JCOM

SCIENCE COMMUNICATION IN HIGHER EDUCATION:
GLOBAL PERSPECTIVES ON THE TEACHING
OF SCIENCE COMMUNICATION

The distribution of science communication teaching around the globe

Luisa Massarani, Heather Bray, Marina Joubert, Andy Ridgway, Joseph Roche, Fiona Smyth, Elizabeth Stevenson, Frans van Dam and Willian Vieira de Abreu

Abstract

In the context of a special issue of this journal focused on teaching science communication, we present a map of the geographical distribution of 122 science communication teaching programmes from 31 countries around the world. This mapping study resulted from a collaboration between members of the PCST Teaching Forum and the research team at GlobalSCAPE, a research project funded by the European Commission to explore the global state of science communication. Our findings highlight the concentration of these programmes in the U.S.A. and Europe, and the dominance of English as the language of instruction. We ponder the causes and implications of the disparities in opportunities for studying science communication in other world regions and languages. The dearth of science communication educational pathways in developing countries may limit the professionalisation of the field, as well as research and evidence-based practice that is locally needed and relevant.

Keywords

Professionalism, professional development and teaching in science communication; Science communication degree programmes; Science communication teaching

DOI

https://doi.org/10.22323/2.22060205

Submitted: 31st May 2023
Accepted: 17th October 2023
Published: 11th December 2023

Introduction and study rationale

Although it is still a relatively nascent discipline, science communication has become consolidated as a field of study at both undergraduate and postgraduate levels across the globe, with most programmes[1] offered at postgraduate levels [Gascoigne et al., 2010; Mulder, Longnecker & Davis, 2008; Trench, 2012; Schiele & Gascoigne, 2020].

[1] In this paper, we use the term 'programme' to denote a complete programme of study leading to an award such as an MSc or a postgraduate diploma, while 'module' denotes an individual component of a programme. We appreciate that terminology differs between universities, but we use consistent terminology to avoid confusion.

Supporters and developers of tertiary teaching in the field of science communication justify and promote these academic offerings in several ways. These include the development of scholarship in a novel multi-disciplinary field, capacity building of scientists and science communicators, contributions to the development of evidence-based policy around public participation in science, provision of authentic educational experiences involving academics and communication professionals, as well as the contributions of this type of programme to the employability of students [Longnecker, 2014; Longnecker & Gondwe, 2014; McKinnon & Bryant, 2017; Ramani & Pitrelli, 2007].

Existing research about capacity development in science communication is fragmented [Achiam, Kupper & Roche, 2022; Davies et al., 2021; Kupper, Moreno-Castro & Fornetti, 2021]. Much of the scholarly literature around this topic deals with science communication training courses that are designed to equip scientists with communication skills [e.g., Bankston & McDowell, 2018; Fähnrich et al., 2021; Mannino et al., 2021] or reflect on single case study examples of science communication teaching programmes [e.g., Longnecker, 2022; Mellor, 2013].

From 2018 to 2020, the European Commission invested almost €10 million in eight separate science communication research projects tasked with taking stock of the field of science communication and examining the teaching of science communication within scientific disciplines and as a dedicated academic discipline [European Commission, 2020]. Until now, these are the only research and innovation actions (RIAs) that the European Commission has funded in the area of science communication [Roche et al., 2021]. While those projects (CONCISE, RETHINK, QUEST, TRESCA, NEWSERA, ENJOI, ParCos and GlobalSCAPE) explored many aspects of global science communication theory and practice [Fähnrich, 2021; Roedema, Broerse & Kupper, 2021; Weitkamp, Milani, Ridgway & Wilkinson, 2021], delivering a comprehensive map of the distribution of science communication teaching programmes worldwide fell outside their scope.

To address this knowledge gap, the current study mapped the global distribution of teaching programmes in science communication offered at higher education institutions around the world, i.e. programmes that lead to the award of a specific degree, diploma or certificate in science communication. To our knowledge, it is the first global map of science communication education at higher education institutions. This overview of the distribution and language of instruction of these programmes on offer at universities around the world provides useful baseline information for the further advancement of science communication as an academic discipline. It should act as an impetus for further research characterising the nature of science communication teaching regionally and globally. In addition, we also hope this research will inspire and facilitate collaborations and the sharing of approaches and teaching materials between these programmes.

Literature overview

Our overview of the relevant literature provides a reflection on how science communication teaching can be defined, as well as the trends and challenges that influence this field.

Defining science communication teaching and training

Turney [1994] distinguishes science communication programmes within the broader field of communication by noting two distinctive features in terms of their theoretical and practical components. In the first place, these programmes are about communicating science; secondly, they focus on communicating to audiences outside the science arena.

In the context of our research, it is furthermore essential to distinguish between science communication 'teaching' and science communication 'training'. The latter (i.e. training) is typically presented over one to five days with a focus on practical skills and aimed at research-active scientists or practitioners. In contrast, science communication teaching relates to longer academic programmes presented by universities and other higher education institutions as postgraduate certificates, diplomas, master's programmes and PhD tracks. Some universities offer science communication content as modules within the curricula of different degrees.

Several earlier studies related to professional development in the field of science communication have addressed both 'teaching' and 'training'. For example, in their reflection on the learning goals and content of science communication, Lewenstein and Baram-Tsabari [2022] identify a number of institutional settings for capacity building in science communication ranging from short workshops to master's degrees. These authors identify several so-called 'threshold concepts' that occasional, active and professional science communicators should master, adding that reaching a professional level requires more depth in the learning objectives. Clearly, there is overlap in the type of content presented as practical training and academic teaching in the field, but there are differences in the academic rigour, orientation and nuance. In both cases (i.e. professional training and academic teaching), the students may be research-active scientists or professional communicators such as science journalists and institutional communicators [e.g., Llorente & Revuelta, 2023].

Trends that shape science communication teaching

As science communication became more professionalised and institutionalised, the demand for professionals in the field increased accordingly [Davies & Horst, 2016]. Around the world, universities and other higher education institutions responded by launching a range of degrees, diplomas and certificates focused on aspects of public communication of science, as has been documented by some scholars [e.g., Massarani, Reynoso-Haynes, Murriello & Castillo, 2016; Turney, 1994; Trench, 2012, 2017]. Schiele and Gascoigne [2020] record how university-based programmes in science communication started to emerge in the 1960s, spreading to countries worldwide since then, and note this as an indicator of the steady professionalisation of the field over time. According to these authors, the earliest examples of university programmes in science communication were established in the Philippines, the U.S.A. and the Netherlands (1960 to 1976), with the latest programmes launched in South Africa, Iran and Ghana (2015 to 2019). The first master's programme in science communication was presented in the United States in 1960, with the second in France following 24 years later. The emergence of master's and PhD programmes in science communication indicates not only the

professionalisation of the field, but also its academic legitimisation and growing autonomy.

Trench and Bucchi [2021] also reflect on the global spread of science communication teaching as an indicator of the growth and maturation of the field and its associated infrastructure. These authors record that the earliest examples of master's degrees and postgraduate diplomas in science communication originated in Australia, Britain, France, Italy and Spain, but that many such programmes are now found in other European countries, as well as in Asia and Latin America. Several scholars recognise that both teaching and training in the field contributed to establishing science communication as an academic discipline [Gascoigne et al., 2010], as well as the professionalisation of the sector [Trench, 2017].

Challenges in the field of science communication teaching

Despite agreement about the need for and value of academic science communication teaching programmes that lead to the award of a formal graduate or postgraduate qualification [e.g. Bankston & McDowell, 2018; Fähnrich et al., 2021; Karikari, Yawson & Quansah, 2016; Trench, 2017], these programmes face many challenges that could make them politically vulnerable and susceptible to funding cuts. Around the world, several master's programmes have been discontinued within a few years since their launch [Costa et al., 2019; Trench, 2012]. Some of the critical challenges that have been documented include institutional instability, funding and recruitment challenges, the diverse nature of science communication as an academic field of enquiry, and the difficulties of assessing the quality and impact of these programmes. There are also wider issues around the lack of recognition of science communication as a legitimate field of study in parts of the academic world. Moreover, science communication programmes require ongoing adaptation in order to stay relevant. Arguably, some of these challenges may not be unique to science communication and may also apply to similar interdisciplinary and emerging fields that are taught across the globe, they act synergistically to make science communication teaching within universities particularly complex. These challenges are discussed briefly below.

- Institutional instability stems from the fact that science communication degree programmes are often not fully (or sufficiently) institutionalised, resulting in a general lack of recognition as a field of academic study and research [Longnecker, 2022; Mellor, 2013; Trench, 2012].
- As relatively new and interdisciplinary offerings in many countries, science communication degree programmes may struggle to attract sufficient student numbers, adding to concerns about their financial feasibility and long-term sustainability [Longnecker, 2014, 2022; Trench, 2012]. It is noted that it may require significant lobbying, consultation and marketing to secure sufficient support and student enrolments for this kind of education in a university environment. The vulnerability of these programmes is further heightened by the fact that many of them are linked to the personal ambition of programme leaders or to short-term funding [Costa et al., 2019].
- Science communication is, by nature, a multi-faceted topic with diverse histories and trajectories. As a field of research and teaching, science

communication draws on a wide range of disciplines across natural and social sciences and humanities, including social psychology, communication science, media studies, journalism, history of science, philosophy of science, and education, to name but a few. The content of the science that has to be communicated is often located in the domain of natural sciences. As a discipline, however, science communication is situated in the domain of social sciences and humanities, demanding its scholars and students to reflect critically on science and how it interacts with society [Mellor, 2013; Longnecker, 2022]. As such, academic teaching in the field of science communication requires a multi-, inter- and trans-disciplinary approach [Kiprijanov & Joubert, 2023]. The inherent multi- and inter-disciplinary nature of science communication can be considered as one of its strengths, but also a potential weakness that may add to the lack of recognition as an academic field [Trench, 2012].

– Since science communication is affected and shaped by local cultural and societal contexts, there is no standard curriculum to guide science communication teaching in postgraduate programmes [e.g., Davies & Horst, 2016; Bankston & McDowell, 2018]. The composition (or curricula) of these programmes are often linked to national and institutional science communication objectives and/or shaped by individuals who champion these programmes at a local level [Longnecker & Gondwe, 2014].

– In general, science communication programmes display a high degree of variation in terms of their academic emphasis and the type of professional skills on which they focus [Trench & Bucchi, 2021]. A consequence of the diverse nature of science communication programmes is that they are located in a range of different departments at universities — ranging from natural and life sciences to social sciences, applied sciences and also in departments of journalism and media studies, with some even 'free-flowing between departments [Massarani et al., 2016; Trench, 2012]. This lack of a uniform and widely recognised academic home may be considered a drawback of these academic programmes.

– Science communication is a dynamic field that demands ongoing adaptation from teachers and trainers in order to respond to novel needs and expectations of students and future employers [Fähnrich, 2020; Ramani, 2009]. In terms of programme content, Lewenstein and Baram-Tsabari [2022] highlight that a multitude of new topics have emerged that must be addressed in science communication programmes, with a specific mention of the importance of addressing ethics, inclusion and uncertainty, as well as digitisation. Given that science (and science communication) is becoming increasingly intertwined with politics, students have to be able to cope with the polarised debates and controversies that often characterise the communication of science-rooted topics and issues that have economic, social, moral or ethical dimensions [Scheufele, 2014]. Additionally, students must be prepared for the ever-changing ecosystems of science communication — a landscape that is increasingly characterised by fragmentation, digitisation, and the influence of artificial intelligence. The explosive growth of digital communication channels and user-generated content means that today's science communicators must be able to negotiate with diverse actors and navigate influences that may challenge the authority and autonomy of science.

- The inherent diversity of science communication degree programmes (as discussed above) means that it may be challenging to evaluate these programmes in terms of quality and impact, and providing empirical evidence of the success of these programmes remains a challenge [Baram-Tsabari & Lewenstein, 2017; Longnecker, 2022].
- While scientists and heads of communication at research centres describe a sense of "duty" and "responsibility" to communicate research [Casini & Neresini, 2012], acceptance of the value of science communication as a field is not universal. A lack of recognition of the value of science communication by institutions presents a barrier to communicators and researchers engaging in such activities [TNS BMRB & University of Westminster, 2015]. It is a challenge seen in many regions around the world including Europe [Neresini & Bucchi, 2011] and North America [Merino & Tarhuni Navarro, 2018]. Female science communicators have reported challenges in convincing their male supervisors of the merits of science communication as a career path [AbiGhannam, 2016] and some scientists perceive science communication "…as an adjunct to their research." [Casini & Neresini, 2012, p. 58]. It is in this somewhat mixed environment in terms of the perceived value of science communication that science communication courses find themselves.

These challenges constitute the context for making this inventory of science communication programs and these will be revisited in the discussion. In this way, this research provides a baseline of a current global record, with which we can track changes over time.

Research methodology

We set out to produce a series of maps that would present a visual overview of the geographical distribution of educational programmes in science communication on offer at institutions of higher learning around the world. At the same time, we wanted to capture information about the study level and language medium of each programme. This mapping study [Cooper, 2016] was done collaboratively by members of the PCST Teaching Forum[2] which is a working group linked to the global Public Communication of Science and Technology (PCST) Network, and GlobalSCAPE, a research project funded by the European Commission to explore the global state of science communication.

While there are many opportunities for short-term training in science communication, these offerings are mostly of short duration and aimed at continuing professional development for scientists and others. In contrast, this paper is concerned solely with educational (or teaching) programmes offered by universities and other higher education institutions that lead to a recognised graduate or postgraduate qualification. We define a graduate qualification as a first or undergraduate degree and a postgraduate qualification as a degree which is completed following an undergraduate degree. In our data gathering, we focused on degrees, diplomas and certificates at postgraduate level (in other words, programmes available to students who already have a first degree). However, in a few exceptional cases, we identified programmes at first degree (undergraduate) level that had an explicit science communication focus, and these degrees were

[2] See https://www.pcst.network/teaching-forum/.

included in the data. The undergraduate programmes are of significant interest in a landscape dominated by postgraduate (post undergraduate) degree programmes. It should also be noted that some of the programmes included in this study are not exclusively targeted towards science communication for example, some have a focus on science education or environmental communication. We included these programmes if they contained an explicit component of science communication. We did not include information about science communication modules taught within undergraduate degree programmes.

The programmes included in this study are those that were identified as being active in the time period February 1st, 2021, until December 10th, 2022, when the research was being conducted. As a first step, the research team members (who collectively work on all continents across the globe) participated in a brainstorming session to identify and list all the relevant teaching programmes that they were collectively aware of. Then, we added the details of teaching programmes that we could identify from previously published research studies [e.g., Longnecker & Gondwe, 2014; Massarani et al., 2016]. In the next step, we consulted several online sources and databases to extract information on relevant teaching programmes relevant to science communication. These included:

- A database of science communication programmes developed by the Science Communication programme at Rhine-Waal University of Applied Sciences in Germany[3]
- A 'Scicom Education Map' for Europe developed by the QUEST project[4]
- A list of postgraduate courses in science communication in Europe developed by Postgrad.com[5]
- An overview of master's programmes in the field of communication in Mexico, developed by Keystone Masterstudies[6]
- A database of science communication master's programmes in Australia and Oceania created by Eduniversal Rankings[7]

We added to the information we could glean from these databases via conducting our own online searches for relevant science communication teaching programmes using a list of keywords which was refined and augmented as the research proceeded. We used the search term 'science communication' in combination with various iterations of degree types and geographic locations. This initial search delivered basic information related to the global distribution of these programmes, but it was not comprehensive or geographically representative. Using the same search terms (i.e. "science communication master's") returned different results in their hierarchy depending on the geographic location and IP address of the person performing the search. We also noted that certain programmes appeared more

[3] http://www.scicommfinder.info.
[4] https://enricounive.carto.com/builder/d4da5208-e732-4034-b789-e4ce86b86fdb/embed.
[5] https://www.postgrad.com/courses/science-communication/europe/.
[6] https://www.masterstudies.com/Masters-Degree/Communication/Mexico/.
[7] https://www.best-masters.com/ranking-master-corporate-communication-in-oceania/master-of-science-communication-the-australian-national-university-anu-college-of-medicine-biology-and-environment-informations.html.

frequently regardless of whether a geographical region was specified. For example, including the search term "master's" in the search yielded a predominance of the science communication programmes at Johns Hopkins University, Arizona State University, The University of Sheffield, and The University of Otago, regardless of region and the IP address and location of the researcher. Removing the search term "master's" resulted in a more comprehensive list of internet sources related to science communication in that specific region (i.e. articles, webinars, tweets, networks, journal papers). In other words, the results were more region-specific, but not specifically relevant to educational programmes. However, this provided valuable clues for further searching, bringing up indirect links, i.e. via blogs, social media professional profiles, and discussion boards. We expanded our online search strategy by extracting additional search terms from programme and module descriptions emerging from the initial set of search results. The terms we used were 'public engagement', 'outreach', 'journalism', 'creative writing', 'science and technology', 'science in society', 'history and philosophy of science', 'education', 'science communication courses'. Using these descriptors — related to constituent elements of faculty alignments of science communication degree programmes and modules — broadened the scope of results considerably.

Based on the research steps described above, we were able to produce a list of programmes that we could present to global, regional and national role players and networks related to science communication education. Using a snowball sampling approach [Creswell, 2012, p. 209], we asked network members to help us identify any other relevant programmes, with a particular focus on regions where we had information about programmes offered in languages in which we (the research team) had limited literacy/fluency. Amongst others, we reached out to individuals and networks in China, Japan, Peru, Chile, Spain, Colombia, Korea, Algeria, Lebanon, Turkey, and Israel, as well as several other countries in the Middle East and North Africa.

Finally, we made a working version of the map available via the PCST Network website, and collaborators were invited to add further information, and/or to identify and update any incorrect entries. This interactive online map[8] (see Figure 1) is the result of the collective inputs of members of the PCST Teaching Forum and the extended PCST Network. By clicking on different data points on this map, users can access information about the specific locations and host institutions of a range of science communication teaching programmes at the level of PhD, master's, and undergraduate (first) degrees, as well as postgraduate diplomas and certificates. This map is not exhaustive, but provides an initial overview of the presence and distribution of degree programmes in science communication around the globe. Given that degree programmes in this field will continue to change and emerge, the map remains available online as a work in progress where the global science communication community may continue to add new information to this online resource.

Study limitations

The inconsistent terminologies used by universities around the world when describing and advertising their educational programmes related to science

[8]See https://www.pcst.network/teaching-forum/science-communication-programmes-and-courses/.

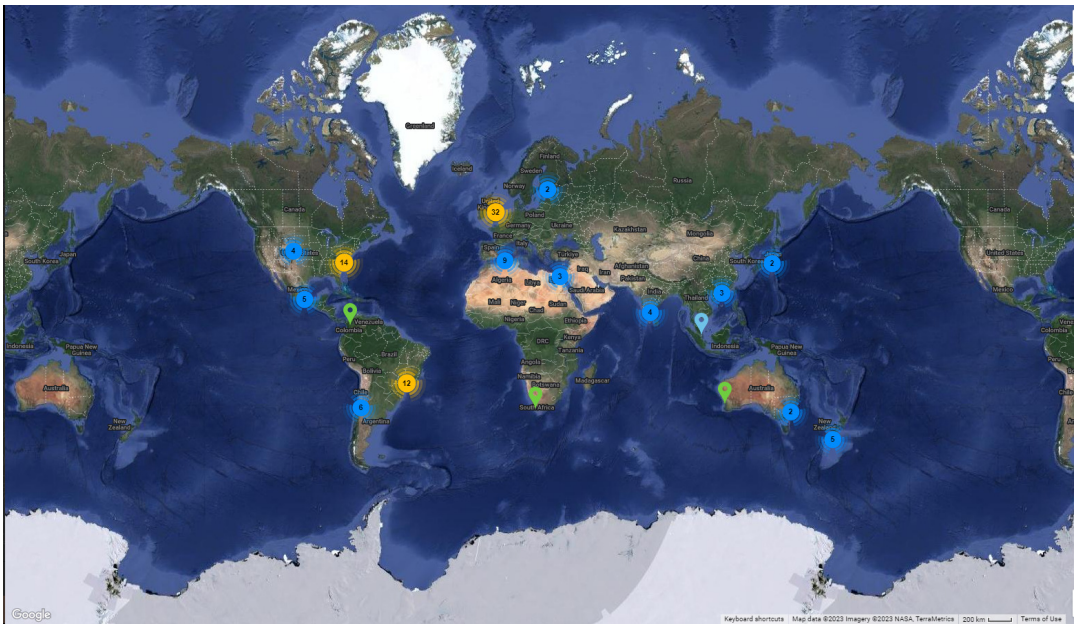

Figure 1. Interactive online map of science communication teaching programmes developed by the PCST Teaching Forum.

communication, necessitated using a wide range of terms when we searched for information. Also, we extracted data from a range of different databases and sources. We made every effort to find information about programmes in languages other than English, but we recognise that some of our search strategies could have been skewed towards English-language results. It also proved to be difficult to identify doctoral programmes comprehensively, since these programmes are often offered on an ad-hoc basis when funding is available. We also acknowledge that our search strategies focused more on advanced degrees and that this means that our findings regarding undergraduate programmes are likely to be incomplete.

Results

This research project identified 122 science communication teaching programmes distributed over 31 countries, as shown in Figure 2 (For a full list of the programmes, see appendix A). The top countries in terms of the number of programmes on offer are the U.S.A. (14), Brazil (13), the Netherlands (9), England (9), Mexico (8), India (7), Canada (6), with five programmes each in Argentina, Canada, and New Zealand. As can be seen in Figure 2, most countries on the list offer between one and three programmes. Notably, out of 195 countries in the world (as listed on Worldometer[9]) we could identify only 31 (16%) that currently host one or more science communication teaching programmes.

Once the country results reported above are grouped per broad geographical region, the unequal distribution of programmes becomes even more evident. With 42 programmes in Europe (including one in Russia), this region had the most programmes (34%), followed by Latin America and the Caribbean with 32 programmes (26%). Canada and the U.S.A. combined had 20 programmes (16%), with 17 programmes (14%) in Asia; eight in Oceania (7%), and three in Africa (2%).

[9]See https://www.worldometers.info/.

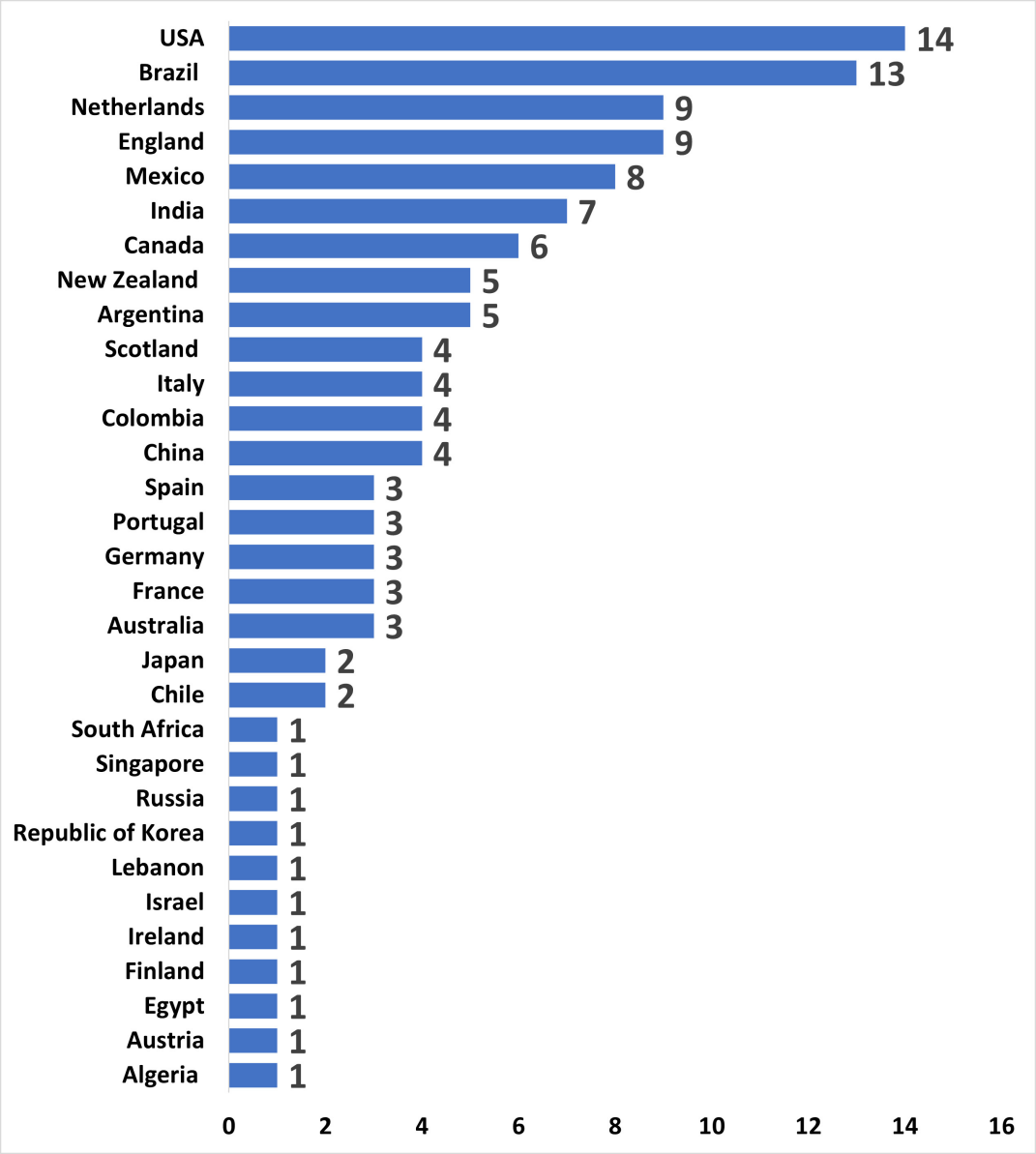

Figure 2. Number of science communication teaching programmes by country (N = 122).

We identified only one programme in Russia (a country that straddles Asia and Europe). These results are illustrated in Figures 3 and 4.

The 42 science communication education programmes in Europe are located in 11 countries (see Figure 5). Of the 42 programmes identified in Europe, only one is in Russia (ITMO University, St. Petersburg). As such, a vast geographical area in Europe is not well-represented in terms of science communication teaching. There is a high concentration of programmes in The Netherlands, where nine of these programmes are offered. In Scotland, all four programmes are offered by the University of Edinburgh, but notably, one of the master's programmes is entirely online.

In Asia, the 17 programmes identified via this study are located across seven countries (see Figure 6). Of these, seven programmes (41%) are in India.

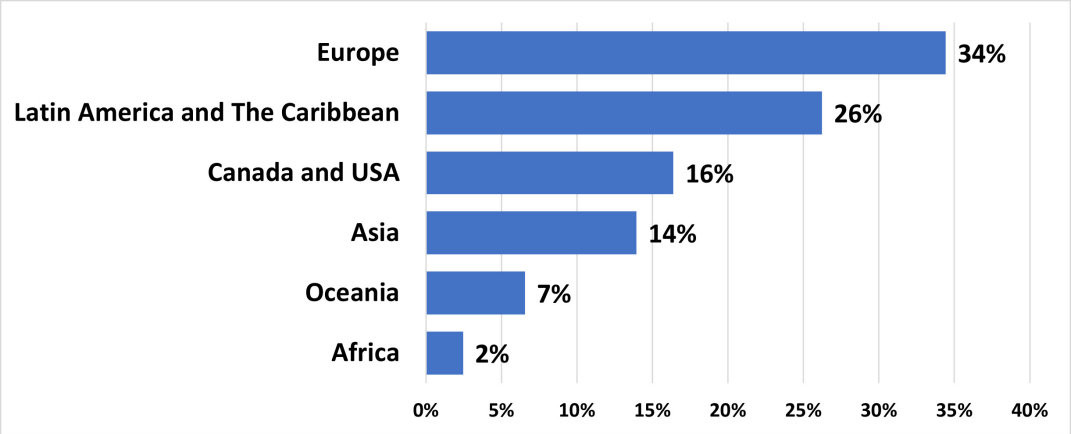

Figure 3. Percentage distribution of science communication teaching programmes by geographical region (N = 122).

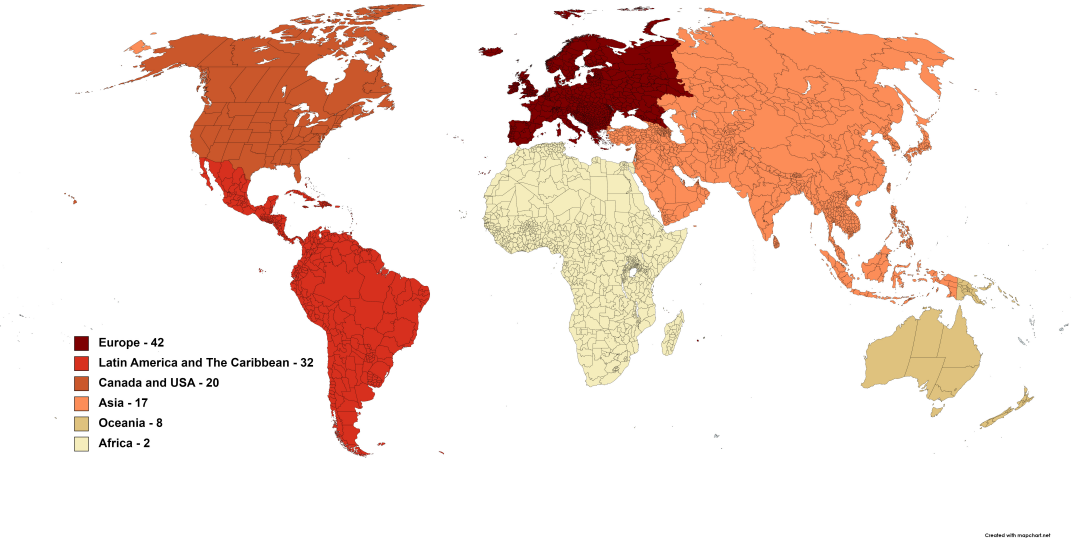

Figure 4. Geographical spread of science communication teaching programmes (N = 122).

The distribution of science communication degree programmes in The Americas is illustrated in Figure 7. In the United States, the 14 programmes identified in this study are on offer at 14 different institutions spread across 10 states.

In Latin America and the Caribbean, there is a high concentration of programmes in specific countries, as shown in Figure 7. We also noted an unequal spread within countries. For example, in Brazil, 12 of the 13 programmes (92%) are from the southeast region of the country.

Figure 8 illustrates the scarcity of postgraduate science communication programmes in Africa, where only three programmes were identified, namely one each in Egypt, Algeria and South Africa.

Figure 9 shows that we identified eight programmes in Oceania. Five are located in New Zealand, and three in Australia.

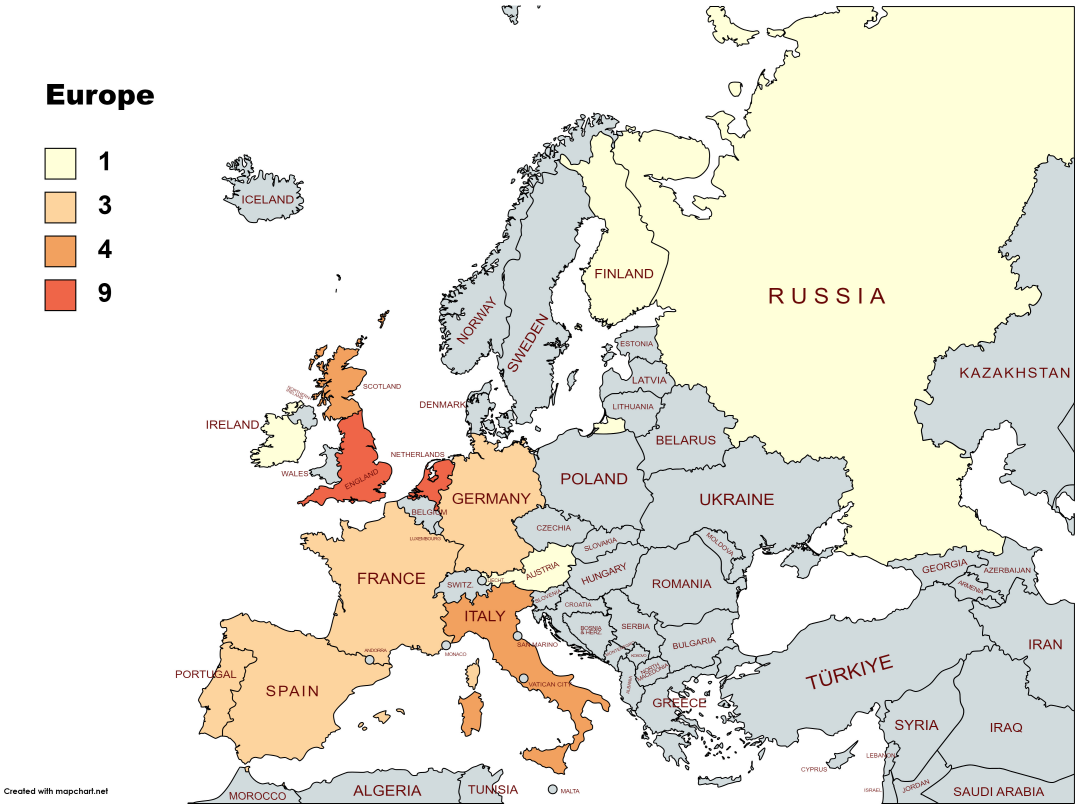

Figure 5. Distribution of science communication teaching programmes across Europe (n = 42).

Figure 6. Distribution of science communication teaching programmes across Asia (n = 17).

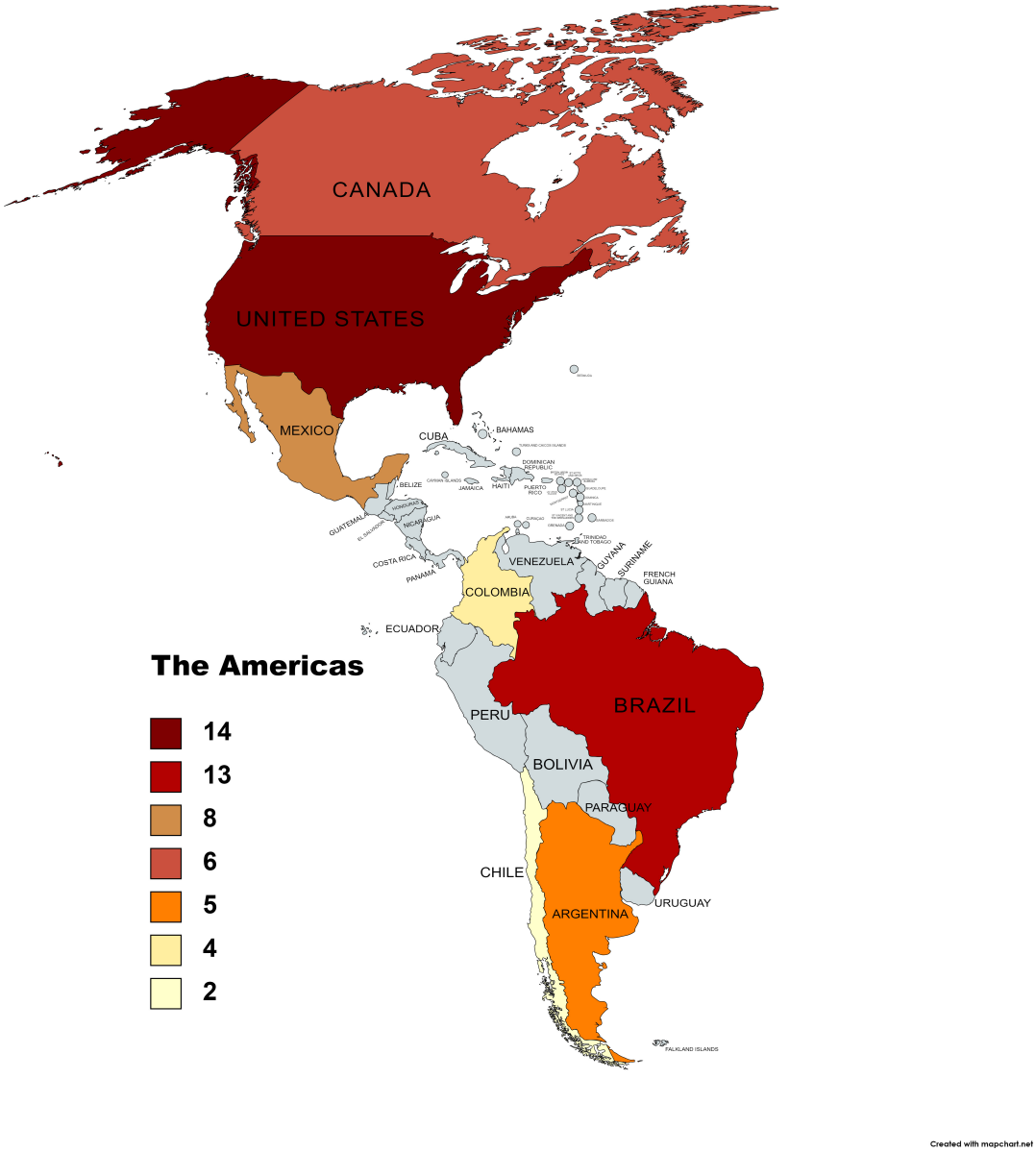

Figure 7. Distribution of science communication teaching programmes in the Americas (n = 52).

As far as language is concerned, Figure 10 illustrates the predominance of programmes taught in English, adding up to 62 (50%), followed by 21 programmes in Spanish (17%). With 16 programmes (13%) in Portuguese, this was the next most prevalent language. We identified five (4%) multilingual programmes, followed by four (3%) in French. Finally, we found only three (2%) programmes taught in each of Chinese and German, two each (2%) in Dutch and Italian, and one each (1%) in Arabic, Hebrew and Japanese. In one case, we could not identify the primary language of instruction.

Regarding the educational level of the programmes (see Figure 11), we noted a prevalence in master's degrees, with 63 programmes (52 %) identified at this level. There were 43 (35%) postgraduate certificates or diplomas, seven (6%) PhD programmes, and nine (7%) programmes at undergraduate level. In terms of the

Figure 8. Distribution of science communication teaching programmes across the African continent (n = 3).

PhD programmes that we could identify, four of the seven were from Brazil, and the other three were from India, Mexico, and New Zealand. Of the 63 master's programmes, nine were offered in England and seven in the Netherlands.

Discussion and conclusions

This research adds to a growing body of literature seeking to map and characterise science communication education [Fähnrich, 2020; Massarani et al., 2016; Neeley, Goldman, Smith, Baron & Sunu, 2014] by providing a global picture of science communication teaching programmes at higher education institutions. Our findings highlight the large number of science communication teaching programmes around the world. We did not try to identify defunct programmes, focusing instead on programmes that were actively recruiting students at the time of our study. A total of 122 programmes were identified. This shows that in the 40 years since many science communication programmes emerged during the 1980s,

Figure 9. Distribution of science communication teaching programmes in Oceania (n = 8).

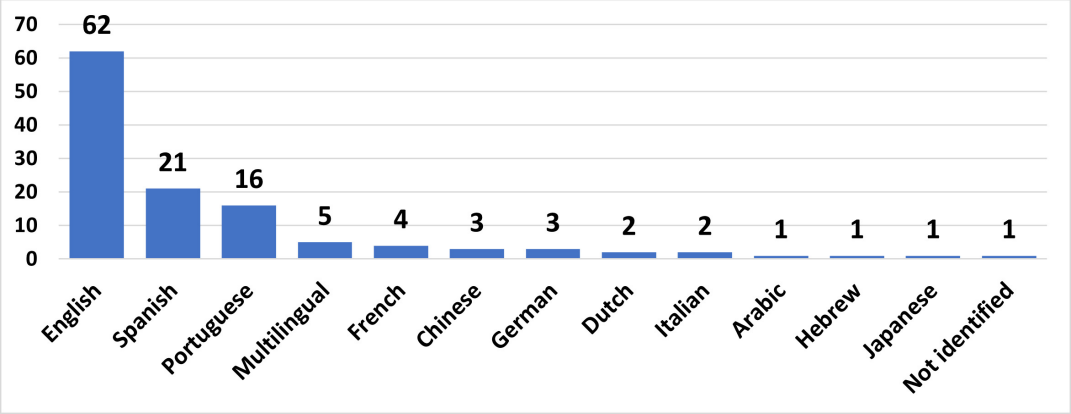

Figure 10. Distribution of science communication teaching programmes by language (N = 122).

the teaching of science communication has spread to many parts of the world. These findings are in line with what Schiele and Gascoigne [2020] report when they documented the emergence of university courses in science communication as an indicator of the increasing professionalisation of the field, adding how these university programmes also stimulated related academic research, thereby strengthening the academic legitimisation of science communication.

Variations and disparities in science communication teaching

While the overall number of science communication postgraduate programmes globally may be impressive, particularly for an emerging field, this research also

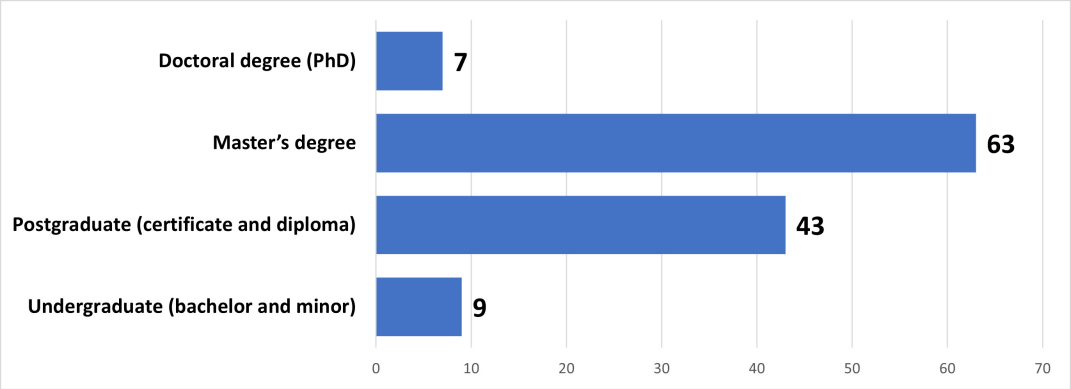

Figure 11. Distribution of science communication teaching programmes by level of study (N = 122).

points to substantial disparities in the availability of formal science communication education in different regions of the world and within different countries. It is notable and concerning that we could not identify any science communication teaching programmes in more than 80% of the countries of the world, indicating a need for further development and expansion of the field. On a regional basis, those seeking a science communication education in Europe, Latin America, as well as Canada and the U.S., have far more choice of where to study than those contemplating this field of study in Oceania and Africa.

The variations and disparities in the geographical distribution of opportunities to study science communication raise questions about the consequences of these inequalities. In particular, the scarcity or absence of science communication programmes in many countries must affect the local and regional capacity bases that are able to engage with current scholarship and implement evidence-based science communication strategies that are relevant within those regions. While some students may be able to travel to other countries to study science communication, the lack of study opportunities closer to home will surely put these studies out of reach for many prospective students, particularly those from lower-income countries. Furthermore, studying science communication in a foreign country will provide an expertise base that may not be fully relevant to the needs of students from different parts of the world, since science communication actors, formats, channels and publics are directly influenced by culture, politics and socio-economic conditions [Trench et al., 2014]. In this context, Lewenstein and Baram-Tsabari [2022] underline the importance of real-world contexts in the teaching of science communication. For example, science communication in some developing countries faces particular challenges related to cultural diversity, language and literacy barriers, poverty, colonial histories and the remoteness of rural populations [du Plessis, 2008; Joubert, 2018; Manzini, 2003]. The challenges to science communication capacity building in certain regions, such as Africa, have been noted and explained [e.g., Rasekoala, 2022; Walker et al., 2020].

Regional and language imbalances

In addition to differences in the capacity for professional and evidence-based practice, the disparities highlighted here also present challenges regarding the

capacity for science communication research in different countries and regions. In this context, a study by Guenther and Joubert [2017] produced a world map of science communication research that demonstrated the dominance of authors from the U.S.A. and the U.K. when it came to published science communication studies. The authors also note the paucity of science communication research in some parts of the world, specifically Africa and the Middle East. It seems logical that in countries where there are few opportunities to study towards advanced degrees in science communication, the science communication communities are increasingly falling behind in terms of research and contextualised evidence-based practice.

Our research highlights large imbalances in the languages in which science communication education is provided. More than half (51%) of all science communication programmes globally that we identified in this study were taught in English. Only 2% of science communication teaching programmes were offered in Chinese, despite the fact that it is one of the most dominant languages globally [Ethnologue, 2023]. There is a need to consider the implications of the dominance of English and what could be done to support more language diversity in the teaching of science communication in higher education.

In general, our findings about inequalities and gaps in science communication teaching programmes demonstrate the scale of the challenge faced by new initiatives aimed at capacity building such as COALESCE, a pan-European competence centre funded by the European Commission to support science communication. Also, the challenges we experienced when using various online search strategies to identify these programmes confirmed that information about many of these programmes is not readily available. This underscored the need for a resource such as the interactive map developed by the PCST Teaching Forum as a tool that can be used by prospective students to find and compare information about study options around the world.

Implications for future research

We hope that our study will lead to further research characterising the nature of contemporary science communication teaching. The interactive map we describe in our study should enable researchers to draw on a wider range of science communication teaching programmes for insights into future pedagogic studies and for comparisons to be made regarding what is taught in different countries and regions. This study should also act as a baseline for future studies tracking the emergence and endurance of science communication teaching programmes, something that is particularly important given the vulnerability of these programmes over time [Costa et al., 2019; Trench, 2012]. Questions for future research could include a longitudinal mapping of when and where science communication programmes in higher education have emerged, and how this has changed over time. In addition, the ways in which science communication teachers deal with challenges mentioned in the introduction can be tracked over time.

A particular research gap pertains to the curriculum content and outcomes of science communication teaching programmes. For example, Mercer-Mapstone and Kuchel [2017] created a basis for the development of a basic science communication teaching curriculum at undergraduate level by distilling a list of key elements and core skills from existing literature. Similarly, Lewenstein and Baram-Tsabari [2022] identified core concepts for science communication training. Hong and Wehrmann

[2010] explored the nature and level of the professional skills that students can obtain via 20 science communication master's programmes around the world, concluding that the objectives and outcomes of most programmes were vague, with many variations between countries in terms of eligibility criteria, duration, and study topics. Other authors have documented the diversity of learning goals, topics and approaches in science communication programmes or suggested essential components and topics to be taught. These include Bray, France and Gilbert [2012], Mulder et al. [2008], Costa et al. [2019], Fähnrich et al. [2021] and Longnecker and Gondwe [2014]. While these studies provide a valuable starting point for further research, they are mostly limited to a specific region or country, and/or focused on practical training, rather than academic teaching, in the field, while some of the earlier studies may be outdated. As such, we lack insight and understanding about the contemporary curricula of science communication teaching programmes, including how and why they differ across countries and contexts, and how they evolve over time. As stated by Trench [2012] we need greater clarity of what is meant by professional education in science communication. This kind of information could be hugely valuable to those who are developing and launching new academic programmes.

Furthermore, we know very little about the composition of student cohorts and the career paths of alumni in science communication teaching programmes. It would be valuable to gain a better understanding of the disciplinary backgrounds and nationalities, as well as the career expectations and post-study career trajectories of students. In particular, it would be insightful to know to what extent students move to other countries in order to study science communication, and how these students perceive and experience the career implications of studying science communication in a foreign country. Similarly, it would be insightful to gain a deeper understanding of the academic profiles and backgrounds of science communication teachers, and their teaching objectives, around the world.

An important question prompted by our findings is how the differences in the regional and national prevalence of science communication programmes have arisen, since seeking to answer this may point to potential approaches to a more even distribution of programmes. Earlier research has highlighted differences in institutional perceptions of the value of science communication [TNS BMRB & University of Westminster, 2015] and public engagement [Neresini & Bucchi, 2011] and this may account, at least to some degree, for differences in the occurrence of degree programmes in science communication. Given the recent focus of many governmental bodies on science communication competencies and impacts in modern societies, exploring whether are there, for example, democracy-related or utility-related arguments to be made for science communication education (and thus practice) across the world would further our understanding the influence of socio-political factors on science communication programs.

We hope that increased knowledge of the science communication education landscape globally will strengthen the growing community of practice within the field, and add to opportunities for knowledge sharing and the development of support networks.

Finally, our findings remind us that science communication as a field of teaching is indeed 'vital, but vulnerable', and that this vulnerability largely stems from the diverse nature of these programmes and the blurry boundaries with related fields

such as science journalism, as argued by Trench [2012]. We hope that the next phase of our research will provide more insight into the origins, evolutionary paths and institutional contexts of these programmes, and the nature of the curricula, to help us to address weaknesses, but also build on their collective strengths. Equally, tracer studies of alumni may help us to provide evidence of the impact of these programmes. Ultimately, we hope to provide evidence that can strengthen the case for science communication teaching, including its academic validity and practical utility. This evidence base will support those who want to start up new programmes, and will help to make the case for sustaining and expanding current programmes.

Acknowledgments

The authors would like to extend their gratitude to all of the members of the PCST Teaching Forum for their collaboration and contributions towards this study. In particular, we thank Kathryn Murphy for her assistance during the early stages of data collection via the GlobalSCAPE Project. This work was supported with funding from the EU Horizon 2020 Research and Innovation Programme under Grant Agreement No. 101006436 (GlobalSCAPE).

Appendix A. List of 122 science communication teaching programmes

Table 1: 122 courses.

	Name of Programme/Course	Name of Organisation	Type of Programme/course	Country
1	Curating Science	University of Leeds	Masters Degree	England
2	Science Communication Certificate	Hong Kong University (HKU Space)	Graduate certificate/ diploma/major	China
3	Masters in Communication Science	The University of Vienna	Masters Degree	Austria
4	Master Audiovisuel, journalisme et communication scientifiques	University of Paris Diderot	Masters Degree	France
5	Masters in Science Communication (MSc)	"University of Sheffield, taught in collaboration with the Department of Journalism"	Masters Degree	England
6	Masters in Journalism and Institutional Communication of Science	University of Ferrara	Masters Degree	Italy
7	Postgraduate Certificate in Practical Science Communication	University of Cambridge	Graduate certificate/ diploma/major	England

Continued on the next page.

Table 1: *Continued from the previous page.*

	Name of Programme/Course	Name of Organisation	Type of Programme/course	Country
8	"Masters in Science Communication — endorsements in: 1) Science and Natural History Filmmaking 2) Creative Non-Fiction Writing in Science 3) Science in Society"	"University of Otago Te Whare Wānanga o Ōtāgo, taught in collaboration with NHNZ."	Masters Degree	New Zealand
9	Graduate Certificate of Science Communication	Australian National University	Graduate certificate/ diploma/major	Australia
10	Master of Science Communication	Australian National University	Masters Degree	Australia
11	M.S. in Journalism and Media Communication	Colorado State University	Masters Degree	U.S.A.
12	"Master of Arts in Communication Specialization in Science, Society and Policy"	University of Ottawa	Masters Degree	Canada
13	Masters in Science Communication	University of College London	Masters Degree	England
14	MPhil in Science and Technology Studies (Science and Public Engagement)	"Stellenbosch University, Centre for Research on Evaluation, Science and Technology (CREST)"	Masters Degree	South Africa
15	MSc in Science Communication and Public Engagement (Online)	University of Edinburgh	Masters Degree	Scotland
16	Certificate in Science Communication and Public Engagement Online	University of Edinburgh	Graduate certificate/ diploma/major	Scotland
17	Diploma in Science Communication and Public Engagement Online	University of Edinburgh	Graduate certificate/ diploma/major	Scotland
18	Graduate Program in Science Writing, Master of Science	Massachusetts Institute of Technology	Masters Degree	U.S.A.
19	Master of Science Education and Communication	Utrecht University	Masters Degree	The Netherlands
20	Bachelor in Science Communication	Stevens Institute of Technology	Bachelors Degree	U.S.A.
21	Masters in Science Communication	"Scuola Internazionale Superiore di Studi Avanzati (International School of Advanced Studies, SISSA)"	Masters Degree	Italy
22	Especialización en Comunicación, Gestión y Producción Cultural de la Ciencia y la Tecnología	Universidad Nacional de Quilmes (UNQ)	Graduate certificate/ diploma/major	Argentina
23	Diplomado de Divulgación de la Ciencia (Diploma in Science Popularisation)	Dirección General de Divulgación de la Ciencia de la Universidad Nacional Autónoma de México (UNAM)	Graduate certificate/ diploma/major	Mexico

Continued on the next page.

Table 1: *Continued from the previous page.*

	Name of Programme/Course	Name of Organisation	Type of Programme/course	Country
24	Diplomado en Comunicación Pública de la Ciencia y la Tecnología (Diploma in Public Communication of Science and Technology)	Sociedad Mexicana para la Divulgación de la Ciencia y la Técnica	Graduate certificate/ diploma/major	Mexico
25	Diplomado en Comunicación de la Ciencia y Periodismo Científico (Diploma in Science Communication and Scientific Journalism)	Centro Morelense de Comunicación de la Ciencia	Graduate certificate/ diploma/major	Mexico
26	Diplomado en Periodismo Científico (Diploma in Scientific Journalism)	Centro de Bioinformática y Biología Computacional de Colombia, Universidad de Manizales	Graduate certificate/ diploma/major	Colombia
27	Postítulo en Comunicación de la Ciencia (Specialised Postgraduate Programme in Science Communication)	Facultad de Ciencias de la Universidad de Chile	Graduate certificate/ diploma/major	Chile
28	Especialización en Comunicación Pública de la Ciencia y Periodismo Científico (Specialisation in Public Communication of Science and Scientific Journalism)	Universidad Nacional de Córdoba (UNC)	Graduate certificate/ diploma/major	Argentina
29	Carrera de Especialización en Comunicación Pública de la Ciencia y la Tecnología (Specialisation Degree in Public Communication of Science and Technology)	Facultad de Ciencias Exactas y Naturales, Facultad de Filosofía y Letras, Facultad de Ciencias Sociales de la Universidad de Buenos Aires (UBA)	Graduate certificate/ diploma/major	Argentina
30	"Especialización en Divulgación de la Ciencia, la Tecnología y la Innovación (Specialisation in Popularisation of Science, Technology and Innovation)"	Sede Andina de la Universidad Nacional de Río Negro (UNRN)	Graduate certificate/ diploma/major	Argentina
31	Especialização em Educação e Divulgação Científica (Specialisation in Scientific Education and Popularisation)	Instituto Federal do Rio de Janeiro (IFRJ)	Graduate certificate/ diploma/major	Brazil
32	Divulgação da Ciência, da Tecnologia e da Saúde (Popularisation of Science, Technology and Health)	Fundação Oswaldo Cruz (Fiocruz), Museu de Astronomia e Ciências Afins, Fundação CECIERJ, Instituto de Pesquisa Jardim Botânico do Rio de Janeiro, Casa da Ciência (UFRJ)	Graduate certificate/ diploma/major	Brazil

Continued on the next page.

Table 1: *Continued from the previous page.*

	Name of Programme/Course	Name of Organisation	Type of Programme/course	Country
33	"Curso de Pos-grado — Especialización en Periodismo Científico (Postgraduate Course — Specialisation in Scientific Journalism) KM FS — check if same as row 30"	Laboratório de Jornalismo Científico (Labjor), Departamento de Política Científica e Tecnológica del Instituto de Geociencias; Departamento de Multimeios del Instituto de Arte, Universidade Estadual de Campinas (Unicamp)	Graduate certificate/ diploma/major	Brazil
34	Especialidad en Divulgación de la Economía (Specialisation in Popularisation of Economy)	Museo Interactivo de la Economía (MIDE)	Graduate certificate/ diploma/major	Mexico
35	Maestría en Ciencia, Tecnología e Innovación, Orientación en Divulgación de la Ciencia, la Tecnología y la Innovación (Master in Science, Technology and Innovation, Specialisation in Popularisation of Science, Technology and Innovation)	Universidad Nacional de Río Negro (UNRN)	Masters Degree	Argentina
36	Ensino em Biociências e Saúde (Teaching of Biosciences and Health)	Instituto Oswaldo Cruz (IOC), Fundação Oswaldo Cruz	Masters Degree	Brazil
37	"Divulgação Científica e Cultural (Scientific and Cultural Popularisation) KM: note, content same as row no.30 (Masters in Scientific and Cultural Communication (MDCC)"	Laboratório de Estudos Avançados em Jornalismo Instituto de Estudos da Linguagem Universidade Estadual de Campinas (Unicamp)	Masters Degree	Brazil
38	Mestrado em Divulgação da Ciência, da Tecnologia e da Saúde (Master in Popularisation of Science, Technology and Health)	"Casa de Oswaldo Cruz/ Fundação Oswaldo Cruz (Fiocruz); Instituto de Pesquisa Jardim Botânico do Rio de Janeiro; Museu de Astronomia e Ciências Afins; Fundação CECIERJ; Universidade Federal do Rio de Janeiro (UFRJ). Collaboration: Cornell University (U.S.A.); Oregon State University (U.S.A.); Scuola Internazionale Superiore di Studi Avanzati (Italy); Université Paris 8 (France)."	Masters Degree	Brazil

Continued on the next page.

Table 1: *Continued from the previous page.*

	Name of Programme/Course	Name of Organisation	Type of Programme/course	Country
39	Programa de Pós-Graduação Stricto Sensu em Informação e Comunicação em Saúde (PPGICS) (Postgraduate Programme Sensu Stricto in Information and Communication in Health)	Instituto de Comunicação e Informação Científica e Tecnológica em Saúde (Icict), Fundação Oswaldo Cruz (Fiocruz)	Masters Degree	Brazil
40	Educação, Difusão e Gestão em Biociências (Education, Dissemination and Management in Biosciences)	Instituto de Bioquímica Médica Universidade Federal do Rio de Janeiro (UFRJ)	Masters Degree	Brazil
41	Posgrado en Filosofía de la Ciencia, línea de Comunicación de la Ciencia (Postgraduate degree in Philosophy of Science, Specialisation in Science Communication)	Instituto de Investigaciones Filosóficas, Facultad de Filosofía y Letras, Facultad de Ciencias y Dirección General de Comunicación de la Ciencia, Universidad Nacional Autónoma de México (UNAM)	Masters Degree	Mexico
42	Maestría en Comunicación de la Ciencia y la Cultura (Master in Science and Culture Communication)	Instituto Tecnológico y de Estudios Superiores de Occidente	Masters Degree	Mexico
43	Estudios de Ciencia, Tecnología e Innovación (CTS+i) (Studies of Science, Technology and Innovation)	Instituto Tecnológico Metropolitano (ITM)	Masters Degree	Colombia
44	Ensino em Biociências e Saúde (Teaching of Biosciences and Health)	Instituto Oswaldo Cruz (IOC), Fundação Oswaldo Cruz (Fiocruz)	Doctoral Degree	Brazil
45	Doutorado Multi-institucional e Multidisciplinar em Difusão do Conhecimento (Multi-institutional Doctorate and Multidisciplinary Degree in Dissemination of Knowledge)	Universidade Federal da Bahia; Universidade Estadual de Bahia; Instituro Federal de Educação, Ciência e Tecnologia; Universidade Estadual de Feira de Santana; Federação das Indústrias do Estado de Bahia; Laboratório Nacional de Computação Científica; Instituto de Humanidades, Artes e Ciências de Bahia	Doctoral Degree	Brazil
46	Programa de Pós-Graduação Stricto Sensu em Informação e Comunicação em Saúde (PPGICS) (Postgraduate Programme Sensu Stricto in Information and Communication in Health)	Instituto de Comunicação e Informação Científica e Tecnológica em Saúde (Icict), Fundação Oswaldo Cruz (Fiocruz)	Doctoral Degree	Brazil
47	Educação, Difusão e Gestão em Biociências (Education, Dissemination and Management in Biosciences)	Instituto de Bioquímica Médica Universidade Federal do Rio de Janeiro (UFRJ)	Doctoral Degree	Brazil

Continued on the next page.

Table 1: *Continued from the previous page.*

	Name of Programme/Course	Name of Organisation	Type of Programme/course	Country
48	Posgrado en Filosofía de la Ciencia, línea de Comunicación de la Ciencia (Postgraduate degree in Philosophy of Science, Specialisation in Communication of Science)	Instituto de Investigaciones Filosóficas, Facultad de Filosofía y Letras, Facultad de Ciencias y Dirección General de Comunicación de la Ciencia, Universidad Nacional Autónoma de México (UNAM)	Doctoral Degree	Mexico
49	Science Communication and Public Engagement	Cornell University	Undergraduate (minor)	U.S.A.
50	MSc in Science Communication	Imperial College London	Masters Degree	England
51	MSc Science and Health Communication	University of Manchester	Masters Degree	England
52	"Masters in Science Education and Communication KM — Twente also offers a MS in Educational Science and Technology"	University of Twente	Masters Degree	The Netherlands
53	MSc in Science Communication	University of the West of England	Masters Degree	England
54	MSc in Science and Health Communication	Dublin City University	Masters Degree	Ireland
55	Master In Communication of Science and Innovation	University of Trento	Masters Degree	Italy
56	MSc in Science Communication	Manchester Metropolitan University	Masters Degree	England
57	Master 's in Science Journalism	"École Nationale Supérieure de Journalisme et des Sciences de l'Information (National School of Journalism and Information Sciences)"	Masters Degree	Algeria
58	Bachelor of Arts in Health Communication	American University of Beirut	Bachelors Degree	Lebanon
59	Masters in Science Communication	"TECHNION: Israel Institute of Technology, Faculty of Education in Science and Technology"	Masters Degree	Israel
60	Masters Program in Science Journalism	"KAIST (Korea Advanced Institute of Science and Technology)"	Masters Degree	Republic of Korea
61	Master of Science Communication	The University of Western Australia	Masters Degree	Australia
62	master of science communication	"University of Chinese Academy of Sciences (UCAS) School of Humanities"	Masters Degree	China
63	Master of Journalism and Communication	University of S&T of China (USTC)	Masters Degree	China

Continued on the next page.

Table 1: *Continued from the previous page.*

	Name of Programme/Course	Name of Organisation	Type of Programme/course	Country
64	Bachelor of Communication / Bachelor or Science	Victoria University of Wellington Te Herenga Waka	Bachelors Degree	New Zealand
65	Graduate Certificate in Science / Graduate Diploma in Science	Victoria University Wellington Te Herenga Waka	Graduate certificate/ diploma/major	New Zealand
66	Master of Science in Society	Victoria University Wellington Te Herenga Waka	Masters Degree	New Zealand
67	PhD Science in Society	Victoria University Wellington Te Herenga Waka	Doctoral Degree	New Zealand
68	Graduate Certificate in Science Communication	Florida International University; College of Communication, Architecture + The Arts	Graduate certificate/ diploma/major	U.S.A.
69	Masters in Science Communication	Laurentian University, in partnership with Science North	Masters Degree	Canada
70	Graduate Diploma in Science Communication	Laurentian University, in partnership with Science North	Graduate certificate/ diploma/major	Canada
71	Graduate Diploma in Communication and Humanities	Universitat Autònoma de Barcelona	Graduate certificate/ diploma/major	Spain
72	Master of Science in Journalism	Medill University, Chicago	Masters Degree	U.S.A.
73	Masters in Communication Science	Vrije Universiteit Amsterdam	Masters Degree	The Netherlands
74	Science Communication Graduate Certificate	Northern Arizona University	Graduate certificate/ diploma/major	U.S.A.
75	Science Communication Program	University of Maryland	Certificate	U.S.A.
76	Science Communication and Public Engagement	Developed by University of Turin, Universidad Autónoma de Madrid, and European Institute of Innovation and Technology (EIT)	Certificate	Italy
77	Science Communication Graduate Certificate	University of Florida	Graduate certificate/ diploma/major	U.S.A.
78	Certificate in Science Communication	Carleton University	Certificate	Canada
79	Certificate in Science Communication	Technische Universität Berlin	Certificate	Germany
80	Certificate in Science Communication	Beckman Institute for Advanced Science and Technology, University of Illinois Urbana-Champaign	Graduate certificate/ diploma/major	U.S.A.
81	MSc in Science Education and Communication	Delft University of Technology	Masters Degree	The Netherlands

Continued on the next page.

Table 1: *Continued from the previous page.*

	Name of Programme/Course	Name of Organisation	Type of Programme/course	Country
82	MSc in Science Education and Communication	University of Groningen	Masters Degree	The Netherlands
83	MSc Science Education and Communication	Eindhoven University of Technology	Masters Degree	The Netherlands
84	Master of Science, Science & Technology Communication	CSIR- NISCAIR (National Institute of Science Communication and Information Resources)	Masters Degree	India
85	PhD, Science & Technology Communication	CSIR- NISCAIR (National Institute of Science Communication and Information Resources)	Doctoral Degree	India
86	M.Sc. in Science Communication	The University of Trans-Disciplinary Health Sciences and Technology, Bangalore	Masters Degree	India
87	Certificate course in Science Communication-UGC Recognized	Guru Nanak College of Arts, Science and Commerce	Certificate	India
88	Certificate course in Science Communication	HSNC University	Certificate	India
89	Master differentiation Science communication (Major)	Vu University Amsterdam	Graduate certificate/ diploma/major	The Netherlands
90	Master specialisation Science communicaion and society (SCS)	Leiden University	Graduate certificate/ diploma/major	The Netherlands
91	Master Science in Society	Radboud University Nijmegen	Masters Degree	The Netherlands
92	Foundations of Science Communication	Mount Saint Vincent University	Undergraduate (minor)	Canada
93	M.Sc. Science Media Production	Imperial College London	Masters Degree	England
94	Science Communication	ITMO University	Masters Degree	Russia
95	Cooperstown Graduate Program	SUNY Oneonta	Masters Degree	U.S.A.
96	Master in Scientific Culture and Science Dissemination	University of Lisbon	Masters Degree	Portugal
97	Masters of Arts in Bioethics, Techethics, and Science Policy	Duke University	Masters Degree	U.S.A.
98	Program in Science, Technology & Society (Bachelor of Arts & Bachelor of Science)	Stanford University	Bachelors Degree	U.S.A.
99	Masters Programme in Global Politics and Communication	University of Helsinki	Masters Degree	Finland
100	Exploring Science Communication through Popular Science	National University of Singapore	Graduate certificate/ diploma/major	Singapore

Continued on the next page.

Table 1: *Continued from the previous page.*

	Name of Programme/Course	Name of Organisation	Type of Programme/course	Country
101	Science Journalism Training Programme	British Council Egypt	Graduate certificate/ diploma/major	Egypt
102	Science and Technology Interpreter Training Program	The University of Tokyo	Graduate certificate/ diploma/major	Japan
103	CoSTEP: Science and Technology Communication Training Program	Hokkaido University	Graduate certificate/ diploma/major	Japan
104	Masters in Scientific, Medical and Environmental communication	Pompeu Fabra University — Barcelona School of Management	Masters Degree	Spain
105	Master's in Science, Technology Communication and Society	National Cheng Chung University	Masters Degree	China
106	Master's in Science, Media and Communication	Karlsruhe Institute of Technology	Masters Degree	Germany
107	Bachelor's in Science, Media and Communication	Karlsruhe Institute of Technology	Bachelors Degree	Germany
108	Master's in Social Communication of Scientific Research	Valencia International University	Masters Degree	Spain
109	Master's in Science Communication	University of Minho	Masters Degree	Portugal
110	Master's in Science Communication	NOVA University of Lisbon	Masters Degree	Portugal
111	Master's in Communication of Science and Culture	Grenoble Alpes University	Masters Degree	France
112	University Diploma in Innovative Scientific Mediation	Paris City University	Graduate certificate/ diploma/major	France
113	Training Course Science Journalism	Indian Science Communication Society	Graduate certificate/ diploma/major	India
114	Specialisation Course in Public Communication of Science	Federal University of Minas Gerais	Graduate certificate/ diploma/major	Brazil
115	Maestría en Estudios Sociales de la Ciencia	Universidad Nacional de Colombia	Masters Degree	Colombia
116	Maestría en Periodismo Científico	Universidad Javeriana de Colombia	Masters Degree	Colombia
117	Diplomado en Comunicación de la Ciencia	Universidad Veracruzana	Graduate certificate/ diploma/major	Mexico
118	Diplomado en Divulgación Científica	Universidad de Antofagasta	Graduate certificate/ diploma/major	Chile
119	Science, Technology, and Society (STS) Minor	University of Toronto	Undergraduate (minor)	Canada
120	MSc in Science Communication and Public Engagement	University of Edinburgh	Masters Degree	Scotland
121	Science Communication Minor	University of Oregon	Undergraduate (minor)	U.S.A.
122	Fundamentals of Science Communication	Tata Institute of Fundamental Research	Graduate certificate/ diploma/major	India

References

AbiGhannam, N. (2016). Madam Science Communicator: a typology of women's experiences in online science communication. *Science Communication 38* (4), 468–494. doi:10.1177/1075547016655545

Achiam, M., Kupper, J. F. H. & Roche, J. (2022). Inclusion, reflection and co-creation: responsible science communication across the globe. *JCOM 21* (04), E. doi:10.22323/2.21040501

Bankston, A. & McDowell, G. S. (2018). Changing the culture of science communication training for junior scientists. *Journal of Microbiology & Biology Education 19* (1). doi:10.1128/jmbe.v19i1.1413

Baram-Tsabari, A. & Lewenstein, B. V. (2017). Science communication training: what are we trying to teach? *International Journal of Science Education, Part B 7* (3), 285–300. doi:10.1080/21548455.2017.1303756

Bray, B., France, B. & Gilbert, J. K. (2012). Identifying the essential elements of effective science communication: what do the experts say? *International Journal of Science Education, Part B 2* (1), 23–41. doi:10.1080/21548455.2011.611627

Casini, S. & Neresini, F. (2012). Behind closed doors: scientists' and science communicators' discourses on science in society. A study across european research institutions. *Tecnoscienza 3* (2), 37–62. Retrieved from http://www.tecnoscienza.net/index.php/tsj/article/view/113

Cooper, I. D. (2016). What is a "mapping study"? *Journal of the Medical Library Association: JMLA 104* (1), 76–78. doi:10.3163/1536-5050.104.1.013

Costa, E., Davies, S. R., Franks, S., Jensen, A., Villa, R., Wells, R. & Woods, R. (2019). *D4.1: Science communication education and training across Europe* [D4.1 eu h2020-funded 824634 quest project]. Retrieved from https://questproject.eu/download/deliverable-4-1-summary-report-science-communication-education-and-training-in-europe

Creswell, J. W. (2012). *Educational research: planning conducting and evaluating quantitative and qualitative research* (4th ed.). Boston, MA, U.S.A.: Pearson.

Davies, S. R., Franks, S., Roche, J., Schmidt, A. L., Wells, R. & Zollo, F. (2021). The landscape of European science communication. *JCOM 20* (03), A01. doi:10.22323/2.20030201

Davies, S. R. & Horst, M. (2016). *Science communication: culture, identity and citizenship*. doi:10.1057/978-1-137-50366-4

du Plessis, H. (2008). Public communication of science and technology in developing countries. In M. Bucchi & B. Trench (Eds.), *Routledge handbook of public communication of science and technology* (pp. 227–238). doi:10.4324/9780203928240-21

Ethnologue (2023). What is the most spoken language? Retrieved May 4, 2023, from https://www.ethnologue.com/insights/most-spoken-language/

European Commission (2020). Horizon 2020 — work programme 2018–2020: science with and for society [European commission decision c(2020)6320 of 17 september 2020]. Retrieved September 21, 2023, from https://ec.europa.eu/research/participants/data/ref/h2020/wp/2018-2020/main/h2020-wp1820-swfs_en.pdf

Fähnrich, B. (2020). *An analysis of the status quo and demands for science communication training*. Retrieved May 4, 2023, from https://www.rethinkscicomm.eu/wp-content/uploads/2020/06/D3.1-Report-on-analysis-of-status-quo-and-requirements-in-focus-countries.pdf

Fähnrich, B. (2021). Conceptualizing science communication in flux — a framework for analyzing science communication in a digital media environment. *JCOM 20* (03), Y02. doi:10.22323/2.20030402

Fähnrich, B., Wilkinson, C., Weitkamp, E., Heintz, L., Ridgway, A. & Milani, E. (2021). RETHINKING science communication education and training: towards a competence model for science communication. *Frontiers in Communication 6*, 795198. doi:10.3389/fcomm.2021.795198

Gascoigne, T., Cheng, D., Claessens, M., Metcalfe, J., Schiele, B. & Shi, S. (2010). Is science communication its own field? *JCOM 09* (03), C04. doi:10.22323/2.09030304

Guenther, L. & Joubert, M. (2017). Science communication as a field of research: identifying trends, challenges and gaps by analysing research papers. *JCOM 16* (02), A02. doi:10.22323/2.16020202

Hong, C.-P. & Wehrmann, C. (2010). Do science communication programs equip students to become professionals? A comparison of 20 university programs worldwide. In *Presentation at the 11th International Conference on Public Communication of Science and Technology*, New Delhi, India. Retrieved from https://research.tudelft.nl/en/publications/do-science-communication-university-programs-equip-students-to-be

Joubert, M. (2018). Country-specific factors that compel South African scientists to engage with public audiences. *JCOM 17* (04), C04. doi:10.22323/2.17040304

Karikari, T., Yawson, N. A. & Quansah, E. (2016). Developing science communication in Africa: undergraduate and graduate students should be trained and actively involved in outreach activity development and implementation. *Journal of Undergraduate Neuroscience Education 14* (2), E5–E8. PMID: 27385932

Kiprijanov, K. S. & Joubert, M. (2023). Science communication. In T. Philipp & T. Schmohl (Eds.), *Handbook of transdisciplinary learning* (pp. 317–328). doi:10.14361/9783839463475-033

Kupper, F., Moreno-Castro, C. & Fornetti, A. (2021). Rethinking science communication in a changing landscape. *JCOM 20* (03), E. doi:10.22323/2.20030501

Lewenstein, B. V. & Baram-Tsabari, A. (2022). How should we organize science communication trainings to achieve competencies? *International Journal of Science Education, Part B 12* (4), 289–308. doi:10.1080/21548455.2022.2136985

Llorente, C. & Revuelta, G. (2023). Models of teaching science communication. *Sustainability 15* (6), 5172. doi:10.3390/su15065172

Longnecker, N. (2014). *Science communication at UWA*. doi:10.13140/RG.2.1.1985.2967

Longnecker, N. (2022). Twenty years of teaching science communication — a personal reflection. *JCOM 21* (07), C06. doi:10.22323/2.21070306

Longnecker, N. & Gondwe, M. (2014). Graduate degree programmes in science communication: educating and training science communicators to work with communities. In L. Tan Wee Hin & R. Subramaniam (Eds.), *Communicating science to the public* (pp. 141–160). doi:10.1007/978-94-017-9097-0_9

Mannino, I., Bell, L., Costa, E., Di Rosa, M., Fornetti, A., Franks, S., … Zollo, F. (2021). Supporting quality in science communication: insights from the QUEST project. *JCOM 20* (03), A07. doi:10.22323/2.20030207

Manzini, S. (2003). Effective communication of science in a culturally diverse society. *Science Communication 25* (2), 191–197. doi:10.1177/1075547003259432

Massarani, L., Reynoso-Haynes, E., Murriello, S. & Castillo, A. (2016). Science communication postgraduate studies in Latin America: a map and some food for thought. *JCOM 15* (05), A03. doi:10.22323/2.15050203

McKinnon, M. & Bryant, C. (2017). Thirty years of a science communication course in Australia. *Science Communication 39* (2), 169–194. doi:10.1177/1075547017696166

Mellor, F. (2013). Twenty years of teaching science communication: a case study of Imperial College's Master's programme. *Public Understanding of Science 22* (8), 916–926. doi:10.1177/0963662513489386

Mercer-Mapstone, L. & Kuchel, L. (2017). Core skills for effective science communication: a teaching resource for undergraduate science education. *International Journal of Science Education, Part B 7* (2), 181–201. doi:10.1080/21548455.2015.1113573

Merino, N. S. & Tarhuni Navarro, D. H. (2018). Attitudes and perceptions of Conacyt researchers towards public communication of science and technology. *Public Understanding of Science 28* (1), 85–100. doi:10.1177/0963662518781466

Mulder, H. A. J., Longnecker, N. & Davis, L. S. (2008). The state of science communication programs at universities around the world. *Science Communication 30* (2), 277–287. doi:10.1177/1075547008324878

Neeley, L., Goldman, E., Smith, B., Baron, N. & Sunu, S. (2014). *GRADSCICOMM report and recommendations*. Retrieved May 4, 2023, from https://www.compasscicomm.org/wp-content/uploads/2020/06/GradSciComm-Report-and-Recommendations.pdf

Neresini, F. & Bucchi, M. (2011). Which indicators for the new public engagement activities? An exploratory study of European research institutions. *Public Understanding of Science 20* (1), 64–79. doi:10.1177/0963662510388363

Ramani, D. (2009). Master in science communication: an overview. *JCOM 08* (01), C01. doi:10.22323/2.08010301

Ramani, D. & Pitrelli, N. (2007). The output for the Master's degree in Science Communication at SISSA of Trieste. *JCOM 06* (01), L01. doi:10.22323/2.06010101

Rasekoala, E. (2022). Responsible science communication in Africa: rethinking drivers of policy, Afrocentricity and public engagement. *JCOM 21* (04), C01. doi:10.22323/2.21040301

Roche, J., Arias, R., Bell, L., Boscolo, M., Fornetti, A., Knutas, A., … Wolff, A. (2021). Taking stock and re-examining the role of science communication. *Frontiers in Environmental Science 9*, 734081. doi:10.3389/fenvs.2021.734081

Roedema, T., Broerse, J. & Kupper, F. (2021). "Who is going to believe me, if I say 'I'm a researcher?"' — Scientists' role repertoires in online public engagement. *JCOM 20* (03), A03. doi:10.22323/2.20030203

Scheufele, D. A. (2014). Science communication as political communication. *Proceedings of the National Academy of Sciences 111* (Supplement 4), 13585–13592. doi:10.1073/pnas.1317516111

Schiele, B. & Gascoigne, T. (2020). The timelines: a broad-brush analysis. In *Communicating science: a global perspective* (pp. 15–50). doi:10.22459/cs.2020.02

TNS BMRB & University of Westminster (2015). *Factors affecting public engagement by researchers: a study on behalf of a consortium of U.K. public research funders*. London, U.K.: TNS BMRB. Retrieved from https://wellcome.org/sites/default/files/wtp060033_0.pdf

Trench, B. (2012). Vital and vulnerable: science communication as a university subject. In *Science communication in the world: practices, theories and trends* (pp. 241–257). doi:10.1007/978-94-007-4279-6_16

Trench, B. (2017). Universities, science communication and professionalism. *JCOM 16* (05), C02. doi:10.22323/2.16050302

Trench, B., Bucchi, M., Amin, L., Cakmackci, G., Falade, B., Olesk, A. & Polino, C. (2014). Global spread of science communication: institutions and practices across continents. In B. Trench & M. Bucchi (Eds.), *Routledge handbook of public communication of science and technology* (2nd ed., pp. 214–230). New York, NY, U.S.A.: Routledge.

Trench, B. & Bucchi, M. (2021). Global spread of science communication. In *Routledge handbook of public communication of science and technology* (Chap. 6, pp. 97–113). doi:10.4324/9781003039242-6-6

Turney, J. (1994). Teaching science communication: courses, curricula, theory and practice. *Public Understanding of Science 3* (4), 435–443. doi:10.1088/0963-6625/3/4/006

Walker, G., Bantsi, L. B., Bukhosini, S., Chikundi, K., Dusrath, A., Kafeero, M., … Tsie, P. (2020). Models to build capacity for African science centres and science communication: needs and assets. *JCOM 19* (01), A05. doi:10.22323/2.19010205

Weitkamp, E., Milani, E., Ridgway, A. & Wilkinson, C. (2021). Exploring the digital media ecology: insights from a study of healthy diets and climate change communication on digital and social media. *JCOM 20* (03), A02. doi:10.22323/2.20030202

Authors

Luisa Massarani is a Brazilian science communicator who carries out both practical and research activities in the field. She is the coordinator of Brazil's National Institute of Public Communication of Science and Technology, as well as for SciDev.Net in Latin American. She is a researcher at the House of Oswaldo Cruz/Fiocruz (Brazil).

luisa.massarani@fiocruz.br

Heather J. Bray leads the science communication programs at the University of Western Australia including the Master of Science Communication. She has over 20 years of experience in science communication as a practitioner, scholar, teacher, and researcher.

heather.bray@uwa.edu.au

Marina Joubert, corresponding author, is an Associate Professor, lecturer and trainer in the field of science communication and public engagement at the Centre for Research on Evaluation, Science and Technology (CREST) at Stellenbosch University in South Africa. She is particularly interested in the factors that shape scientists' public communication and engagement behaviours.

marinajoubert@sun.ac.za

Andy Ridgway is a Senior Lecturer in science communication at the University of the West of England (UWE) Bristol. His research interests include online trust and misinformation about science online as well as the communication of food in digital spaces. He was co-investigator on the RETHINK project and is UWE's principal investigator on COALESCE.

andy.ridgway@uwe.ac.uk

Joseph Roche is a Researcher and Lecturer at Trinity College Dublin. He is Director of Research for the School of Education and leads international research projects investigating the role of science in society. He is the principal investigator of the EU-funded GlobalSCAPE Project.

joseph.roche@tcd.ie

Fiona Smyth is an Associate Professor in History of Architecture and Science, and Science in Society at the University College Dublin School of Art History and Cultural Policy. Her expertise lies at the interface of the history of architecture and the history of science with particular emphasis on sound and environmental design.

fiona.smyth1@ucd.ie

Elizabeth Stevenson is the originator and Programme Director for the online and on campus MSc Science Communication and Public Engagement programmes at the University of Edinburgh. She has many years of experience in science communication as a practitioner and as a university teacher.

e.stevenson@ed.ac.uk

Frans van Dam is a Project Manager at the Teaching & Learning Lab, as well as a lecturer at the Freudenthal Institute, located within the Faculty of Science at Utrecht University in The Netherlands. He is passionate about embedding science and technology in society and professionalising and improving science communication.

F.W.vanDam@uu.nl

Willian Vieira de Abreu is a postdoctoral researcher at the Federal University of Rio de Janeiro (UFRJ) in Brazil, and also affiliated with two national institutes of science and technology in the country. He holds a Ph.D. in Nuclear Engineering from the UFRJ.

willian.fisico@gmail.com

How to cite

Massarani, L., Bray, H., Joubert, M., Ridgway, A., Roche, J., Smyth, F., Stevenson, E., van Dam, F. and de Abreu, W. V. (2023). 'The distribution of science communication teaching around the globe'. *JCOM* 22 (06), A05. https://doi.org/10.22323/2.22060205.

ISSN 1824-2049. Published by SISSA Medialab. jcom.sissa.it