialogue with the public. This is done, although simply disseminating scientific information does not necessarily improve public scientific knowledge or change attitudes toward science [Akin & Scheufele, 2017; Lewenstein, 2015].

Professional domains associated with science communication, including science education [Song, Chen, Hao, Liu & Lan, 2019] and science journalism [Fahy & Nisbet, 2011], are progressively recognizing the benefits of adopting more dialogical approaches to meet the needs of their respective audiences. Dialogic education encourages students to be active learners and promotes more profound and meaningful learning than traditional teacher-centered lecturing [France, 2019].

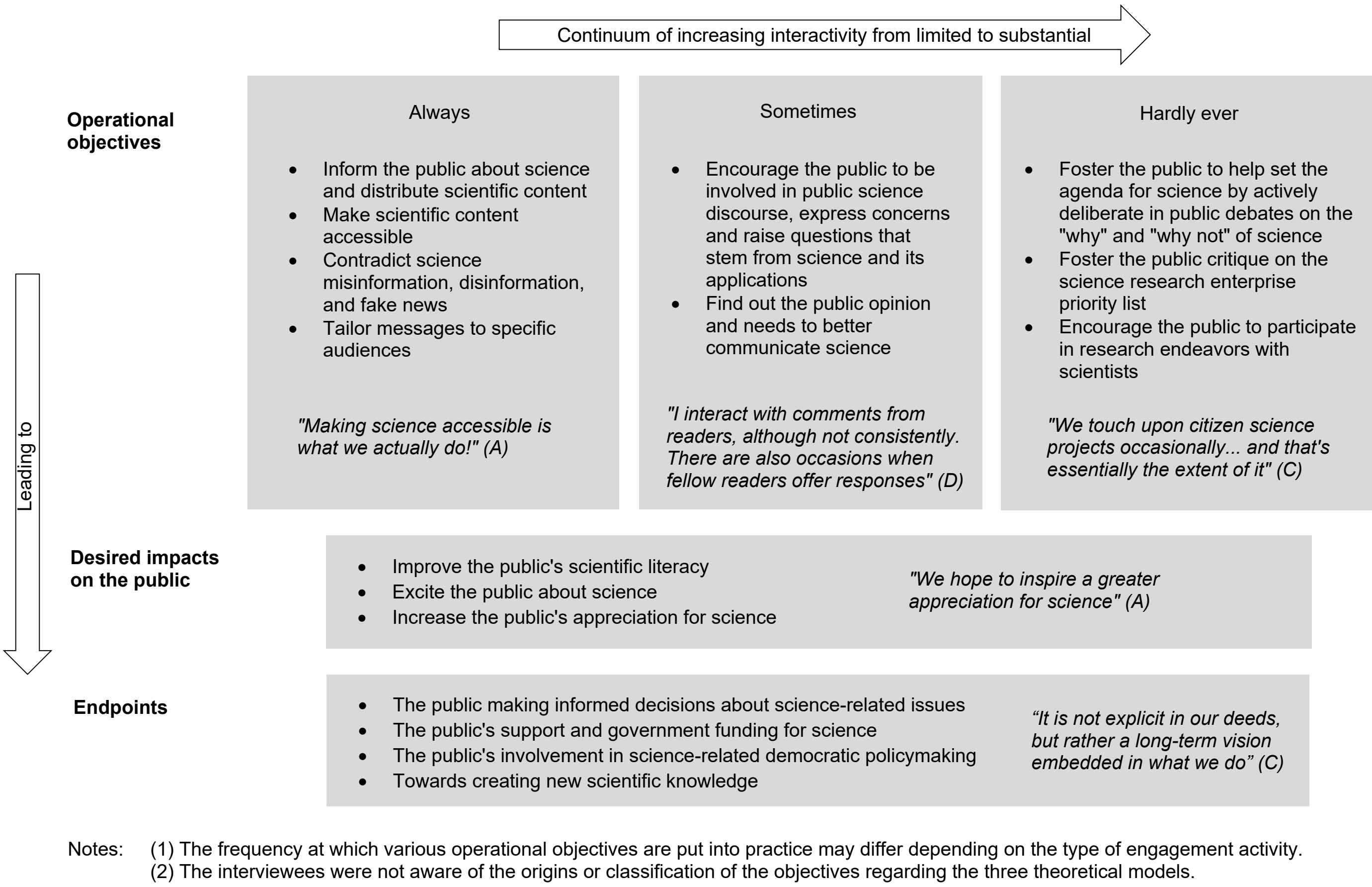

Figure 1. Science communication objectives reorganized into operational objectives sorted by their occurrence rate within SNWs' practice, desired impacts on the public, and endpoints, accompanied by sample quotes.

Dialogical journalism considers interactive conversations with diverse stakeholders and reader collaboration fundamental to science reporting [Deuze, 2003]. James Randerson, the Guardian's environment and science news editor, emphasized that reporters should view reader interactivity "as part of the journalistic process, not as a kind of add-on" [Fahy & Nisbet, 2011, p. 785]. While we recognize that online news comments sections can be problematic sites for attracting abuse and harassment – particularly when research is controversial [Anderson, Brossard, Scheufele, Xenos & Ladwig, 2013] or when writers are women [Dalyot, Rozenblum & Baram-Tsabari, 2022] or from marginalized community groups [Saldaña & Proust, 2022], we encourage SNWs, serving as science communicators, to embrace scholarly recommendations and acknowledge their professional commitment to engage actively in dialogue with the public. They possess technical expertise and staff capable of engaging in meaningful discussions with readers interested in science, including individuals who can engage in constructive arguments drawing upon their knowledge and experiences and those who simply seek answers and clarification.

SNWs' staff are not alone. Likewise, many science communication practitioners prioritize communications designed to provide knowledge rather than establish a dialogue with the public [e.g. Nerghes, Mulder & Lee, 2022; Yuan & Besley, 2021]. This practice persists despite increasing calls to play a more prominent role at the interface between science and society by facilitating dialogue [Reincke, Bredenoord & van Mil, 2020]. This may be viewed as a result of a lack of resources and support for more actively engaging diverse audiences [Rose, Markowitz & Brossard, 2020], or attributed to the relative ease of delivering additional information, which aligns with the scientific mindset, as opposed to the more significant challenge of engaging in dialogue and actively listening to different perspectives. Still, it may simply be a conscious choice to focus on remedying what they view as the public's insufficient knowledge that guides their approach, emphasizing information sharing and education [Calice et al., 2022].

Dissemination practices may be affected by structural, organizational, and economic factors, where the cost-benefit analysis of engaging in dialogue and participation may not always be favorable. That is, the balance between disseminating information and fostering discussions might be influenced by the incentives embedded in the business model of SNWs. The administrators indicated that their performance is valued through metrics like Google Analytics views rather than the level of active interactions. Hence, their focus is attracting readership, though not necessarily encouraging extensive engagement. This approach is rooted in the assumption that publishing a higher volume of news items will lead to increased viewership. This orientation avoids hosting potentially time-consuming debates in readers' comment sections, aligning to maximize content production efforts while minimizing resource expenditure on participating in contentious discussions. Furthermore, two websites define themselves as news agencies disseminating their content to general news platforms, indicating a clear focus on producing more content. The priorities of SNWs appear to reflect a strategic science communication [Kessler, Schäfer, Johann & Rauhut, 2022] motivated by their incentives rather than a sense of the democratization of science responsibility.

The SNWs' practice mirrored their prioritization: Website administrators were involved in fewer than half of the discussion threads, and about a fifth of all reader questions went unanswered (Table 3). Other readers filled some of this void by participating in and developing discussions independently. Both asymmetrical and symmetrical communication were presented at similar rates (Table 3). Wynne [2006] argues that asymmetric communication is merely a refinement of the dissemination model because the sender retains primary control, filling perceived knowledge deficits, with all that has been added to the communication is a feedback loop. Nonetheless, asymmetrical communication still has its merits in advancing better dissemination. By discovering lay knowledge and public perception of science issues, practitioners can gain insights into how to frame messages and tailor them to specific audiences to effectively communicate and build trust [Druckman & Lupia, 2017]. The presence of these two communication types underscores the significance of facilitating a dialogue that enables readers to engage in ways that best align with their preferences, be it through asymmetrical or symmetrical communication approaches.

User interactivity, however, does not always translate into deliberative democratic potential. Instead, it sometimes manifests as a superficial and aggressive form of audience participation, characterized by polarized and rude comments that discourage alternative viewpoints [Collins & Nerlich, 2014]. Moderating the diverse views that readers bring to the table can help alleviate rudeness and polarization [Meyer et al., 2019]. The limited involvement of administrators in the discussions signifies inadequate moderation, which can have serious repercussions. Uncivil user comments may escalate into harassment and bullying and create a toxic environment that negatively affects both the cognitive and affective aspects of the discussion [Wang, 2020], hindering further engagement [Jennings & Russell, 2019]. Moreover, uncivil comments are often used by readers as interpretational lenses for inferred content, potentially influencing their perception of the presented information [Anderson et al., 2013].

While SNWs are clearly not citizen science platforms, some participatory objectives can be relevant to them. For example, enabling discussion on issues of public agenda-setting and deliberation regarding science policy and ethics. However, since these are built upon dialogue, they are destined to fall short, given the limited discourse observed between administrators and readers. SNWs present a potential for dialogue and engagement, opportunities that administrators may not fully embrace. This may be particularly authentic in the context of news agencies, which have their specific constraints and normative responsibilities.

If so desired, how could more dialogue and participation be encouraged? To promote constructive dialogue, administrators should consistently respond thoughtfully to reader comments, in contrast to the scenario noted by readers: *"On several occasions, readers contributed their thoughts, but received no responses" (#17)* (appendix D). In this context, readers recalled methods that spurred them to post comments: *"Incorporated questions into the content prompted me to respond and express my thoughts... the manner in which information was presented occasionally inspired me to ask questions" (#15)* (appendix D). Discussing SSIs in the articles is another potential avenue for stimulating dialogue, given their significant relevance to the public. This approach has the potential to generate interest, capture attention, and encourage engagement [Shasha-Sharf & Tal, 2023; Tal & Ginosar, 2023]. Different points of view on such disputes are likely to prompt people to respond and act [Kolstø, 2001]. Hence, limited use of SSIs constitutes a missed opportunity to facilitate public engagement. The relatively little attention given to SSIs puzzles, particularly when administrators consider individuals' capacity to make well-informed science-related decisions as a significant endpoint (Figure 1) and rank it highly (Table 4).

According to Secko, Amend and Friday [2013], a dissemination approach aiming to transmit scientific knowledge to audiences views science as an authoritative form of knowledge; hence, it suits affirmative coverage of core-science topics that presents scholarly findings and avoids controversy. Dialogic approaches, on the other hand, value knowledge outside science. Therefore, they are ideal for covering scientific information tied to audience realities relevant to daily life and discussing their controversies. We suggest that SNWs' scant implementation of dialogic objectives goes hand in hand with their limited reporting on SSIs and may influence the composition of their readership. Despite SNWs' statements of targeting a broad audience, their on-site readership is relatively narrow (i.e., educated and science-minded) and not representative of the general public. The SNWs did not reach their target audience on their sites. Are the SNWs catering to the needs of those already engaged, creating a community of like-minded people? Scheufele [2018] argues that selective publication of science news that fits the pre-existing preferences of the information-rich and engaged audience exacerbates the gap with those less knowledgeable and interested, even though online media allows wide connection with the broad public. By focusing on dissemination while giving less emphasis to facilitating discussions about SSIs, SNWs miss out in accomplishing their objective of engaging a broader readership. Disengagement may be an active choice [Burns & Medvecky, 2016]. Would science news attract the disengaged if it addressed SSIs and encouraged dialogue?

The findings imply that the administrators may have a different perspective on science communication objectives than those presented in the literature. The distinction between operational objectives (what the SNWs do or do not invest in), desired impacts on the public, and endpoints (long-term goals), originated from administrators' interviews, provides a fresh way to think about science communication objectives based on science communicators' logic and perspective. This echoes Metcalfe's [2022] argument that each model has benefits as well as limitations; thus, in practice, it is essential for models to coexist, frequently with blurred boundaries, collaborating synergistically to attain favorable results.

The endpoints, as perceived by administrators, touch upon the idea of democratizing science, granting the public increased influence over scientific matters [Kurtulmuş, 2021]; thus, somewhat intersect with the framework proposed by Mede and Schäfer [2020], which delves into the antagonistic relations between the ordinary people and the academic elite. Their framework concerns two domains of science-related authority: *Decision-making sovereignty*, which encompasses the control to shape science research agendas, allocate funding, and the right to formulate science-related power claims. The second domain is *Truth-speaking sovereignty*, which involves the authority to define what constitutes "true" scientific knowledge, determine what information is valid, and interpret its implications. As the endpoints indicate the ongoing discourse regarding power dynamics arising from the democratization of science concepts, they highlight this morally charged conflict, accentuate the query about possessing science-related power, and underscore the importance of investing in dialogic approaches for promoting constructive deliberative communication.

Limitations

While data was collected from multiple sources, including interviews, questionnaires, and content analysis, it is pertinent to acknowledge that the dataset is drawn exclusively from four SNWs within a specific country, amounting to 298 news items. That said, this sample encompasses all the prominent SNWs available in Hebrew, and the collected items represent pre-COVID practice both from a content and quantity perspective. Another limitation stems from the inherent characteristics of SNWs, which naturally emphasize the science communication functions of dissemination and education as their primary focus. Exploring alternative science communication platforms, such as podcasts or TikTok, for analysis could potentially unveil different priorities.

Conclusion

The SNWs studied provide additional evidence for the gap between science communication theory and practice. Even though they are active on social media and allow readers to comment, it appears that administrators' and readers' perceptions of the roles of SWNs do not support dialogue, debate, or critique about how science is applied in society, despite the wide recognition that dialogue is an essential form of science communication and a key component of building democratic capacity. In this gap between theory and practice, we see a missed opportunity to engage non-experts in meaningful, productive science-related conversations, thus creating a like-minded community of the already engaged. We are not implying that traditional dissemination activities are inherently inferior and recognize that occasionally it occurs in response to public demand for specific information, as was observed recently with Covid-19. While acknowledging the limitations and resource-intensive nature of engaging in extensive online public dialogic activities, we suggest that SNWs should strive to get out of their comfort zone. SNWs can utilize their available resources to produce stories covering socio-scientific issues, invite public commentary, and moderate productive discussions using recognized strategies to manage online incivility and improve the quality of public news comment threads.

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