RETHINK SciComm Training Navigator

Resources for training science communicators in a changing SciComm landscape

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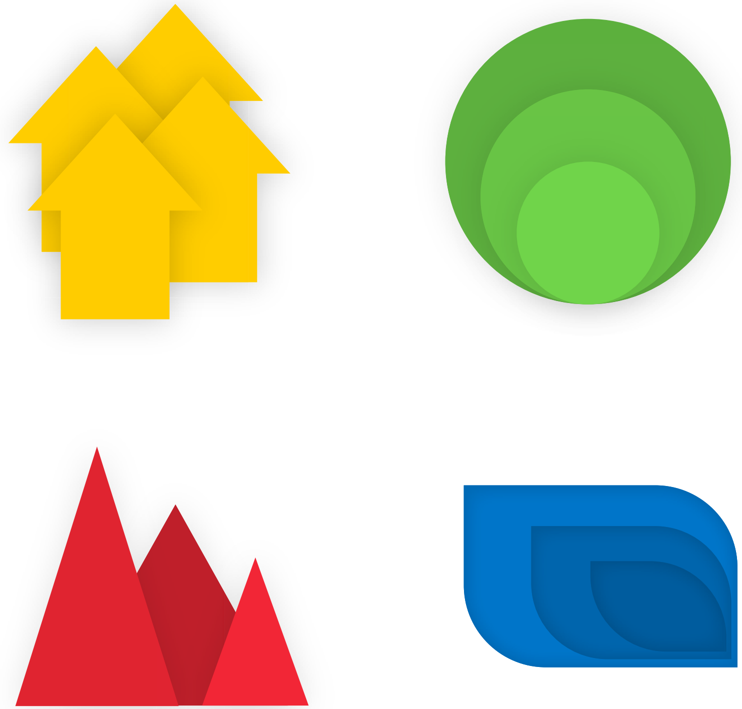
About

This manual was developed by a group of European science communication scholars in the context of the EU-funded project RETHINK, https://www.rethinkscicomm.eu/. Its development was supported by international science communication trainers and professionals who contributed to the overall development of the project, the actual research conducted within RETHINK and both the interpretation and dissemination of the research findings.

Overall, RETHINK is not only the name for our project but mirrors the fundamental objective of our research and outreach activities. We started from the observation that the science communication landscape is changing fundamentally. Digital transformation and related changes in public communication have been important driving forces behind these developments. Despite many challenges, this new science communication landscape offers opportunities for reflective practice to learn about those developments; to investigate the new interfaces between science, media and society; and to change our understanding of science communication practices. Therefore, RETHINK has aimed at uncovering (some) blind spots and broadening the perspective to contribute to a comprehensive understanding of science communication. To this end, we wanted to address a broad range of actors involved in and responsible for the further development of the field. Therefore, we developed this RETHINK SciComm Training Navigator for you as science communication trainers. Our objective is to involve both you and your students in a conversation about the future directions of science communication practice and research. Our training navigator entails a number of suggestions for teaching resources. These are applicable to a broad range of training settings from science communication graduate programmes at the bachelor and master level to further education of science communication professionals to workshops and training for scientists. The resources were developed to stimulate reflection and discussion and to help broaden perspectives among these diverse groups engaged in science communication. We hope you find them useful!

Birte Fähnrich & Laura Heintz on behalf of the RETHINK team



Getting Started with the RETHINK Training Navigator

Frequently Asked Questions

Using the Content

Using the Navigator

To help you get started with the tools, research and frameworks presented in this navigator, have a look at the following sections.

Frequently Asked Questions
Here you can find a number of useful FAQs ranging from background on the project to information for using content found in the navigator.

Using the Content
Here we explain how to best use the navigator. We like to think of it like a map or a compass, helping you understand different parts of the SciComm landscape.

Using the Navigator
We wanted to make the navigator as interactive as possible, and in this section you can read up on the different ways of using the navigator to see the content and information you want.

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Using the Content in This Navigator

To help you understand the scope of RETHINK's research and outcomes, we use a symbolic shortform which we call the "landscape of science communication".

The red mountains stand for our insights and research findings. From here you can gain a perspective and an overview of the realm of science communicaton today. This section highlights three fields of enquiry undertaken: sensemaking in science communication, assessing and promoting science communication quality and barriers to and opportunities for reaching audiences. We give a brief summary of our research and hint at consequences, challenges and open questions linked to our observations.

The green tree stands for our model of science communicators' competence levels. Moving from its outermost layers to its center, we present different aspects of the skills needed by a communicator. We outline our basic ideas of training objectives. Science communication training not only aims to enhance science communication skills but also to enable students to fill prospective roles as professional communicators. We briefly explain three different levels of competence that should be strengthened in the context of training: picture of the world, professional norms and roles, and working knowledge.

Finally, informed by both the insights and competence levels, we have the blue resource pool, which reaches from shallow areas to deep dives to help train budding communicators. The resources refer to one or more of the insights and can be categorized under different competence levels. They can be applied individually or in combination and can be easily adapted to your needs.

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Using the Navigator

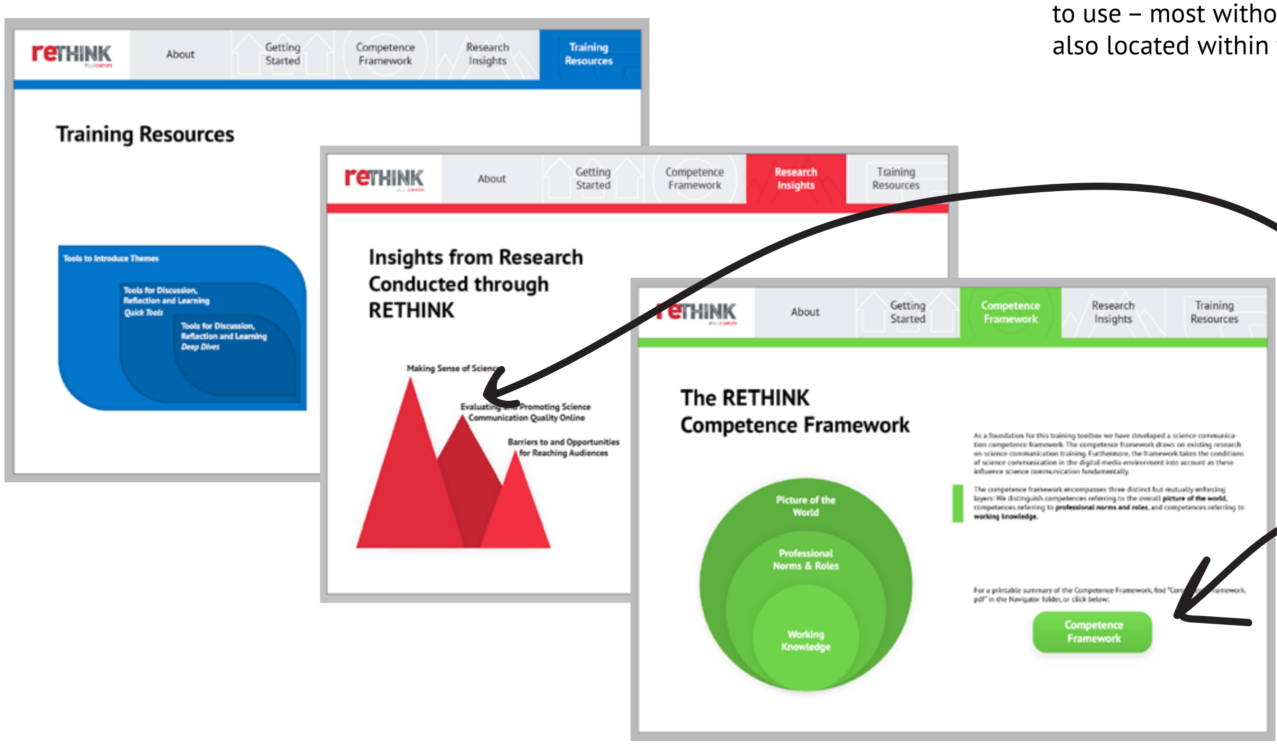
You can always return to the front page of the navigator by clicking on the RETHINK logo.

Click on any of these tabs to go to the respective section.

Head back to the main page of the section by clicking here.

We wanted to make the navigator as interactive as and intuitive as possible so that you can get to the resources and information you need with little effort. The navigator is designed much like a website but functions nearly completely offline.

At the top of each page is a menu with the main sections. Within different sections, an aspect of the landscape of science communication is shown – clicking on part of this image will take you to a page with more information and useful resources. Whenever you see a button, this can open a PDF with more information or a resource to use – most without the need for an internet connection. All of the resources are also located within the folder in which this navigator is found on your computer.



Try clicking on the shapes – each one will lead you to a dedicated page with more information and resources.

Buttons like this one are found throughout the navigator. They can open resources like PDFs, presentation slides or videos.

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Frequently Asked Questions

Why aren't the navigation links working?

- Make sure to download the full resource pack from the RETHINK website https://www.rethinkscicomm.eu/. Also make sure that you are using the most recent version of Adobe Acrobat Reader. If this is not available or the links still do not work, you can scroll through like a normal PDF.

I scrolled down to a resource, but now how do I get back to the navigator easily?

- Simply click on the RETHINK logo, found at the top of every page to return to the front page of the navigator, or if you would like to return to the page you came from, look for the back buttons at the top of each resource. There you will find all of the pages that link to that resource, and return to the one you came from.

Is there an easier way to share or print individual parts of the navigator?

- Yes, take a look at the 'Resources' folder in the zip file containing the navigator. There you will find each section as a seperate PDF, named accordingly.

Can I share the resources or the toolbox with others or host it on my own website?

- The resources are open access and free to use. Please indicate the source when shared with colleagues. To host the resources on your website, please contact Frank Kupper in advance at f.kupper@vu.nl.

When was the toolbox created, and who made it?

- The SciComm Training Navigator was developed in 2021 as part of the Horizon-2020 funded project RETHINK. The RETHINK team, which has members across Europe, carried out research into how science is communicated online regarding vital issues such as climate change, health and artificial intelligence. As part of this research, we looked at who is writing and talking about science online, including scientists, PR people, journalists, bloggers, vloggers or influencers, and how they are doing it. They were also interested in how members of the public who aren't experts in science make sense of the science they read or hear about online. Finally, we wanted to figure out whether "good" and "bad" science communication exist and how its quality can be improved. To bring our insights across, our RETHINK team developed this science communication training resource.

Who can I contact if I have questions about the navigator?

- You can contact Birte Fähnrich, Principle Investigator for RETHINK. Please write her at birte.faehnrich@fu-berlin.de. Moreover, Frank Kupper, Coordinator for RETHINK, can be accessed for questions related to the project at f.kupper@vu.nl.

Where can I find more information about RETHINK?

- The Horizon-2020 project RETHINK ran from January 19 until March 22, 2021. Further information on the objectives, European partners involved, research conducted and its participatory approach can be found at https://www.rethinkscicomm.eu/.

The RETHINK Competence Framework

As a foundation for this training navigator, we developed a science communication competence framework. The competence framework draws on existing research on science communication training. Furthermore, the framework takes the conditions of science communication in the digital media environment into account, as these influence science communication fundamentally.

The competence framework encompasses three distinct but mutually enforcing layers: referring to the overall **picture of the world**, **professional norms and roles** as well as **working knowledge.**

For a printable summary of the Competence Framework in PDF format, click below:
Also available in the navigator folder under "CompetenceFramework.pdf"

Competence Framework

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Competence Layer 1: Picture of the World

Competences related to the "picture of the world" relate to overall mental models and perceptions of the changing science communication landscape.

These competences encompass...

- Overall 'mental models' and
- Perceptions of the changing societal framework in which science communication takes place and how it affects the conditions for the interactions of science and society.

These competences develop through...

- Offering new insights and perspectives,
- (Guided) observation and reflection and
- Challenging existing mindsets and world views.

For a printable summary of the Competence Framework in PDF format, click below:
Also available in the navigator folder under "CompetenceFramework.pdf"

Competence Framework

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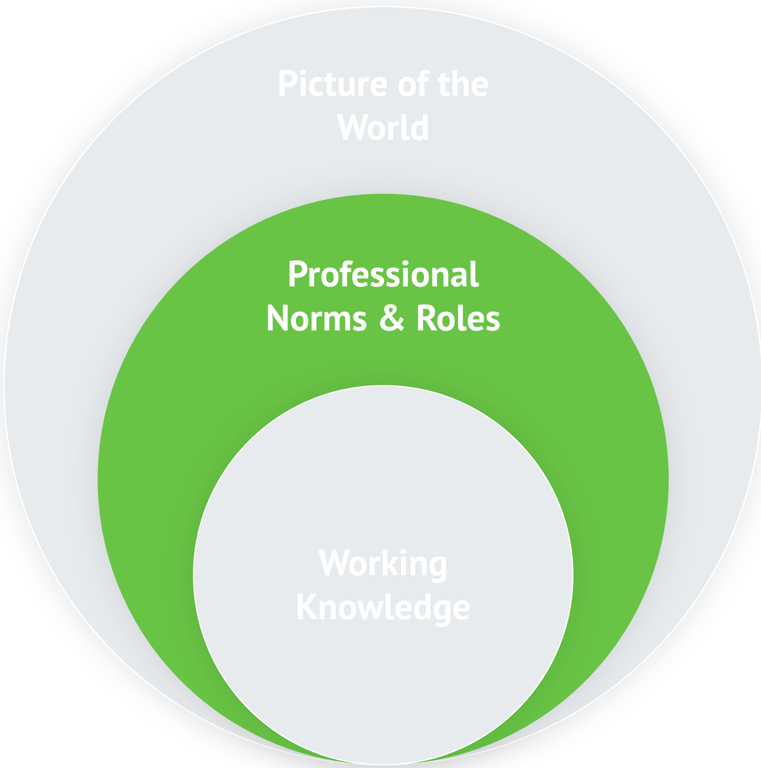
Competence Layer 2: Professional Norms and Roles



Competences at this level refer to professional norms, values and role perceptions that can be reflected and further developed in the context of science communication training.

These competences encompass...

- What it means to be 'professional' and
- Guiding norms, values, demands and role models developed by science communication as a field of practice.

These competences develop through...

- Self-perceptions and others' perceptions of roles;
- Getting to know and adopting professional standards; and
- Interaction, (self-)reflection, feedback, development and adjustment of professional attitudes.

For a printable summary of the Competence Framework in PDF format, click below:
Also available in the navigator folder under "CompetenceFramework.pdf"

Competence Framework

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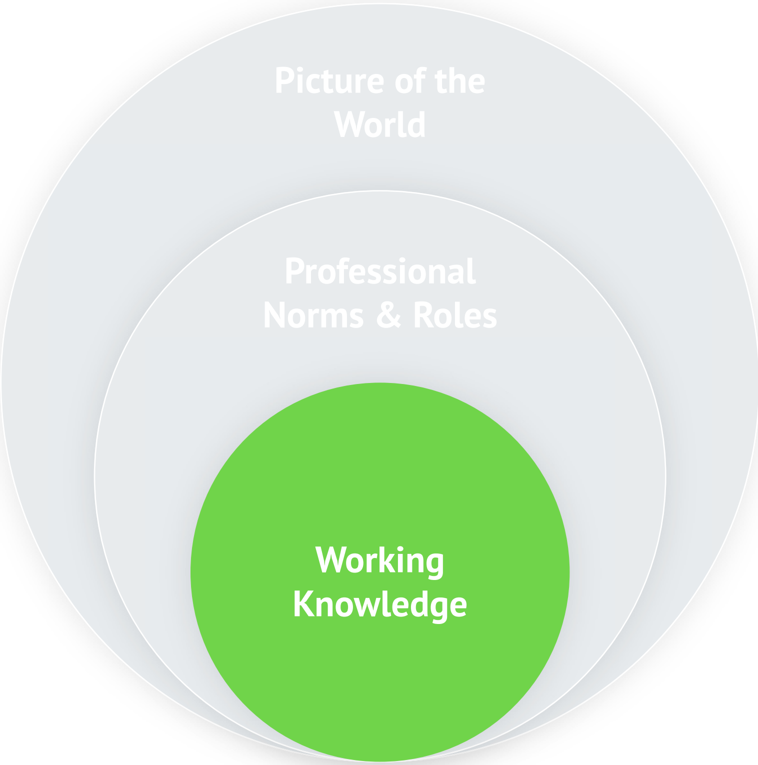
Competence Layer 3: Working Knowledge



Competences at the working knowledge level refer to skills and practices in the everyday business of science communication.

These competences encompass...

- Skills and practical knowledge and
- Ability to deal with technical, strategic and operational demands of everyday science communication practice.

These competences develop through...

- Getting to know models, methods and techniques;
- Practical training, e.g., use of examples and application to other cases; and
- Analysing problems and failures and searching for ways to improve.

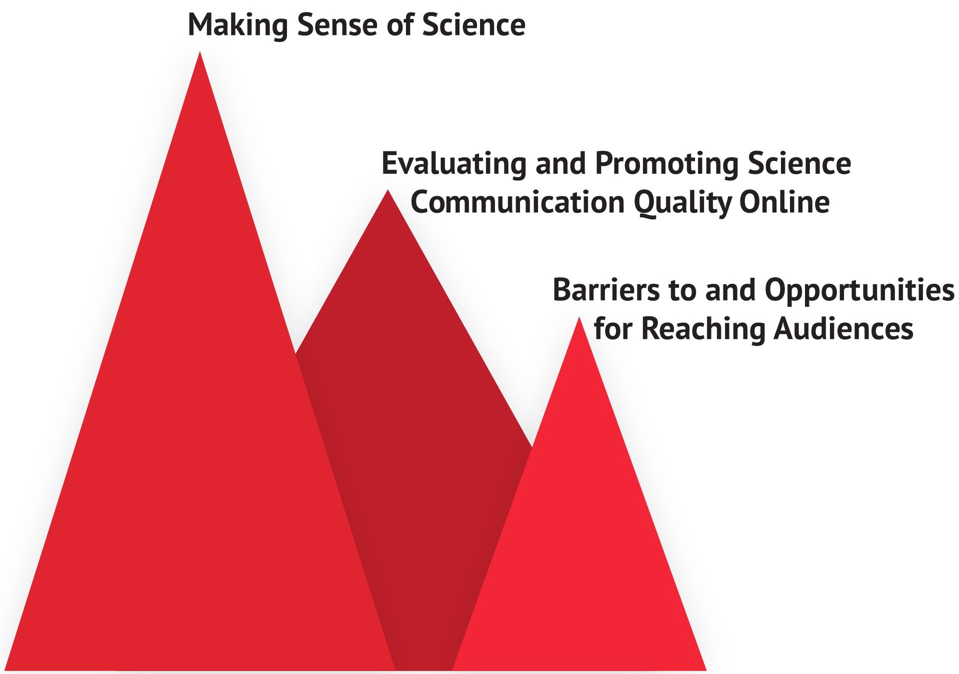
For a printable summary of the Competence Framework in PDF format, click below:
Also available in the navigator folder under "CompetenceFramework.pdf"

Competence Framework

Insights from Research Conducted through RETHINK

In this section, we give a brief overview of the themes that are the focus of the training resources. For reflection on and discussion of the training contexts, three themes were chosen from the RETHINK research objectives that were most applicable to science communication training. These are **making sense of science**, **evaluating and promoting science communication quality online** as well as **barriers to and opportunities for reaching audiences**.

In the following sections, more information about the insights can be accessed by clicking on the button for the respective factsheets. Theses feature extended discussions on the topic as well as figures, references and more reading on the topic.



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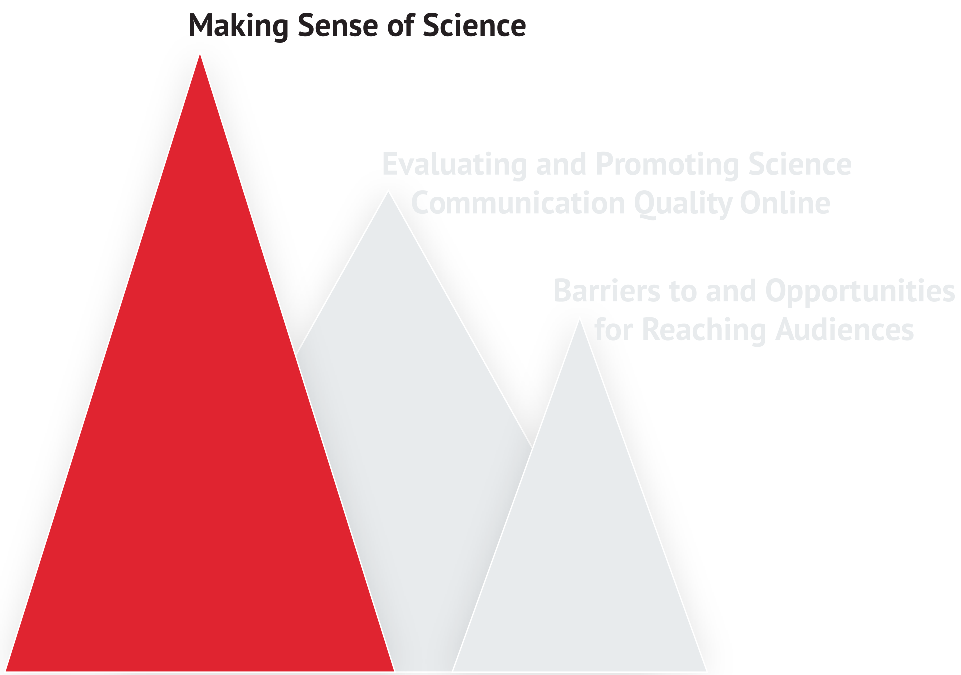
Insight 1.
Understand How Citizens Make Sense of Science



The aim of the study presented was to understand what enables and what hinders the interaction of science and society in the digital media environment.

Question in focus
How do 'lay' audiences understand, perceive and interpret science communication in their everyday practice?

Empirical approach
- 81 semi-structured interviews in seven European countries to analyse sense-making practices
- Workshops with researchers and science communicators to develop strategies to open up sensemaking

Core findings
- 'Gaps' in dealing with science-related information take the form of uncertainty and ambiguity.
- Personal situation and context have a large influence on the use of and trust in sources that help to build 'bridges' to overcome sensemaking gaps.

Future directions
- Develop strategies to apply sensemaking as an approach to understand and adapt citizens' perspectives on science communication

More Information:
For a deeper discussion of this insight, click here:
Also available in the navigator folder under "Insight01.pdf"

Insight 1. Factsheet

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Insight 2.
Science Communication Quality

The study explored how experts define and assess science communication quality in the digital science communication landscape and which strategies they would recommend to promote quality standards in science communication.

Question in focus

How can science communication quality be assessed in the complex digital media environment?

Empirical approach

- Delphi study with 32 international and interdisciplinary science communication researchers, two waves of consecutive surveys
- Workshop with science communication practitioners in seven European countries

Core findings

- Quality criteria for online science communication can be distinguished into five main categories: content, presentation, procedural, technical and context criteria.
- Quality assessment is regarded as highly context dependent; criteria relating to 'new' settings and actors in science communication especially challenge traditional quality assessments.
- Experts agree that promoting science communication quality is important. Education, reflection and raising awareness within the science communication community are considered the most important approaches, and combining different interventions seems most appropriate.

Future directions

- Develop and foster approaches to promote and enhance science communication quality

More Information:

For a deeper discussion of this insight, click here:

Also available in the navigator folder under "Insight02.pdf"

Insight 2. Factsheet

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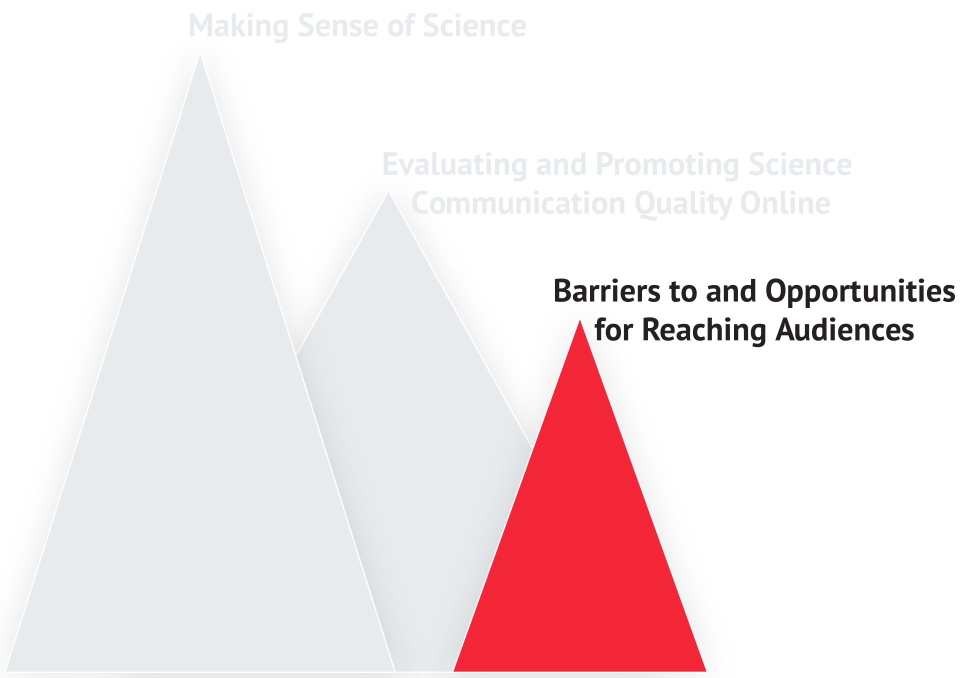
Insight 3.
Reaching Audiences



The aim of this study was to learn about the challenges that occur at the science–society interface, which become especially visible in the context of citizens' sensemaking of science, and to shed light on the consequences for science communication.

Question in focus

Who is addressed by science communicators across Europe? What enables and hinders dialogue and interaction between science and society in the digital media environment?

Empirical approach

- Survey of science communicators across Europe
- Case studies

Core findings

- Most important audiences: university students, school teachers, researchers, policymakers, non-governmental organisations and businesses
- Important motivations to communicate science: information and education, create conversations between researchers and the public, encourage evidence-based attitudes and behaviours and counter misinformation
- Barriers to science communication: lack of time, resources and support
- Barriers to communication and interaction: competition for attention, lack of interest, speed of online communication, missing knowledge and uncertainty regarding how to reach out to specific audiences

Future directions

- Develop science communicators' roles as an opportunity to foster mutual exchange between science and society

More Information:

For a deeper discussion of this insight, click here:

Also available in the navigator folder under "Insight03.pdf"

Insight 3. Factsheet

Training Resources

The following resources can help you to develop your students' science communication competence levels by focusing on the three themes outlined above.

We included materials for the introduction of themes and to help you to stimulate discussion, reflection and learning, which will seed new ideas. For the latter, we have developed quick tools that are applicable within single training sessions as well as deep dives that need a bit more time and can be applied over more sessions.

Tools for introducing themes contain several resources for getting people acquainted with overarching themes of science communication.

Quick tools contain a summary of resources that are applicable within a single session of a course. Resources are developed for specific competence levels and themes. Quick tools can be used in combination with every introductory resource and also in combination with deep dives and in a flexible order.

Deep dives encompass resources that can be used over the course of two or more sessions up to a whole term. Again, resources are developed for specific competence levels and themes. The work on these single or group activities takes place during or outside of course time. Students report their findings during the training sessions in front of the plenary and/or submit a report. Deep dives can be used in combination with every introductory resource and also in combination with quick tools.

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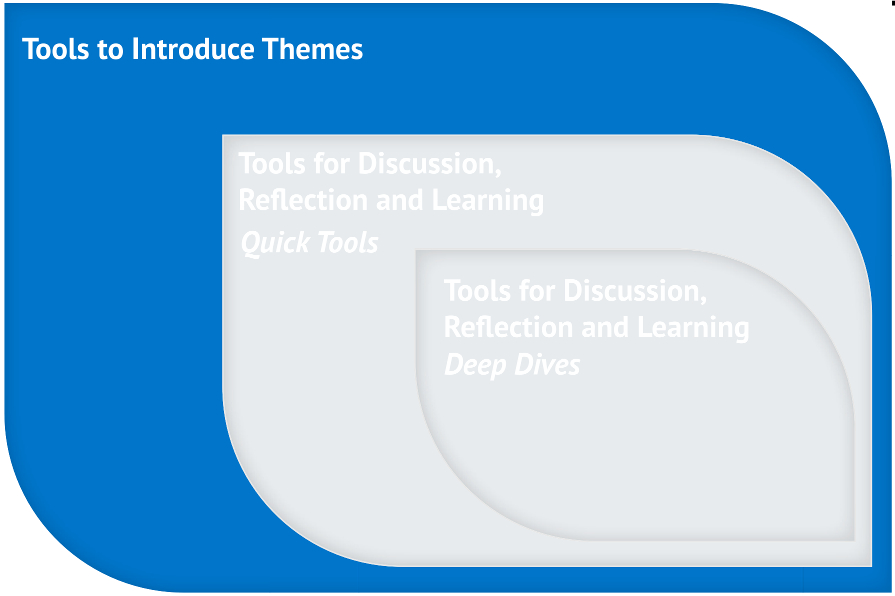
Tools to Introduce Themes

Resources presented in this section are meant to
- Give an overview of the issue in focus,
- Outline problems and relevance,
- Agree on terms and definitions and
- Develop a basis for discussion and reflection.



Tools in this section:

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Factsheets	View
Mini Lectures (Presentation Slides)	View

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Kickstarter Videos

Training Resources

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Competence Framework

Picture of the World

Professional Norms & Roles

Working Knowledge

Required Prior Knowledge

Applicable for all training contexts. Participants would benefit from basic knowledge in science communication.

Complete Guide to this Resource:

Also in the navigator folder under "Resource-Introductions01.pdf"

Resource PDF

Description

The kickstarter introduction contains three short educational videos (2 minutes each) that we created to communicate our research findings in an accessible and entertaining way. The videos address a broad range of stakeholders and thus work as an easy and quick introduction to the RETHINK themes.

Learning Objectives

- Introducing the RETHINK research topics: reaching audiences, making sense of science and science communication quality
- Learning about conditions of the changing science communication landscape
- Getting to know and reflecting on the perspectives of different actors involved in science communication

Technical Requirements and Preparation

- You can download the videos or go online to show them.
- Please check the speakers to make sure that the sound works.
- When used in online settings, students can also watch the video clips on their own devices.

Resources

View videos on the insights by clicking below:

Making sense of science:
Also available online at https://youtu.be/lzIBvNUcCH4

Video Link 1

Science communication quality:
Also available online at https://youtu.be/SMrOofK-UQo

Video Link 2

Reaching audiences:
Also available online at https://youtu.be/htKVHlZBHJg

Video Link 3

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Factsheets

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Picture of the World

Professional Norms & Roles

Working Knowledge

Required Prior Knowledge

Applicable for training contexts that contain more than one session.

Complete Guide to this Resource:

Also in the navigator folder under "Resource-Introductions02.pdf"

Resource PDF

Description

Factsheets present research conducted within RETHINK in a concise and summarizing way. They are available for three themes: making sense of science, science communication quality and reaching audiences. Factsheets can be used for course preparation to give students a first overview and to prepare group work and discussions. All factsheets contain links to complete research reports, related papers and recommendations for further reading.

Learning Objectives

- Receiving an overview of RETHINK's main outcomes
- Gaining insights into the research project and applied methods
- Developing a basis for further discussion on science communication from different perspectives

Technical Requirements and Preparation

- Factsheets can be read on the computer or can be printed.

Resources

View detailed information about the insights by clicking below.

Factsheet on making sense of science
Also in the navigator folder under "Insight01.pdf"

Insight Factsheet 1

Factsheet on science communication quality
Also in the navigator folder under "Insight02.pdf"

Insight Factsheet 2

Factsheet on reaching audiences
Also in the navigator folder under "Insight03.pdf"

Insight Factsheet 3

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Mini Lectures (Presentation Slides)

Training Resources

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Picture of the World

Professional Norms & Roles

Working Knowledge

Required Prior Knowledge

Applicable for all training contexts. It is up to the trainer to tailor the lectures to students' needs.

Complete Guide to this Resource:

Also in the navigator folder under "Resource-Introductions03.pdf"

Resource PDF

Description

To help you to introduce the themes of the courses, we prepared slides for mini lectures. The slides contain basic information on RETHINK research in the three themes making sense of science, science communication quality and reaching audience. They are meant to support your talk. We recommend reading the factsheets, the full research reports and/or related papers for preparation.

Learning Objectives

- Learning about the relevance, approaches and outcomes of RETHINK research in the fields making sense of science, science communication quality and reaching audiences
- Building the basis for further discussion and group work

Technical Requirements and Preparation

- Applicable to face-to-face sessions (beamer required) and online settings
- Can also be offered to students as digital/printed handouts

Resources

Open the presentation files by clicking below:

Presentation on making sense of science
Also in the navigator folder under "Presentation01.pdf"

Presentation 1

Presentation on science communication quality
Also in the navigator folder under "Presentation02.pdf"

Presentation 2

Presentation on reaching audiences
Also in the navigator folder under "Presentation03.pdf"

Presentation 3

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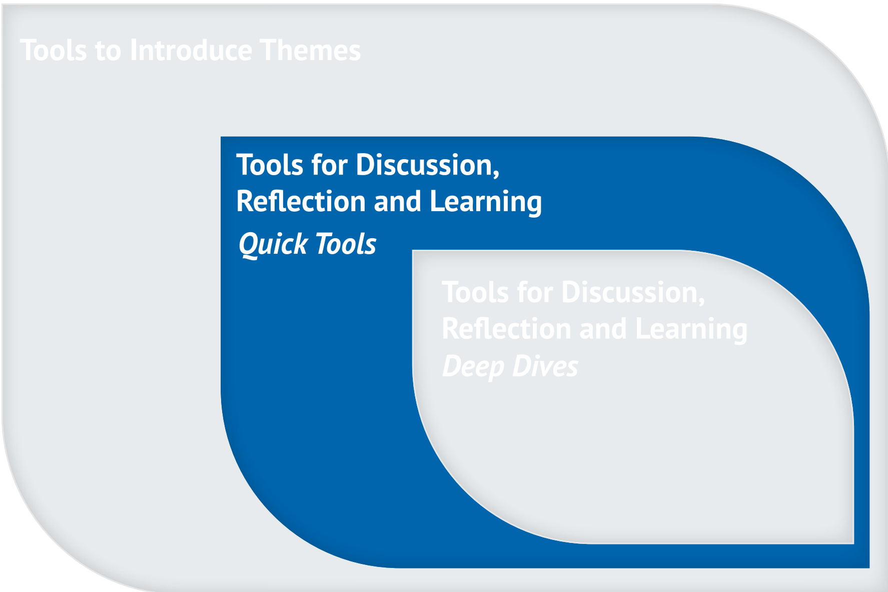
Tools for Discussion, Reflection and Learning: Quick Tools

Resources presented in this section are meant to
- Prompt discussions,
- Enable reflection,
- Stimulate learning and development and
- Enable short-term (quick tools) involvement of students.



Tools in this section:

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Approaching Audiences/Joint Problem Solving	View
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Discussion Prompts

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Competence Framework

Picture of the World

Professional Norms & Roles

Working Knowledge

Required Prior Knowledge

Not required, but basic understanding of science and public communication could be an advantage.

Complete Guide to this Resource:

Also in the navigator folder under "Resource-QuickTool01.pdf"

Resource PDF

Description

Discussion prompts are short activating questions to facilitate discussions among participants. The questions can be used individually or before/during the mini lecture presentations and in plenum or in smaller groups. The prompts provide a starting point for activities concerning the development of the science communication environment and refer to the three RETHINK themes: making sense of science, science communication quality and reaching audiences.

Learning Objectives

- Reflecting on themes
- Developing different or new perspectives/points of view
- Finding solutions and strategies in a collaborative way

Technical Requirements and Preparation

- Presentation equipment and/or (black/white) board
- Use of flipcharts or digital alternatives

Resources

For a set of discussion prompts, click here:

also available in the Navigator folder under "DiscussionPrompts.pdf"

Discussion Prompts

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Discovering the Science Communication Ecosystem

Training Resources

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Tools for Discussion, Reflection and Learning: Deep Dives

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Competence Framework

Picture of the World

Professional Norms & Roles

Working Knowledge

Required Prior Knowledge

Not required, but basic understanding of science and public communication could be an advantage.

Complete Guide to this Resource:

Also in the navigator folder under "Resource-QuickTool02.pdf"

Resource PDF

Description

Working on their own or in groups, students visualise their understanding of the science communication ecosystem. Participants are asked to modulate (e.g., draw) and explain their ideas about the science–society interface. This can include communicators, issues, audiences, media or other aspects considered relevant.

Learning Objectives

- Explicating oftentimes vague understandings and ideas of the (digital) science communication ecosystem
- Getting to know different perspectives and broaden own views
- Challenging mental models by discussing and exchanging different perceptions

Technical Requirements and Preparation

- Modelling clay (depending on size, one block per student)
- Underlay (e.g., flip chart sheets)

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Actor Mapping

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Tools for Discussion, Reflection and Learning: Deep Dives

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Competence Framework

Picture of the World

Professional Norms & Roles

Working Knowledge

Required Prior Knowledge

Not required, but basic understanding of science and public communication could be an advantage.

Complete Guide to this Resource:

Also in the navigator folder under "Resource-QuickTool03.pdf"

Resource PDF

Description

Understanding and observing the complexity of the science communication landscape is essential for professional science communicators and scientists.
To this end, this task aims at mapping actors involved in the public communication of science-related issues. Students work individually or in small groups to develop actor maps for specific science-related communication issues such as climate change, nutrition, endangered species, gentech or vaccination.

Learning Objectives

- Realising the diversity of actors involved in the public communication of science
- Developing a realistic understanding of the competition for public attention in science communication
- Recognising the dual role of actors as audiences and science communicators

Technical Requirements and Preparation

- Internet access and notebooks for students (at least one per group)
- In case of group work: sufficient space or breakout rooms
- Flipcharts or online equivalent
- Depending on platform used, personalised settings could lead to different results for the same search strings. This is not a problem in the context of the training setting, but students should be made aware of this.

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Science Communicators' Personas

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Competence Framework

Picture of the World

Professional Norms & Roles

Working Knowledge

Required Prior Knowledge

Prior knowledge about contexts and workings in professional science communication could be an advantage.

Complete Guide to this Resource:

Also in the navigator folder under "Resource-QuickTool04.pdf"

Resource PDF

Description

Students develop and reflect upon typical 'personas' representing the various actors in the science communication field. On this basis, students develop their personas in small groups by describing organisational and working contexts (e.g., organisational structures and hierarchies), media and audience contexts (e.g., overall objectives and target groups, platforms and media), general tasks and challenges for those 'personas' working in the field.

Learning Objectives

- Reflecting working conditions of science communicators
- Gaining insights into professional working conditions
- Understanding science communicators' perspectives and decisions

Technical Requirements and Preparation

- Internet access
- Space/breakout rooms for group work
- Optional: materials (job interviews, case studies) in print or online
- Flipcharts or online equivalent for presentation of results

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Approaching Audiences/ Joint Problem Solving

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Competence Framework

Picture of the World

Professional Norms & Roles

Working Knowledge

Required Prior Knowledge

Knowledge about science communication audiences and related difficulties when engaging specific segments of society could be an advantage.

Complete Guide to this Resource:

Also in the navigator folder under "Resource-QuickTool05.pdf"

Resource PDF

Description

In recent years, much attention has been paid to the question of how science communication can reach out to different audiences in an effective and responsible way. Students can both learn from case studies that we conducted for RETHINK and 'help' the communicators to reach out to their audiences in focus by using an approach called joint problem solving. Important steps of this task are to detect the problems and barriers that the actors face when approaching specific audiences online and offline. Students rank the problems with regard to their importance for reaching the science communicators' objectives and can then decide on up to three problems that they will aim to solve. In the next step, students discuss potential ways and required resources to tackle the identified problems.

Learning Objectives

- Reflecting on science communication audiences and challenges to address specific segments of society
- Analysing science communication practices
- Developing skills for joint problem solving and constructive critique

Technical Requirements and Preparation

- Case studies in print or digital form
- Flipcharts or online equivalent
- Optional: sticky notes (offline/online) to rank problems and solutions

Resources

For a set of case studies, click here:
also available in the Navigator folder under "CaseStudies.pdf"

Case Studies

Back
Return to 'Tools for Discussion, Reflection and Learning: Quick Tools'

First Aid Bridge Building

Complete Guide to this Resource:

Also in the navigator folder under "Resource-QuickTool06.pdf"

Resource PDF

Description

Research on sensemaking points to the complex and multifaceted situations in which individuals encounter science in their everyday lives. Against this backdrop, the research conducted within RETHINK aimed at exploring the sensemaking of citizens in the context of the COVID- 19 pandemic. The sensemaking methodology explains the gaps that individuals are facing with and their individual approaches to overcome these and to build bridges to make sense of and cope with the health crisis. Against this backdrop, the task aims at developing instant strategies that respond to the gaps articulated by the people in focus.

Learning Objectives

- Recognising audience's needs
- Learning and improving skills to develop communication strategies
- Developing strategic thinking

Technical Requirements and Preparation

- Visual presentations in print or digital form
- Flipcharts or online equivalent to support students' strategy development
- Equipment for presentation (notebooks, whiteboards etc.)

Resources

For a set of visual presentations, click here:
also available in the Navigator folder under "VisualPresentations.pdf"

Visual Presentations

Training Resources

Tools to Introduce Themes
Tools for Discussion, Reflection and Learning: Quick Tools
Tools for Discussion, Reflection and Learning: Deep Dives

Research Insights

Making Sense of Science
Evaluating and Promoting Science Communication Quality Online
Barriers to and Opportunities for Reaching Audiences

Competence Framework

Picture of the World
Professional Norms & Roles
Working Knowledge

Required Prior Knowledge

Knowledge of sensemaking methodology and basic knowledge of communication strategy development needed.

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Return to 'Training Resources'

Tools for Discussion, Reflection and Learning: Deep Dives

Resources presented in this section are meant to

- Prompt discussions,
- Enable reflection,
- Stimulate learning and development and
- Enable long-term (deep dives) involvement of students.

Tools in this section:

Science Communication Diary — View

SciComm Insta Story — View

Creating a Manual for Young Scientists — View

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Return to 'Tools for Discussion, Reflection and Learning: Deep Dives'

Science Communication Diary

Training Resources

Tools to Introduce Themes

Tools for Discussion, Reflection and Learning: Quick Tools

Tools for Discussion, Reflection and Learning: Deep Dives

Research Insights

Making Sense of Science

Evaluating and Promoting Science Communication Quality Online

Barriers to and Opportunities for Reaching Audiences

Competence Framework

Picture of the World

Professional Norms & Roles

Working Knowledge

Required Prior Knowledge

Basic knowledge of science communication and scientific working needed.

Complete Guide to this Resource:

Also in the navigator folder under "Resource-DeepDive01.pdf"

Resource PDF

Description

Science communication training aims at supporting (prospective) science communicators in their professional development and thus helps to improve science–society interactions in general. In this task, students use a diary technique to either observe their own science communication activities online, monitor their science communication encounters (i.e., their use of science communication) or apply the diary technique with one to three individuals (e.g., friends/family) to understand their use of science communication.

Learning Objectives

- Reflecting about science communication online
- Systematically observing science communication as a basis for development and improvement
- Getting to know social science approaches (i.e., diary technique) and improving scientific working capabilities

Technical Requirements and Preparation

- Online access and hardware
- Optional: diary app or other applicable tools
- Space (e.g., digital) for group work
- Equipment for presentation (notebooks, whiteboards etc.)

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Return to 'Tools for Discussion, Reflection and Learning: Deep Dives'

SciComm Insta Story

Training Resources

Tools to Introduce Themes
Tools for Discussion, Reflection and Learning: Quick Tools
Tools for Discussion, Reflection and Learning: Deep Dives

Research Insights

Making Sense of Science
Evaluating and Promoting Science Communication Quality Online
Barriers to and Opportunities for Reaching Audiences

Competence Framework

Picture of the World
Professional Norms & Roles
Working Knowledge

Required Prior Knowledge

Basic knowledge of science communication required; knowledge about science communication quality an asset. Basic experience in scientific working, esp. conducting literature reviews and summarising study findings, needed. The trainer should possess technical knowledge and experience with Instagram or other social media applied.

Complete Guide to this Resource:

Also in the navigator folder under "Resource-DeepDive02.pdf"

Resource PDF

Description

Using social media has become a standard in science communication to address a broad range of different audiences. However, the use of online platforms can make it difficult to conform to quality standards. Against this backdrop, this task aims at helping students to experience and reflect on the challenges of social media use in science communication and to practice its application. Students develop their own science communication for Instagram and prepare and produce an Insta feed post and stories. Alternatively, they can produce short videos for YouTube or TikTok. Depending on the course, the theme for the task could refer to the question of what the 'science of science communication' is all about. Of course, more specific questions derived from science communication research could be used, too.

Learning Objectives

- Reflecting on science communication as a discipline
- Reflecting on reaching audiences and quality
- Understanding new conditions of the science communication landscape
- Writing for different audiences

Technical Requirements and Preparation

- Instagram app (on a mobile device) and accounts (at least one per group)
- (Private) Instragram account for the course (to be set up by the trainer)
- Optional: access to literature (e.g., Web of Science license or comparable)
- Space (e.g., digital) for group work
- Equipment for presentation (notebooks, whiteboards etc.)

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Creating a Manual for Young Scientists

Training Resources

Tools to Introduce Themes

Tools for Discussion, Reflection and Learning: Quick Tools

Tools for Discussion, Reflection and Learning: Deep Dives

Research Insights

Making Sense of Science

Evaluating and Promoting Science Communication Quality Online

Barriers to and Opportunities for Reaching Audiences

Competence Framework

Picture of the World

Professional Norms & Roles

Working Knowledge

Required Prior Knowledge

Solid science communication knowledge and experience with scientific working and practical science communication needed.

Complete Guide to this Resource:

Also in the navigator folder under "Resource-DeepDive03.pdf"

Resource PDF

Description

In recent years, public engagement has developed into an important activity of scientific work and a professional demand for academic careers. However, we also know from previous research on public engagement – also conducted within RETHINK – that scientists do not always feel well-equipped for engaging with society, and only some scientists have opportunities to take part in science communication trainings to develop their competences. Against this background, the task is to develop a manual for young scientists that gives them guidance for their own science communication and public engagement activities. When conducting this task, students themselves can thus become 'trainers' for science communication and take up the important role of spreading science communication quality and promoting professionalism.

Learning Objectives

- Applying science communication theory and evidence
- Putting oneself in the position of young scientists who are expected to or want to engage with the public
- Developing writing skills and own science communication competences
- Learning from other perspectives, esp. in interaction with scientists

Technical Requirements and Preparation

- Optional: access to literature (e.g., Web of Science license or comparable)
- Space (e.g., digital) for group work
- Equipment for presentation (notebooks, whiteboards etc.)

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Return to 'The RETHINK Competence Framework'

Competence Framework

Science communication training equips participants with the ability to reflect on certain circumstances of communication practices, for example, topics they communicate or specific requirements of the platform they use (e.g., interactive features; Howell & Brossard, 2020). Often, short training courses for scientists and practitioners teach practical communication skills, for example, how to use media or how to approach audiences (e.g., Miller & Fahy, 2009; Silva & Bultitude, 2009). In contrast, degree programmes in science communication encompass theory and professional development in a more comprehensive approach (Mulder et al., 2008) and therefore help to provide a bigger picture (Turney, 1994).

In both cases, research on science communication training highlights the need to develop generalisable learning outcomes for science communication, especially with regard to different contexts of information and communicator roles (Baram-Tsabari & Lewenstein, 2017). Moreover, the overall understanding for societal and media changes is emphasised, as these developments are crucial for science–society interactions. Reflecting on these new conditions also promotes science communicators' self-perceptions and helps them to develop adequate roles for the constantly changing communication environment (Baram-Tsabari & Lewenstein, 2017; Pieczka, 2002).

Against this backdrop, we developed a science communication competence framework as a foundation for the training toolbox. The competence framework draws on existing research on science communication training; most importantly, we refer to the approaches by Baram-Tsabari and Lewenstein (2017) and Pieczka (2002). Furthermore, the framework takes the conditions of science communication in the digital media environment into account (Neuberger et al., 2019; Pieczka, 2002), as these influence science communication fundamentally.

The competence framework encompasses three distinct but mutually enforcing layers: we distinguish competences referring to the overall picture of the world, professional norms and roles as well as to working knowledge.

Competence level	Refers to	Develops through
Picture of the world	• Overall mental models • Perceptions of the changing societal framework in which science communication takes place and how it affects the conditions for the interactions of science and society	• Offering new insights and perspectives • (Guided) observation and reflection • Challenging existing mindsets and worldviews
Professional norms and roles	• What it means to be professional • Guiding norms, values, demands and role models developed by science communication as a field of practice • Self-perceptions and others' perceptions of roles	• Getting to know and adopting professional standards • Interaction, (self-)reflection, feedback, development and adjustment of professional attitudes
Working knowledge	• Skills and practical knowledge • Capability to deal with technical, strategic and operational demands of everyday science communication practices	• Getting to know models, methods and techniques • Practical training, e.g., use of examples and application to other cases • Analysing problems and failures and searching for methods of improvement

Table. 1: Competence layers as a basis for science communication training (categories adopted from Pieczka, 2002; Baram-Tsabari & Lewenstein, 2017)

Competence Framework

Fig. 2: Competence layers as depicted throughout RETHINK's SciComm Navigator.

Picture of the world

Pieczka (2002) described societal changes due to globalisation and digitalisation and related demands for professional (science) communicators. Emerging formats are characterised by activity and pace and their ability to allow citizens to take part in an environment with 'new orders of knowledge' (Neuberger et al., 2019). Apart from positive effects like new fora for deliberation and more flexible modes of communication, these structures provide risks that science communicators should be aware of, for example, the misuse of science-related information. Based on these societal developments, Pieczka (2002) built a framework that he/she described as a picture of the world, which serves as the outer layer of the competence framework. To develop the picture of the world within training means to develop students' mental models, how they perceive the changing societal framework in which science communication takes place and how it affects the conditions for the interaction of science and society. Competences that refer to the picture of the world can be developed by offering students new insights, taking on new perspectives, supporting students to make their own and reflect on others' observations and challenging mindsets and worldviews in the context of interactional approaches.

Professional norms and roles

The second layer of the competence model describes professional norms and roles for science communicators and how they have changed in the context of the digital media environment. These competences refer to specific attitudes and norms that professional communicators take up to distinguish themselves from non-professionals (van Ruler, 2005). For instance, these competences include applying integrated communication on different channels, considering ethical standards and being aware of the importance of evaluating science communication. Against this backdrop, being aware of one's and others' roles and related demands (e.g., knowledge broker, curator, bridge builder, enabler) and being able to fill these roles are also important competences. Developing these competences requires getting to know and acknowledging them in the contexts of training and practical experience. Within training programmes, learning approaches that foster interaction and (self-)reflection and allow for feedback, development and adjustment of professional norms and roles are most fruitful.

Working knowledge

Additionally, science communicators need to be equipped with competences and skills to work in a digitalised world. This encompasses technical knowledge of media and digital tools as well as practical skills to transfer communication through different channels. Moreover, science communicators also require competences to develop communication strategies, adapt models for risk or crisis communication or apply specific formats, to name but a few examples. Following Baram-Tsabari and Lewenstein (2017), the will to keep up with new developments displays a dimension in its own within this category. Moreover, critical thinking is needed when assessing the risks and opportunities of digital media. Developing these tools calls for the teaching of models, methods and techniques required in professional science communication. Moreover, practical training is required to equip students with the necessary competences.

Competence Framework

Recommended reading

Akin, H., Rodgers, S., & Schultz, J. C. (2021). Science communication training as information seeking and processing: a theoretical approach to training early-career scientists. *Journal of Science Communication, 20*(05), A06. https://doi.org/10.22323/2.20050206

Fähnrich, B., Wilkinson, C., Weitkamp, E., Heintz, L., Ridgway, A., & Milani, E. (2022). RETHINKING science communication education and training: Towards a competence model for science communication. *Frontiers of Communication*, https://doi.org/10.3389/fcomm.2021.795198

References

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, https://doi.org/10.1080/21548455.2017.1303756

Fähnrich, B. (2020). *D3.1 Analysis of the status quo and demands for science communication training*. European Commission deliverable report. https://www.rethinkscicomm.eu/wp-content/uploads/2020/06/D3.1-Report-on-analysis-of-status-quo-and-requirements-in-focus-countries.pdf

Howell, E. L., & Brossard, D. (2020). Science engagement and social media. Communicating across interests, goals, and platforms. In Todd P. Newman (Ed.). *Routledge studies in environmental communication and media. Theory and best practices in science communication training*, (pp. 57-70). Routledge.

Miller, S., & Fahy, D. (2009). Can Science Communication Workshops Train Scientists for Reflexive Public Engagement?: The ESConet Experience. *Science Communication, 31*(1), 116-126. https://doi.org/10.1177/1075547009339048

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. https://doi.org/10.1177/1075547008324878

Neuberger, C., Bartsch, A., Reinemann, C., Fröhlich, R., Hanitzsch, T., & Schindler, J. (2019). Der digitale Wandel der Wissensordnung. Theorierahmen für die Analyse von Wahrheit, Wissen und Rationalität in der öffentlichen Kommunikation. *Medien & Kommunikationswissenschaft, 67*(2), 167–186. https://doi.org/10.5771/1615-634X-2019-2-167

Pieczka, M. (2002). Public relations expertise deconstructed. *Media, Culture & Society 24*(3), 301-323. https://doi.org/10.1177/016344370202400302

Silva, J., & Bultitude, K. (2009). Best practice in communications training for public engagement with science, technology, engineering and mathematics. *Journal of Science Communication, 8*, 1-13. https://doi.org/10.22323/2.08020203

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

Van Ruler, B. (2005). Commentary: Professionals are from Venus, scholars are from Mars. *Public Relations Review, 31*(2), 159-173. https://doi.org/10.1016/j.pubrev.2005.02.022

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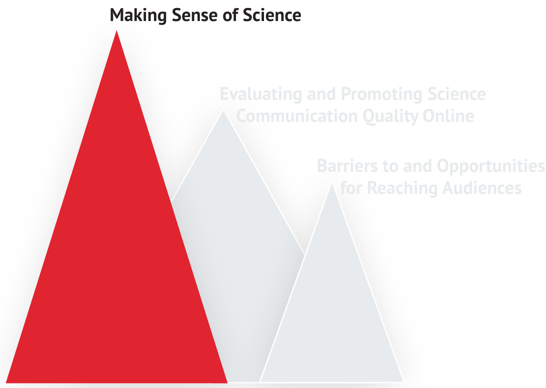
Understanding How Citizens Make Sense of Science



Question in focus

How do 'lay' audiences understand, perceive and interpret science communication in their everyday practice?

Empirical approach

- 81 semi-structured interviews in seven European countries to analyse sensemaking practices
- Workshops with researchers and science communicators to develop strategies to open up sensemaking

Core findings

- 'Gaps' in dealing with science-related information take the form of uncertainty and ambiguity
- Personal situation and context have a large influence on the use of and trust in sources that help to build 'bridges' to overcome sensemaking gaps

Future directions

- Develop strategies to apply sensemaking as an approach to understand and adapt citizens' perspectives in science communication

Objectives and Approach

The second theme of our research was to learn about the challenges that occur at the science–society interface and to shed light on the consequences for science communication. These challenges become especially visible in the context of citizens' sensemaking and thus require closer attention. We used the case of the COVID-19 pandemic, which presents a dramatic but valuable example to investigate the sensemaking practices of citizens across Europe. The pandemic has been difficult to manage and endure, as it is continuously surrounded by complexity and uncertainty and involves fundamental medical, political, societal, economic and ethical issues. Numerous media and other actors are continuously reporting on COVID-19, often highlighting widely differing viewpoints. This situation raises difficult questions for citizens: Which information is true, flawed or even false? Which actors can be trusted to determine what is true? Will containment measures be effective, and are such measures proportional and legitimate? Indeed, the prevailing complexity and uncertainty of the COVID-19 crisis have made it extremely challenging for citizens to come to terms with this new reality. Against this backdrop, the sensemaking approach was considered especially useful as it makes the perspective of the participant (or sensemaker) central to the public discussion, and it, takes the study of an individual's situation as a starting point.

Our goal was to show the diversity of mechanisms that play a role in citizen sensemaking practices using an example of an issue in which the connections between science and society have been brought into sharp view. To understand how citizens make sense of (science) communication related to COVID-19, we conducted 81 in-depth interviews with citizens during the first wave of the pandemic. Participants came from eight European countries: Germany, Italy, the Netherlands, Poland, Portugal, Serbia, Sweden and the United Kingdom. To understand different sensemaking practices, the objective was to interview people who were as diverse as possible (e.g., regarding family status, occupation, age, gender, societal engagement and political attitudes).

Understanding How Citizens Make Sense of Science

Sensemaking as an approach to researching citizens' perceptions of science communication

Sensemaking is the process through which people create an understanding of situations in which they find themselves (Fiss & Hirsch, 2005; P. Zhang & Soergel, 2014). Broadly defined, this process consists of two phases: 1) seeking and filtering information, also called sensing, and 2) actual sensemaking, in which an understanding of the information is established by relating to existing structures and previous experience (Y. Zhang et al., 2019). The sensemaking approach starts from the assumption that information is never complete, implying that people are always capable of finding a way to accommodate for diversity, complexity and incompleteness in information (Dervin, 1998).

The sensemaking methodology is built around the idea that when individuals are confronted with a complex, ambiguous issue relating to science, they are faced with a gap. To 'fill' this gap, people use and reject previous and actual information and knowledge to build bridges over the gaps. This bridge building is influenced by people's individual situations and contexts. Eventually, this leads to an outcome in which a momentary understanding of the particular issue is formulated (Dervin, 1998). However, this sensemaking is always constrained; the perception of reality is neither complete nor constant, but new gaps continuously appear and need to be filled and bridged. Accordingly, sensemaking is not stable but develops over time as a continuous process (Dervin, 1998).

Following the sensemaking methodology (Dervin, 2008), we explored how citizens made sense of so-called micro-moments: specific moments in which they stumbled upon questions and uncertainties related to the pandemic.

Personal situation trumps information

The findings of the interview study emphasise the influence of the personal situation for making sense of science communication. In the case of COVID-19, own affectedness (e.g., own sickness), perceived vulnerability (e.g., series of relatives who became sick) and social context (e.g., professional background, influence of family and friends) had a fundamental impact on the understanding of the pandemic and related (science) communication. Interviews showed that the personal situation shaped the perceived gaps and the bridging strategies employed to a large extent. Further, the outcomes reached often mirrored one's personal situation. For the practice of science communication, it is a sobering insight that the personal situation can outweigh information and insights provided by science communicators.

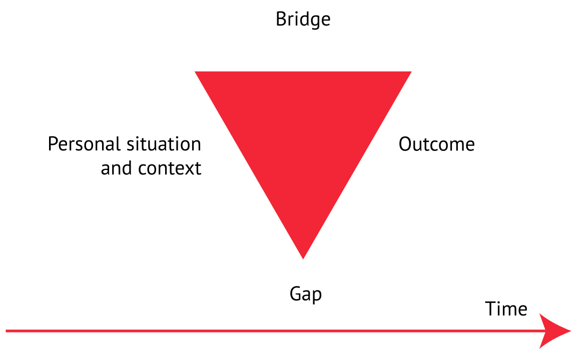


Fig. 1: Mirco-moment triangle that illustrates the five dimensions of the sensemaking process as represented in the SMM (Sense Making Methodology; modelled after Reinhard & Dervin, 2012).

Understanding the unknown

Moreover, the nature of recurring gaps and how these gaps become apparent was an important question. The findings indicate that gaps can be grouped into two overarching categories: fundamental uncertainties and ambiguities. Starting with the uncertainties, participants had numerous questions about the nature, characteristics and origin of the virus. How does it transfer? How harmful is it? How did it originate, and what impact will it eventually have? Ambiguities refer to expressed doubts and worries about the appropriate response to the pandemic, notably from the government. In short, from a societal perspective, interviewees worried whether the cure (political regulations such as lockdowns) might be worse than the disease and its consequences. When looking at how gaps emerge, the two most important sources were being confronted with (an abundance of) information, notably in the case of changing and contradicting information and policies, and interactions with others. Particularly relevant for science communication is the observation that given the uncertainties concerning the virus and the pandemic, participants were continuously

Understanding How Citizens Make Sense of Science

confronted with new information that, in turn, often raised new questions. Moreover, participants found contradictory information one of the most frustrating issues when trying to make sense of the pandemic. Next, interaction with others was prone to reveal gaps. Interaction with others was understood as (direct) personal contact but also observing the behaviour and choices of others. Such interactions often revealed gaps regarding what level of cautious behaviour was adequate (e.g., with regard to social distancing).

Bridging strategies and sources

Looking at the bridges that the participants – explicitly or implicitly – constructed, we identified different elements that play a dominant role in citizens' sensemaking practices. These were different worldviews, the use of information and different (predominantly negative) emotions. First of all, we saw that participants upheld different *a priori* beliefs and ideas about institutions (e.g., society, the government, experts and the media) which we clustered under the heading of worldviews. These were also related to different levels of trust in the aforementioned institutions. One cluster of participants demonstrated an *a priori* trust in institutions (notably [health] authorities and the media), while others distrusted these institutions from the outset. This directly influenced the participants' assessment of the reliability of information provided by these institutions. Still, many participants made use of information to bridge gaps; this included passively received information. Some participants actively looked up information in relation to the gaps they were facing. However, direct reference to dedicated science communication outlets was limited, while personal information (e.g., from friends and family) seemed more important. Lastly, emotions played a very important role in sensemaking practices related to COVID-19. The results clearly indicated that citizens experienced a multitude of emotions regarding the pandemic. these were mostly negative: anxiety, anger and frustration played a fundamental role in reaching certain outcomes. Occasionally participants explicitly referred to positive emotions that provided leverage to make the situation manageable.

Outlook: Developing strategies for science communicators to open up sensemaking

This study revealed important opportunities for improving science–society interactions and as such provides important learning opportunities for the practice of science communication. A better understanding of sensemaking practices can enable the formulation of science communication strategies tailored to various sensemaking styles and local contexts and communities, with the overarching aim to contribute to a constructive public dialogue on science. We believe that insights into the values, worldviews and emotions that citizens have when they make sense of science can help science communicators to establish meaningful interactions, wherein mutual trust and understanding is facilitated. Insights into sensemaking processes can help science communicators to adopt practices that connect to various sensemaking practices. Such science communication practices are necessarily focused on opening up the sensemaking practices of citizens, as this facilitates science communicators to connect to citizens' underlying values, emotions and worldviews on science.

Therefore, we suggest that science communicators in the future develop reflective practices (Roedema et al., forthcoming). For instance, science communicators could explore the sensemaking practices that they encounter in their audience and at the same time reflect on their own actions and approach in reaching out to these audiences (Roedema et al., forthcoming; Schön, 1983). This might be especially important in online interactions, where differing opinions and worldviews have become more numerous and explicit.

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Understanding How Citizens Make Sense of Science

Recommended readings

On reflective practice and sensemaking:

Chilvers, J. (2012). Reflexive Engagement? Actors, Learning and Reflexivity in Public Dialogue on Science and Technology. *Science Communication, 35*(3), 283-310.

Ridgway, A., Milani, E., Wilkinson, C., & Weitkamp, E. (2020). *Report on the Barriers and Opportunities for Opening Up Sensemaking Practices*. European Commission deliverable report. https://www.rethinkscicomm.eu/wp-content/uploads/2020/12/D2.3-RETHINK_Derivable.pdf.

Roedema, T., Streekstra, K., Berendrecht, E., de Vries, Y., Ramaaker, E., Schoute, K., Rerimassie, V., & Kupper, F. (2021). *Strategies towards a reflective practice for science communicators in order to open-up sensemaking practices of citizens.* European Commission deliverable report. https://www.rethinkscicomm.eu/wp-content/uploads/2021/07/RETHINK_D2.4_Report-on-the-effectiveness-of-engagement-strategies-to-enhance-openness-and-reflexivity-3.pdf

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Reinhard, C. D., & Dervin, B. (2012). Comparing situated sense-making processes in virtual worlds: Application of Dervin's Sense-Making Methodology to media reception situations. *Convergence, 18*(1), 27–48. https://doi.org/10.1177/1354856511419914

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Zhang, P., & Soergel, D. (2014). Towards a Comprehensive Model of the Cognitive Process and Mechanisms of Individual Sensemaking. *Journal of the Association for Information Science and Technology, 65*, 1733-1756. https://doi.org/10.1002/asi.23125

Zhang, Y., Lu, T., Phang, C. W., & Zhang, C. (2019). Scientific Knowledge Communication in Online Q&A Communities: Linguistic Devices as a Tool to Increase the Popularity and Perceived Professionalism of Knowledge Contributions. *Journal of the Association for Information Systems, 20*(8), 1129–1173. https://doi.org/10.17705/1jais.00563

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Science Communication Quality

Question in focus

How can science communication quality be assessed in the complex digital media environment?

Empirical approach

- Delphi study with 32 international and interdisciplinary science communication researchers, two waves of consecutive surveys
- Workshops with science communication practitioners in seven European countries

Core findings

- Quality criteria for science communication online can be distinguished into five main categories: content, presentation, procedural, technical and context criteria.
- Quality assessment is regarded as highly context dependent; criteria relating to 'new' settings and actors in science communication especially challenge traditional quality assessments.
- Experts agree that promoting science communication quality is important. Education, reflection and raising awareness within the science communication community are considered the most important approaches, and combining different interventions seems most appropriate.

Future directions

- Develop and foster approaches to promote and enhance science communication quality

Objectives and Approach

Science communication via the Internet and social media has been associated with a number of opportunities; for instance, online communication has been said to lower the hurdles for scientists' public engagement (Jünger & Fähnrich, 2020). Moreover, with the developments around open access and open science, scientific knowledge has become more accessible to those outside science. In contrast, recent debates around 'fake news', misinformation, science denial or the so-called 'infodemic' in the context of COVID-19 indicate the threats and challenges that the digital media environment poses for public communication in general and science communication in particular. It goes without saying that these developments are not without consequences for the quality of public science communication (Peters, 2012). Previous research on science journalism has focused on standards to assess quality and has developed quality frameworks (e.g., Bachmann et al., 2021; Rögener & Wormer, 2017). Moroever, professional science communication has dealt with ethics and related criteria in science communication (Medvecky & Leach, 2017), and Dudo and Besley (2016) indicated that scientists must follow scientific quality control criteria when undertaking public engagement. However, with the tremendous changes to science communication in the digital media environment, the applicablity of these frameworks needs to be scrutinised. Against this backdrop, the maintenance of science communication quality has become of central concern, and reflecting upon this quality is of vital importance. Our research investigated how 'good' science communication could be conceptualised in the digital science communication ecosystem. We investigated which standards should be applied to assess the quality of science communication and whether there are different standards for different online science communication. Finally, we investigated how quality standards of science communication can be promoted in an increasingly complex digital media environment.

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Science Communication Quality

To address these questions, we conducted a Delphi study with 31 science communication scholars. The Delphi method is an approach that allows a group of experts to deal effectively with a complex problem in the context of an iterative and anonymous process (Linstone & Turoff, 1975; Niederberger & Renn, 2019). Participating experts represented 17 different national perspectives: Austria, Australia, Brazil, Denmark, Estonia, Germany, Ireland, Israel, Italy, Japan, the Netherlands, New Zealand, Norway, the UK, the USA, South Africa and Switzerland. Scholars were full or associate professors (63% for Wave 2), meaning that junior scholars were less well-represented. Experts had a background in communication science, STS (Science and Technology Studies), media studies, political science, psychology and other fields. To deal with the questions of focus, the Delphi study was conducted in two survey waves. In addition, we presented our data to science communcation professionals in seven European countries to reflect upon the findings and discuss implications for practice.

Quality complexity

Our first approach was to ask experts for criteria that they would associate with science communication quality in a digital media environment. Overall, experts' responses resulted in a comprehensive list of criteria that can be grouped into five categories.

(1) Content criteria refer to characteristics of the information *per se*. These encompass aspects such as accuracy, objectivity, relevance, the presentation of multiple perspectives, completeness, truthfulness and credibility – criteria known from (science) journalism and science itself. In addition, aspects such as the legitimacy and reputation of sources fall into this category and might be associated with strategic communication.

(2) Presentation criteria refer to how information is exchanged and which modes of interaction are applied. In this regard, quality criteria include transparency (of authors, sources, backgrounds) and language characteristics, such as readability and comprehensibility. In addition, criteria include reading appeal and whether online science communication is engaging.

(3) These criteria show several overlaps with a group of criteria that we denominate as procedural criteria, which refer to aspects relating to goals and audience orientation and thus align with effectiveness. These criteria seem to apply more strongly in online contexts and can thus be considered increasingly important in the context of the digital media environment.

(4) In addition, technical quality criteria are considered to have a large impact on quality. In this category, the adoption of specific platform criteria (e.g., regarding different standards, such as the lengths and tone of posts on social media platforms) and interactivity are associated with quality. Moreover, overall characteristics of online communication, such as the level of hybridity and media convergence (e.g., through links), are indicated.

(5) Finally, context criteria form a meta category that deals with the institutional and moral framework of science communication online.

As the list of criteria derived from the Delphi survey was comprehensive, complex and difficult to apply in practice, we asked the experts to indicate which criteria they considered the most important to evaluate quality in science communication online at a general level. Responses included the following 14 criteria.

Meta-Criteria	Description	Most important criteria
Content	What is communicated?	• Relevance • Accuracy
Presentation	How is it communicated?	• Accessible language & style • Comprehensibility • Engaging communication
Technical	How does the infrastructure interact with the communication?	• Opportunities for dialogue and feedback • Technical accessibility
Context	What is the context of communication?	• Transparency • Clear purpose/ motivation • Reliability of evidence • Expertise of sources
Process	What precedes/follows the communication?	• Definition of goals • Standards • Evaluation

Table 1: Overview of meta-criteria of science communication quality online derived from the Delphi study.

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Science Communication Quality

Quality in context

Some experts argued that context is so important that overall science communication quality criteria cannot be defined. This is in line with previous literature that has pointed to a huge variety of definitions, the relativity and dynamics of the concept and related difficulties assessing and evaluating communication quality (Lacy & Rosenstiel, 2015). There is agreement that quality cannot be assessed objectively but is dependent on the expectations of certain actors (journalists, scientists, bloggers, users). Previous research has examined public communication quality from different sides. From a demand perspective, the focus is on the interaction between the needs and requirements of media users and the media content (Dohle, 2017; Prochazka et al., 2014; Urban & Schweiger, 2014). From a production perspective, those who produce media content specify and apply characteristics that are associated with high or low quality (Gertler, 2013). From both perspectives, however, quality is a 'matter of degree. It is not as simple as having or not having quality' (Lacy & Rosenstiel, 2015, p. 11). In a digital context, content is 'created by users from different backgrounds, for different domains and consumed by users with different requirements' (Chai et al., 2009, p. 791). Against this backdrop, we aimed to explore quality requirements for different situational settings in which science communication occurs and asked experts to compare these with regard to quality criteria. We proposed the following settings:

A. A news section on a university website presenting the latest research from their organisation,
B. A scholar's Twitter thread commenting on policy issues by referring to the latest evidence,
C. A governmental campaign on different social media sites referring to public health issues,
D. A blog by environmental activists citing scientific studies to strengthen their argument,
E. An influencer's post on Instagram presenting spectacular scientific experiments and
F. A podcast provided by the science section of a leading daily newspaper.

	Direct intervention	**Incentivisation**	**Self-regulation**
Informal	'Some kind of community assessment, where non-governmental and non-institutional agencies apply critical scrutiny' (p. 6).	'Quality standards should be conveyed and promoted as reflective tools and not as deterministic tools' (p. 21).	'Quality criteria for digital science communication cannot be set top down' (p. 24).
↓	'Evidence-based countering of [false] claims to try to limit the spread of misinformation' (p. 11).	'Foster a culture in which we can discuss openly and constructively criticize outputs with one another" (p. 7)	'Assessments of quality rest with individual audience members' (p. 23).
↓	'One might think of a mechanism similar to fact checking/seal of approval' (p. 22).	'With more science communication done on a professional basis, opportunities to promote quality standards increase" (p. 6)	'Quality should be defined and promoted within the specific communities of practice' (p. 19).
↓	'Partnerships with the major social media platforms to quickly identify problematic content' (p. 11).	'Awards that name role models and provide incentives' (p. 26).	'Starting with the audience to improve media literacy should be prioritized' (p. 25).
↓	'This can only be effective if policy and funding organisations champion the cause of quality' (p. 10).	'Educational institutions and professional member bodies have a responisbility to promote best practice/professional standards for quality' (p. 17).	'To invest in better education and a critical view of society' (p. 24).
Formal	'Direct blocking of content, and criminalization' (w. 2, p. 7).		

Figure 1: Approaches to conveying, promoting and/or securing quality criteria for science communication online (statements from participants of the delphi study)

Science Communication Quality

Although many participants compared the settings and hinted at differences in the quality assessments of different situations, it was obviously difficult for experts to eliminate criteria. Regarding the (ir)relevance of the given criteria in different situational settings, it was argued that it was rather a 'matter of relative importance of different criteria in different settings, than a case of some not applying. They all apply, to a greater or lesser extent' (w2, P2)[1].

Table 1 displays a summary of the responses and lists those criteria that were considered especially relevant for the given situation. This does not mean that other criteria might not apply, but we attempted to mark differences between different science communication settings. Highlighting these differences might be relevant for different stakeholder groups, including science communication trainers, policymakers or lay communicators. It is striking that experts chose those situational settings that they were probably most familiar with: a university website, a scholar's thread on twitter and a newspaper podcast. The government campaign setting was chosen less but still considered. The situational settings of Instagram posts and environmentalists' blogs were not discussed. This is unfortunate, as these examples differ most from the 'old' and analogue science communication world and thus would have been especially interesting to compare.

Quo vadis? Promoting science communication quality in the future

Discussing online science communication quality criteria is closely connected to questions of how these criteria could be transformed into quality standards. Against this backdrop, we asked how experts would convey, promote or even secure the quality criteria that they considered most important. Different arguments could be located on a continuum with direct intervention to secure the quality of science communciation (e.g., fact checking, collaboration with/regulation of platforms) on one end and self-regulation (e.g., quality standards should be conveyed and promoted as reflective tools and not as deterministic tools) on the other, with incentivisation (the best we can hope for is to foster a culture in which we can discuss openly and constructively criticize outputs with one another) in between the extremes. Another distinction can be made between formal and informal approaches. Figure 1 shows the range of possible approaches.

The study results thus offer starting points for the promotion of science communication quality standards in the digital science commnunication environment. For the experts participating in our Delphi study, combining different interventions seemed most appropriate. Overall, experts agreed on the need for education but also for reflection and raising awareness within the science communication community. In this regard, strengthening the collaboration between scientists and practitioners to evaluate the quality discourse was also considered an important approach. Moreover, we are convinced that reflecting upon science communication training is an important step and thus we encourage you to engage your students to contribute to this challenge.

Recommended reading

Science communication in digital contexts:

Davies, S. R., & Horst, M. (2016). The Changing Nature of Science Communication: Diversification, Education and Professionalisation. In S. R. Davies (Ed.), *Science communication* (pp. 79–101). Palgrave Macmillan. https://doi.org/10.1057/978-1-137-50366-4_4

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

Scheufele, D. A. & Krause, N. M. (2019). Science Audiences, Misinformation and Fake News. *Proceedings of the National Academy of Sciences. 116*(6), 7662-7669.

Communication quality

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[1]-w refers to waves of the delphi studies, P to participant

Science Communication Quality

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Linstone, H. A., & Turoff, M. (1975). *The Delphi method: Techniques and applications*. Addison-Wesley.

Medvecky, F., & Leach, J. (2017). The ethics of science communication. *Journal of Science Communication, 16*(04), E. https://doi.org/10.22323/2.16040501

Niederberger, M., & Renn, O. (2019). *Delphi-Verfahren in den Sozial- und Gesundheitswissenschaften: Konzept, Varianten und Anwendungsbeispiele*. Springer VS. https://doi.org/10.1007/978-3-658-21657-3

Peters, H. P. (2012). Scientific sources and the mass media: Forms and consequences of medialization. In S. Rödder, M. Franzen, & P. Weingart (Eds.), *The Sciences' Media Connection – Public Communication and its Repercussions* (pp. 217-239). Springer.

Prochazka, F., Weber, P., & Schweiger, W. (2018). Effects of Civility and Reasoning in User Comments on Perceived Journalistic Quality. *Journalism Studies, 19*(1), 62-78, https://doi.org/10.1080/1461670X.2016.1161497

Rögener, W., & Wormer, H. (2017). Defining criteria for good environmental journalism and testing their applicability: An environmental news review as a first step to more evidence based environmental science reporting. *Public understanding of science, 26*(4), 418–433. https://doi.org/10.1177/0963662515597195

Urban, J., & Schweiger, W. (2014). News Quality from the Recipients' Perspective, *Journalism Studies, 15*(6), 821-840. https://doi.org/10.1080/1461670X.2013.856670

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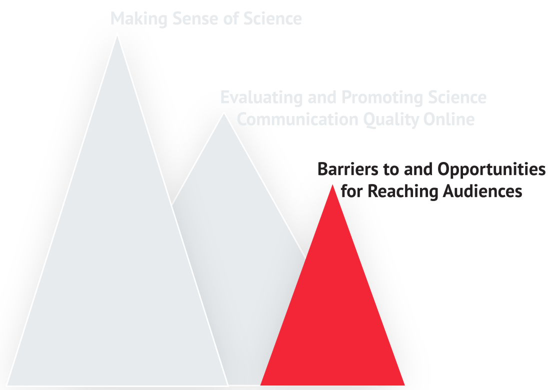
Barriers to and Opportunities for Reaching Audiences



Question in focus

Who is addressed by science communicators across Europe?

What enables and hinders dialogue and interaction between science and society in the digital media environment?

Empirical approach

- Survey of science communicators across Europe
- Case studies

Core findings

- Most important audiences: university students, school teachers, researchers, policymakers, non-governmental organisations, businesses
- Important motivations to communicate science: inform and educate, create conversations between researchers and the public, encourage evidence-based attitudes and behaviours as well as counter misinformation
- Barriers to science communication (lack of time, resources and support) and barriers to communication and interaction (competition for attention, lack of interest, speed of online communication, missing knowledge and uncertainty regarding how to reach out to specific audiences)

Future directions

- Develop science communicators' roles as an opportunity to foster mutual exchange between science and society

Objectives and Approach

In science communication, the question of how to reach audiences and how to get them engaged in dialogue is a core concern. Against this backdrop, our aim was to understand what enables and what hinders the interaction of science and society in the digital media environment.

To respond to this question, research within RETHINK looked at different aspects that together help to identify and tackle science communication barriers and to use opportunities to reach audiences. The research focused on working practices and motivations as well as barriers across a wide range of science communicators. This provided insights into the nature of contemporary science communication and delivered comprehensive information on those involved in it. Eventually, we concentrated on science communication roles and aimed at developing role models who are appropriate for the changing science communication landscape.

We used different empirical approaches and research designs to respond to the research questions. Most importantly, we conducted a survey of science communicators (n = 778) in seven European countries: Italy, the Netherlands, Poland, Portugal, Serbia, Sweden and the UK. Moreover, case studies were conducted with science communication practitioners from the different countries.

It is important to recognise that digital technologies allow anyone to be a content producer (Wilkinson & Weitkamp, 2016). Those who were once science information consumers can now also be producers. As noted by Fahy and Nisbet (2011), today, 'scientists journalists, advocates and the people formerly known as audiences are all content contributors' (p. 782). Such content production may take the form of creating content about contested science issues, such as vaccines (Milani et al., in press). To do justice to this diversifying landscape of science communicators, we included a broad range of different actors, as shown in Figure 1.

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Barriers to and Opportunities for Reaching Audiences

Which Audiences and Why?

The term 'the audience' can be contentious in itself (Wilkinson & Weitkamp, 2016). 'Audience' can imply a passive role for recipients of information, whereas the affordances of online platforms such as news websites and social media mean that they may actively seek out information (Howell & Brossard, 2020). Some may also go beyond simply listening to or seeking out information by actively contributing to it through participation in public engagement activities. The term 'audience' is used here in the broad sense to denote all recipients of (science) information while recognising that they may have played a role in seeking out information or contributing to its development to varying degrees.

We attempted to understand the intended audiences of a wide range of actors engaged in science communication, the nature of the connections they have as well as the barriers they experience in forming or developing these connections.

To shed light on these questions, survey respondents were asked about the audiences that they addressed with their communication efforts. All respondents indicated a desire to reach particular audiences. Most respondents, however, ticked a wide range of audiences they were trying to reach, with only a few respondents selecting three choices or fewer. University students, school teachers and/or researchers were targeted by more than half of the respondents in most countries. Overall, 52.2% (n = 229) of respondents aimed at reaching policymakers, whereas fewer targeted non-governmental organisations (31.9%, n = 140) and businesses (31.4%, n = 138).

Moreover, we asked respondents why they communicated science, technology or health information. To inform (90.9%) was the most frequent answer in every country except Poland, where 96.6% (n = 28) of respondents said they wanted to educate the public. Informing and educating suggest modes of communication more oriented to deficit model framings of science communication (Wilkinson & Weitkamp, 2016). Nevertheless, science communicators in our sample also recognised the value of dialogue, with around two-thirds indicating that they sought to create conversations between researchers and the public (65.4%, n = 302). Encouraging evidence-based attitudes and behaviours was also selected by 57.4% (n = 265) of respondents. Other com-

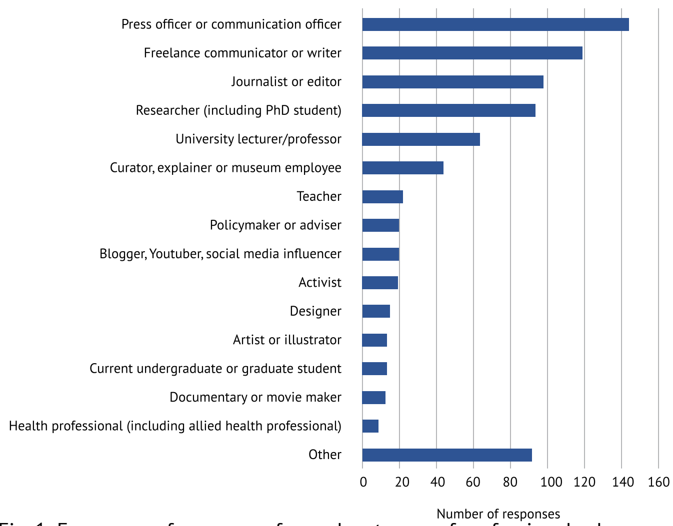

Fig. 1: Frequency of responses for each category of professional roles. Q) How would you describe yourself? Please select a maximum of three answers.

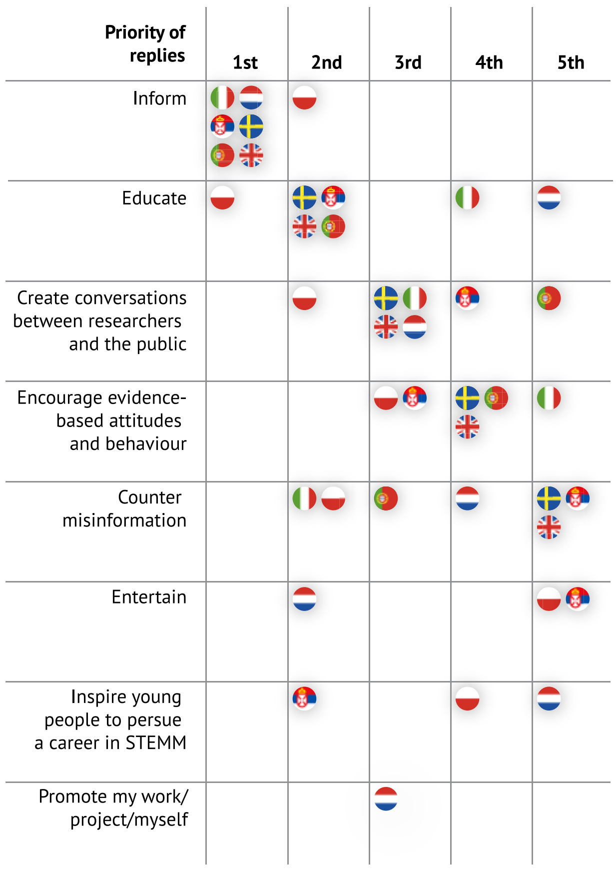

Fig. 2: Priority of replies for each country about what the respondents are hoped to achieve by communicating about science, technology and/or health topics.

Barriers to and Opportunities for Reaching Audiences

mon reasons for communication included to inspire young people to pursue a career in science (52.8%, n = 244) and to entertain (42.2%, n = 195). The responses to influence the public's view on the topic and to reach underserved audiences were both selected by under a quarter of respondents (22.7%, n = 105). Very few said they aimed to persuade their audiences to adopt their point of view (3.0%, n = 14). Figure 2 gives an overview of priorities per country.

Barriers to Science Communication

In recent years, there has been a strong movement to foster and increase science communication both in academia as well as in politics in many countries across Europe. Whereas public engagement has been considered to be the gold standard, of science communication, challenges and barriers to actually reaching and involving audiences (Chilvers & Kearnes, 2016) have oftentimes been overlooked or neglected. Against this backdrop, our research investigated science communicators' perceived barriers to communicating effectively. To respond to this question from a training context, we suggest distinguishing between two different kinds of barriers: barriers to science communication (What are the barriers that stop science communicators from communicating?) and barriers to communication in general (What are the barriers to communication itself?).

Regarding the barriers to science communication, the survey showed that lack of time (47.0%, n = 211) and lack of resources (29.8%, n = 134) were the main barriers that prevented respondents from being more involved in science communication activities. Among the respondents, 19.2% (n = 86) mentioned that they were prevented from doing more science communication activities because it was difficult to get others involved and 16.5% (n = 74) said there was insufficient encouragement from funders for science communication work. Respondents also indicated that they did not do more science communication work because there was not enough financial reward (16.9%, n = 76) and a lack of reward and recognition for it (15.8%, n = 71). Some barriers were related to the respondents' organisational roles, with 14.7% of respondents saying they received insufficient support from their manager or organisation (n = 66), and 9.4% received insufficient support from other staff at their organisation (n = 42). Respondents also mentioned that insufficient communication specialists at their organisation (13.4%, n = 60) prevented them from being more involved

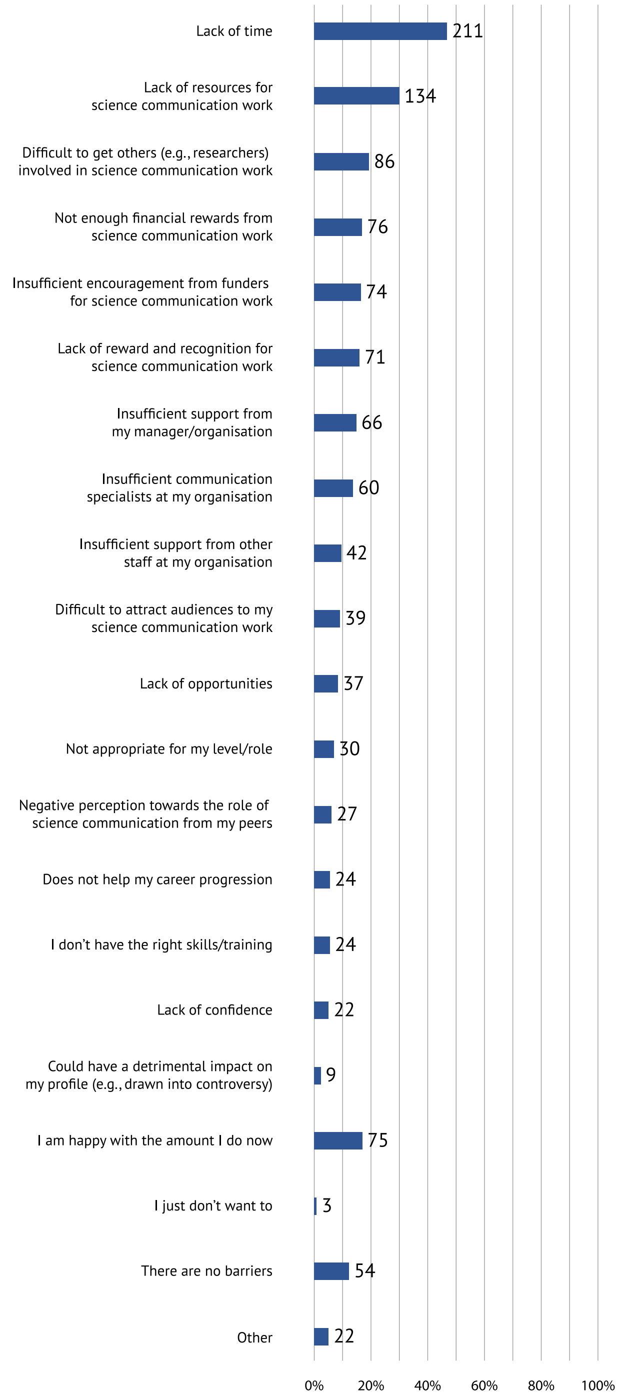

Fig. 3: Barriers to communicating science, technology and/or health topics. Q) Which of the following are the most important reasons that prevent you from getting more involved in activites to communicate science, technology and/or health topics? Select max. three choices. Total respondents: 449; bars: percentage of respondents who ticked the choice: x-axis frequency of responses for each category.

Barriers to and Opportunities for Reaching Audiences

in science communication activities. Among all respondents, only 12% (n = 54) said that there were no barriers preventing them from being more involved in science communication work, while 16.7% (n = 75) said they were happy with the amount they did.

Apart from these structural barriers, we inquired as to how the characteristics of digital communication itself might hinder dialogue and interaction between science and society. In conducting case studies with science communication actors in the different countries involved in RETHINK, we attempted to explore these factors in more detail. Many communicators reported a sense of disconnect from their audience. There were also indications that while digital media, such as social media, offers a mechanism for two-way interaction between the communicator and audience, in practice this often did not happen. More precisely, the following (further) barriers were mentioned. These included:

- Competition for attention (e.g., with other communicators/media/contents),
- Audience targeting (esp. lack of knowledge of the style of content and language that appeals to specific audiences),
- Time constraints and speed of online communication (e.g., longer interactions would be necessary to build solid connections),
- Overall communication habits (e.g., 'browsing through') and
- Prejudice against science communication and lack of interest (e.g., perception of science as difficult to understand).

These findings have implications for the connection between science and society, since they imply that the connections are not equal across all of society. Instead a linear relationship between science and the public persists, even with the existence of the digital media context and its opportunities for interaction.

Outlook: Developing science communication roles as an opportunity for science communication

The term 'role' is used to describe a characterisation of the activities of an individual engaged in science communication that encapsulates several aspects of what they do (Pielke, 2007). Role characterisations are often used to create typologies that describe different roles that actors within a particular field of work enact. They are often used to explore how roles are evolving. Fahy and Nisbet (2011), for example, explored the changing roles of science journalists online due to growth in the number of actors, such as amateur bloggers and scientists, now engaged in online science communication. They developed a role typology for today's science journalists that included the role of the watchdog (holds scientists, scientific institutions and industry accountable) and the civic educator (informs audiences about the methods, aims and limitations of research). The impact of digital transformation makes contemporary research into science communication working practices essential. Existing roles have evolved, boundaries between the work-related activities of different actors have shifted and entirely new roles have appeared. There is evidence of many science communicators taking on a civic educator role (Fahy & Nisbet, 2011), seeking to inform people about how science is doneand its limitations. Accordingly, many survey respondents stated that communicating scientific processes, scientific uncertainty and the enjoyment and enthusiasm of doing science were important. Countering misinformation was important to survey respondents in terms of what they were trying to achieve in their communications, which also provided evidence of a watchdog role for science communicators (Fahy & Nisbet, 2011). There is also evidence of conceptions of a more blurred line between science and society from the respondents who said they aimed to facilitate conversations between researchers and the public and thus take on the role of a bridge builder (Turnhout et al., 2013). However, this was somewhat less prevalent among the survey respondents.

How these changing and emerging roles for science communicators can help them to reach their audiences and to engage with them in dialogue is an essential question worth discussing with prospective science communicators.

Barriers to and Opportunities for Reaching Audiences

Recommended readings

On working practices and barriers experienced by science communicators:

Bauer, M. W., Howard, S., Romo, R., Yulye, J., Massarani, L., & Amorim, L. (2013). *Global Science Journalism Report: Working Conditions and Practices, Professional Ethos and Future Expectations.* Our learning series, Science and Development Network.

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. *Journal of Science Communication, 20*(03), A02. https://doi.org/10.22323/2.20030202

On shifting roles of science communicators:

Jarreau, P. B. (2015). Science Bloggers Self-Perceived Communication Roles. *Journal of Science Communication 14*(4). https://jcom.sissa.it/archive/14/04/JCOM_1404_2015_A02

Milani, E., Ridgway, A., Wilkinson, C., & Weitkamp, E. (2021). *Reaching Underserved Audiences: How Science Communicators are Making New Connections Using Innovative Techniques.* European Commission deliverable report. https://www.rethinkscicomm.eu/wp-content/uploads/2021/04/RETHINK_Derivable_D1.4_V11_FINAL-1.pdf

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Howell, E. L., & Brossard, D. (2020). Science engagement and social media. Communicating across interests, goals, and platforms. In Todd P. Newman (Ed.). *Routledge studies in environmental communication and media. Theory and best practices in science communication training,* (pp. 57-70). Routledge.

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Pielke, R. A. (2007). *The honest broker: Making sense of science in policy and politics*. Cambridge Univ. Press. https://doi.org/10.1017/CBO9780511818110

Turnhout, E., Stuiver, M., Klostermann, J., Harms, B., & Leeuwis, C. (2013). New roles of science in society: Different repertoires of knowledge brokering. *Science and Public Policy, 40*(3), 354–365. https://doi.org/10.1093/scipol/scs114

Wilkinson, C., & Weitkamp, E. (2016). *Creative Research Communication: Theory and Practice*. Manchester University.

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Kickstarters

Training Resource

Tools to Introduce Themes

Tools for Discussion, Reflection and Learning: Quick Tools

Tools for Discussion, Reflection and Learning: Deep Dives

Competence Framework

Picture of the World

Professional Norms & Roles

Working Knowledge

Research Insights

Making Sense of Science

Evaluating & Promoting Science Communication Quality Online

Barriers to & Opportunities for Reaching Audiences

Required Prior Knowledge

Applicable for all training contexts. Participants would benefit from basic knowledge in science communication.

Description

The kickstarter introduction contains three short educational videos (two minutes each) to communicate our research findings in an accessible and entertaining way. The videos address a broad range of stakeholders and thus work as an easy and quick introduction to the themes.

Learning Objectives

- Introducing the RETHINK research topics of making sense of science communication, evaluating and promoting science communication quality online and reaching audiences
- Learning about conditions of the changing science communication landscape
- Getting to know and reflecting on the perspectives of different actors involved in science communication

Technical Requirements and Preparation

- You can download the video or go online to show it.
- Please check the speakers to make sure that the sound works.
- When used in online settings, students can also watch the films on their own devices.

Resources

Videos are accessible via the following links:

Making sense of science communication:	https://youtu.be/lzIBvNUcCH4
Evaluating and promoting science communication quality online:	https://youtu.be/SMrOofK-UQo
Barriers to and opportunities for reaching audiences:	https://youtu.be/htKVHlZBHJg

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Factsheets

Training Resource

Tools to Introduce Themes

Tools for Discussion, Reflection and Learning: Quick Tools

Tools for Discussion, Reflection and Learning: Deep Dives

Competence Framework

Picture of the World

Professional Norms & Roles

Working Knowledge

Research Insights

Making Sense of Science

Evaluating & Promoting Science Communication Quality Online

Barriers to & Opportunities for Reaching Audiences

Required Prior Knowledge

Applicable for training contexts that contain more than one session.

Description

Factsheets contain the most important information regarding the research related to the three themes conducted within RETHINK. They can be used to give students a first overview and to help them prepare for group work and discussions and thus are useful material for course preparation. All factsheets contain links to the complete research reports, related papers and a list of further reading.

Learning Objectives

- Receiving an overview of RETHINK´s main outcomes
- Gaining insights into the research project and applied methods
- Developing a basis for further discussion on science communication from different perspectives

Technical Requirements and Preparation

- Factsheets can be read on the computer or can be printed.

Resources

Factsheets for all insights can be found in the navigator folder under the following names:

Insight01.pdf - Insight 1. Understanding How Citizens Make Sense of Science

Insight02.pdf - Insight 2. Science Communication Quality

Insight03.pdf - Insight 3. Reaching Audiences

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Required Prior Knowledge

Applicable for all training contexts. It is up to the trainer to tailor the lectures to students' needs.

Description

To help you to introduce the themes of the courses, we prepared slides for mini lectures. The slides contain basic information on questions of focus and overall relevance, the empirical approach, findings and conclusion/outlook. They are meant to support your talk and thus merely contain figures and bullet points. We recommend reading the full research reports and related papers for preparation. The slides can also be offered to students as handouts.

Learning Objectives

- Learning about the relevance, approaches and outcomes of RETHINK research in the fields of making sense of science, science communication quality and reaching audiences
- Building the basis for further discussion and group work

Technical Requirements and Preparation

- Applicable to face-to-face sessions (beamer required) and online settings
- Can also be offered to students as digital/printed handouts

Resources

Presentation slides for each insight can be found in the navigator folder under the following names:

Presentation01.pdf - Insight 1. Understanding How Citizens Make Sense of Science

Presentation02.pdf - Insight 2. Science Communication Quality

Presentation03.pdf - Insight 3. Reaching Audiences

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Discussion Prompts

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Required Prior Knowledge

Not required, but basic understanding of science and public communication could be an advantage.

Description

Discussion prompts are short activating questions to facilitate discussions among participants. The questions can be used individually or before/during the mini lecture presentations and in plenum or in smaller groups. The prompts provide a starting point for activities concerning the development of the science communication environment and refer to all science communication themes.

Learning Objectives

- Reflecting about themes
- Developing different or new perspectives/points of view
- Finding solutions and strategies in a collaborative way

Technical Requirements and Preparation

- Presentation equipment and/or (black/white) board
- Use of flipcharts or digital alternatives

Resources

A file containing all discussion prompts can be found in the navigator folder under the file name DiscussionPrompts.pdf

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Discussion Prompts

Sample Schedule

10 minutes	Short introduction on topic
30–45 minutes	Discussion in plenum or small groups
15 minutes	Presentation of results (for small group discussions), wrap-up, conclusion by trainer or students

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Discovering the Science Communication Ecosystem

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Required Prior Knowledge

Not required, but basic understanding of science and public communication could be an advantage.

Description

Working on their own or in groups, students visualise their understanding of the science communication ecosystem using clay. Every student gets a block of clay and is asked to modulate their ideas about the science–society interface. This can include communicators, issues, audiences, media or other aspects considered relevant. Participants then explain their ecosystems to another participant/group, who then presents the respective results in front of the plenary. Alternatively, participants could also be asked to draw the ecosystem; this might be more suitable for online training contexts.

Learning Objectives

- Explicating oftentimes vague understandings and ideas of the (digital) science communication ecosystem
- Getting to know different perspectives and broaden own views
- Challenging mental models by discussing and exchanging different perceptions

Technical Requirements and Preparation

- Modelling clay (depending on size, one block per student)
- Underlay (e.g., flip chart sheets)
- Be aware that the task may require cleaning after the course.

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Discovering the Science Communication Ecosystem

Sample Schedule

10 minutes	Short introduction, incl. dispensing materials
20–30 minutes	Modelling work
20–30 minutes	Presentation and discussion
10–15 minutes	Wrap-up and conclusion

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Actor Mapping

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Required Prior Knowledge

Not required, but basic understanding of science and public communication could be an advantage.

Description

As a result of digital transformation, science communication has changed tremendously. In this context, actors who communicate about scientific issues have also diversified. Accordingly, a broad range of actors, such as universities, scientists, journalistic media, political actors, NGOs and corporations, communicate about science-related issues. Their communication on issues such as climate change or health influence how science is perceived by the broader public. Understanding and keeping track of this complexity of the science communication landscape is essential for professional science communicators and scientists.

This task aims to map the actors involved in the public communication of science-related issues. Students work individually or in small groups to develop actor maps for specific science-related communication issues such as climate change, nutrition, endangered species, gentech or vaccination. Their task is to search for the 10, 15 or 20 most visible communicators associated with these issues via a search engine (e.g., Google or Bing) or on social media (e.g., Twitter, Facebook or Instagram). As a starting point, students should discuss and agree on the search string(s) used before starting the research. In addition, students can code actor types, linked content/references, potential objectives (societal vs strategic), etc. The definition of these and further categories could either be given by the trainer or developed in class. Results of the research can be presented in class. The discussion could also focus on differences in the structures of the respective topical actor maps.

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Return to 'Actor Mapping' summary

Actor Mapping

Learning Objectives

- Realising the diversity of actors involved in the public communication of science
- Developing a realistic understanding of the competition for public attention in science communication
- Recognising the dual role of actors as audiences and science communicators
- Improving in carrying out systematic searches on the web

Technical Requirements and Preparation

- Internet access and notebooks for students (at least one per group)
- In case of group work: sufficient space or breakout rooms
- Flipcharts or online equivalent
- Depending on platform used, personalised settings can lead to different results for the same search strings. This is not a problem in the context of the training setting, but students should be made aware of this.

Sample Schedule

10–15 minutes	Introduction
Minimum 30 minutes, actual tasks need to be tailored to available time	Optional: Development of search strings and/or categories for coding
Minimum 30 minutes, depending on number of actors to be included in the research, actual tasks need to be tailored to available time	Online search for actors
Minimum 30 minutes	Presentation and discussion of results and their implications for science communication as a professional field
10–15 minutes	Wrap-up and conclusion

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Science Communicators' Personas

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Required Prior Knowledge

Prior knowledge about contexts and workings in professional science communication could be an advantage.

Description

There are a broad range of actors in professional science communication, including science journalists, university spokespersons, professionals at museums and science centres as well as bloggers. Understanding the working contexts, conditions and challenges of these science communicators is an important precondition for developing professional attitudes.

To contribute to this objective, students work in pairs or small groups. They develop and reflect upon typical 'personas' representing the variety of actors in the science communication field. To approach the task and depending on the available time, students can 1) search for and analyse job advertisements, 2) approach different science communicators and interview them, 3) use the mini case studies developed by RETHINK or 4) use their personal experience and insights as a starting point.

On this basis, students develop their personas by describing organisational contexts (e.g., organisational structures and hierarchies), media and audience contexts (e.g., overall objectives and target groups, collaborators and competitors and media/platforms used), working conditions, general tasks and challenges. For the presentation of the results, students can prepare posters visualising the profile of their persona. Optionally, the posters could be presented by members of another group.

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Science Communicators' Personas

Learning Objectives

- Reflecting working conditions of science communicators
- Gaining insights into professional working conditions
- Understanding science communicators' perspectives and decisions

Technical Requirements and Preparation

- Internet access
- Space/breakout rooms for group work
- Optional: materials (job interviews, case studies) in print or online
- Flipcharts or online equivalent for presentation of results

Sample Schedule

10–15 minutes	Introduction
30–60 minutes, depending on actual task	Analysis of resources (job advertisements, case studies) and/or summary of own experiences and knowledge Optional: Contacting science communicators (at least one week for preparation: contacting science communicators, developing/adapting short interview guideline, conducting interview)
Minimum 15 minutes	Preparing the poster
Depending on number of groups, approx. 5 minutes per group	Presentation of results
10–20 minutes	Discussion, wrap-up and lessons learnt

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Approaching Audiences/Joint Problem Solving

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Required Prior Knowledge

Knowledge about science communication audiences and related difficulties to engage specific segments of society could be an advantage.

Description

In recent years, much attention has been paid to the question of how science communication can reach out to different audiences in an effective and responsible way. There are different segments of these audiences such as young people or those disinterested in science, who are often the focus of science communication but are difficult to approach. Against this backdrop, RETHINK talked to different science communicators to find out which audiences they want to address and what challenges they face when doing so inside and outside of the context of the digital media environment. These descriptions are summarised as short case studies (Appendix E).

Students can both learn from these cases and 'help' the communicators to reach out to their audiences of focus by using an approach called joint problem solving: students work in pairs or small groups using one or more of the case studies. Their first task is to detect the problems and barriers that actors face when approaching specific audiences online and offline. They can also note which further information would be required for a concise problem definition. Moreover, students rank the problems with regard to their importance for reaching the science communicators' objectives. Students can then decide on up to three problems that they will aim to solve. In the next step, students discuss potential ways as well as required resources to tackle the identified problems. These solutions can be linked to an individual and/or organisation. Again, the ideas can be sorted by priority. To present their work, students should explain both problems and solutions in a comprehensible way. The plenary can be invited to act as a critical friend, evaluating the suggested solutions and hinting at open questions.

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Return to 'Approaching Audiences/Joint Problem Solving' summary

Approaching Audiences/Joint Problem Solving

Learning Objectives

- Reflecting on science communication audiences and challenges to address specific segments of society
- Analysing science communication practices
- Developing skills for joint problem solving and constructive critique

Technical Requirements and Preparation

- Case studies in print or digital form
- Flipcharts or online equivalent
- Optional: Sticky notes to rank problems/solution

Resources

A file containing seven case studies can be found in the navigator folder under the file name CaseStudies.pdf

Sample Schedule

10 minutes	Introduction
5–10 minutes	Reading of case studies
20 minutes	Joint analysis of problems, identification of missing information, ranking of problems
30 minutes	Joint development of ideas for problem solving at individual/organisational level and needed resources, ranking of ideas
20–30 minutes	Presentation of results and discussion
15–20 minutes	Wrap-up and conclusion

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First Aid Bridge Building

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Required Prior Knowledge

Knowledge of the sense-making methodology and basic knowledge of communication strategy development needed.

Description

Research on sensemaking points to the complex and multifaceted situations in which individuals encounter science in their everyday lives. The sense-making methodology is especially helpful as it sheds light on the influences of personal backgrounds when dealing with science. In this context, it reveals both related demands and difficulties in tailoring science communication to the diversity of citizens' needs. Against this backdrop, the research conducted within RETHINK aimed at exploring the sensemaking of citizens in the context of the COVID- 19 pandemic. To condense the results of this research, visual presentations were developed based on the sense-making methodology to explain the gaps that individuals face their individual approaches to overcome these and build bridges to make sense of and cope with the health crisis.

Science communication strategies can be regarded as approaches to help different audiences to overcome gaps in information or trust and to build bridges that allow them to make sense of science. Against this backdrop, the task aims at developing instant strategies that respond to the gaps articulated by the people of focus. Students can work individually or in small groups.

Strategy building should encompass the following steps:
- Identification of problems (i.e., gaps that people are facing);
- Objective (e.g., help people to overcome uncertainties);
- Description of target group (i.e., criteria that can be used to describe the segment of society the person in focus belongs to/represents);
- Development of instruments, platforms and tools (depending on time, this can also include the production of first instruments, such as texts and visuals); and
- First ideas for schedule, budget calculation and evaluation.

Students prepare short presentations to present their strategies in class. Strategies could be evaluated by the other participants with regard to clarity, potential effectiveness and creativity.

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Return to 'First Aid Bridge Building' summary

First Aid Bridge Building

Learning Objectives

- Recognising audience´s needs
- Learning and improving skills to develop communication strategies
- Developing strategic thinking

Technical Requirements and Preparation

- Visual presentations in print or digital form
- Flipcharts or online equivalent to support students' strategy development
- Equipment for presentation (notebooks, whiteboards etc.)

Resources

A file containing all discussion prompts can be found in the navigator folder under the file name VisualPresentations.pdf

Sample Schedule

15 minutes	Introduction of task
15 minutes	Reading and understanding the visual presentation(s) on sensemaking regarding COVID-19
Minimum 45 minutes up to a day, depending on available time	Group work to develop strategy
10–15 minutes per group	Presentation of results
10–15 minutes per group	Discussion
15–20 minutes	Lessons learnt and wrap-up

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Science Communication Diary

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Required Prior Knowledge

Basic knowledge of science communication and scientific working needed.

Description

Science communication training aims at supporting (prospective) science communicators in their professional development and thus helps to improve science–society interactions in general. Developing and improving science communication starts with a sound analysis of existing practices. In this task, students use a diary technique to:

- Observe their own science communication activities online,
- Monitor their science communication encounters (i.e., their use of science communication) or
- Apply the diary technique with one to three individuals (e.g., friends/family) to understand their use of science communication.

The approaches can be used depending on the type of training, available time and participants' backgrounds (e.g., scientists aiming to improve their communication skills vs students with limited practical experience). The task could be specified by focusing on certain platforms and/or certain themes of science communication. To assure comparability, the science communication diary should be used for a clearly specified time, e.g., every day for two weeks or once per week over the period of some months. There is no specific format for the diary; the easiest form would be to use a table (e.g., Excel), although there are a number of diary apps that could be useful.

The task starts with the formulation of a common research question and a joint definition of focal points of the observation and related categories for the diary that should be responded to during the observation. This could include time, duration, platform, actual content as well as different categories for assessments (e.g., numbers of likes/shares, criteria for quality assessment). Moreover, open categories enable students to reflect on their thoughts and reactions regarding the production/use of science communication online. It could be useful to invest some time in coder training to ensure a certain level of reliability.

To analyse and present data, students could gather in groups to allow for a comparison of their data. This could enable the developement of typologies or help them to generalise the data. Students should prepare a research report and present their findings in the context of a presentation.

Science Communication Diary

Learning Objectives

- Reflecting about science communication online
- Observing science communication systematically as a basis for development and improvement
- Getting to know social science approaches (i.e., diary technique) and improving scientific working capabilities

Technical Requirements and Preparation

- Online access and hardware
- Optional: diary app or other applicable tools
- Space (e.g., digital) for group work
- Equipment for presentation (notebooks, whiteboards etc.)

Sample Schedule

30–90 minutes, depending on actual task and involvement of students	Introduction in class
Depending on defined time frame	Diary task
Depending on actual task and background of students, minimum 10 hours	Data analysis in groups
30 minutes per group	Presentations and discussions
30 minutes	Wrap-up and conclusion

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SciComm Insta Story

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Required Prior Knowledge

Basic knowledge of science communication required; knowledge about science communication quality an asset. Basic experience in scientific working, esp. conducting literature reviews and summarising study findings, needed. The trainer should possess technical knowledge and experience with Instagram or other social media applied.

Description

Using Facebook, Instagram, YouTube or TikTok has become a standard in science communication to address a broad range of different audiences. However, the use of online platforms can make it difficult to conform to quality standards. Against this backdrop, this task aims at helping students to experience and reflect on the challenges of social media use in science communication and to practice its application.

Students develop their own science communication for Instagram and prepare and produce an Insta feed post and stories (15 sec per story, 5 to 10 stories recommended) that can be uploaded to a (private) course account (to be prepared by the trainer or students). As an option, producing short videos for YouTube (two minutes max) or TikTok might work, too. In any case, the trainer should be aware of the technicalities of the platform used and support students who have no experience in working with this. This also includes the use of pictures and materials (e.g., with regard to copyright issues and data security).

Depending on the course, the theme for the task could refer to the question of what the science of science communication is all about. This means that students could take their own field as a starting point to develop the communication tools. Of course, more specific questions derived from science communication research could be used, too. Optionally, courses directed at scientists could allow them to develop content related to their own fields. Independent from the theme, a short introduction to storytelling might be useful.

Students work in pairs or small groups and decide upon their theme and a concise question, conduct a literature review (optional, the trainer can preselect relevant literature), summarise the state of the art and translate core results into a script/screenplay. Before starting the actual production of content, we recommend planning a session in which these interim results are presented, discussed and revised. Special focus should be given to the question of which quality standards (e.g., accuracy, accessibility, etc.) are assured and how. Students then produce the feed posts and stories and upload them to the (private) account. The presentation of results should also reflect the working process and the organisation of the work in the group.

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SciComm Insta Story

Learning Objectives

- Reflecting on science communication as a discipline
- Reflecting on reaching audiences and quality
- Understanding new conditions of the science communication landscape
- Writing for different audiences

Technical Requirements and Preparation

- Instagram app (on a mobile device) and accounts (at least one per group)
- Private Instragram account for the course (to be set up by the trainer)
- Optional: access to literature (e.g., Web of Science license or comparable)
- Space (e.g., digital) for group work
- Equipment for presentation (notebooks, whiteboards etc.)

Sample Schedule

Approx. 60 minutes	Introduction in class
Approx. 30 minutes	Decision for a theme
Depending on background of participants, at least 15 hours	Literature research and summary
Approx. 5 hours	Writing of script
Approx. 30 minutes per group	Presentation of interim results and discussion
Approx. 15 hours, depending on experience of students	Production process
30 minutes	Presentation in class, wrap-up and conclusion

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Creating a Manual for Young Scientists

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Required Prior Knowledge

Solid science communication knowledge and experiences in scientific working and practical science communication needed.

Description

In recent years, public engagement has developed into an important activity of scientific work and a professional demand for academic careers. However, we also know from previous research on public engagement – also conducted within RETHINK – that scientists do not always feel well-equipped for engaging with society. At the same time, only some scientists have opportunities to take part in science communication trainings to develop their competences.

Against this background, the task is to develop a manual for young scientists that gives them guidance for their own science communication and public engagement activities. When conducting this task, students themselves can thus become 'trainers' for science communication and take up the important role of spreading science communication quality and promoting professionalism.

As outlined above, developing science communication competences should not be restricted to skills and working knowledge – although these are important pillars of science communication and training, respectively. The manual should thus help scientists to understand the complexities of the current science communication landscape and explain core concepts (e.g., audiences, platforms), principles (e.g., quality standards, dialogue and interactivity) and strategies (e.g., framing). Moreover, the manual could also address questions of effectiveness and evaluation. Aspects should be based on evidence of science communication research.

To plan their manual, students should envision scientists' needs and use literature on public engagement motives and demands. Depending on the time available, the preparation could also include a short research phase in which students conduct exploratory interviews with a small number of scientists to learn about their needs to help the students tailor the manual.

The manual can be developed individually or in small groups. Moreover, the group can agree on a joint structure and share responsibilities for the different parts. For the presentation of results, it would be interesting to invite young scientists to discuss the manual and give feedback.

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Manual for Young Scientists

Learning Objectives

- Applying science communication theory and evidence
- Putting oneself in the position of young scientists who are expected to or want to engage with the public
- Developing writing skills and own science communication competences
- Learning from other perspectives, esp. in interaction with scientists

Technical Requirements and Preparation

- Optional: access to literature (e.g., Web of Science license or comparable)
- Space (e.g., digital) for group work.
- Equipment for presentation (notebooks, whiteboards etc.)

Sample Schedule

30–60 minutes	Introduction
Approx. 2 hours	Joint development of manual structure, pot. division of responsibilities for chapters
	Optional: exploratory interviews with scientists to analyse needs
Approx. 15–20 hours	Literature review
15–20 hours	Writing the manual
30 minutes per participant/ group	Presentation and dicussion of manuals in class
Approx. 2 hours	Optional: discussion with scientists
60–90 minutes	Wrap-up and conclusion

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Understanding How Citizens Make Sense of Science

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824573

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Lecture overview

Objectives and approach

Sense-making as an approach to researching citizens' perceptions of science communication

Personal situation trumps information

Understanding the unknown

Bridging strategies and sources

Outlook: Developing strategies for science communicators to open up sense-making

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Objectives and approach

Investigate challenges that occur at the science–society interface and consequences for science communication

Show the diversity of mechanisms that play a role in citizen sense-making practices

Context of **citizens' sense-making**: Case of the COVID-19 pandemic >> Situation raises **questions for citizens:**

- Which information is true, flawed or even false?
- Which actors can I trust to determine what is true?
- Will containment measures be effective, and are such measures proportional and legitimate?

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Objectives and approach

Methodological approach:

Semi-structured interviews (n = 81)

Eight European countries (Germany, Italy, the Netherlands, Poland, Portugal, Serbia, Sweden and the United Kingdom).
First wave of the pandemic.
Explore various ways in which European citizens make sense of science.

How do 'lay' audiences understand, perceive and interpret science communication in their everyday practice?

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Sensemaking as an approach to research citizens' perceptions of science

Sensemaking is the process through which people create an understanding of situations they find themselves in (Fiss & Hirsch, 2005; Zhang & Soergel, 2014).

Sensing: **seeking/ filtering information** + ***Making Sense:*** **link to prev. experience** = ***Sense making***

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Sensemaking as an approach to research citizens' perceptions of science

1. individuals confronted with a complex, ambiguous issue relating to science → individuals facing a gap

Micro-moment

2. 'fill' this gap by using and rejecting previous and actual information and knowledge → build bridges over the gaps

3. bridge building influenced by individual situation and context → in which a momentary understanding of the particular issue is formulated; perception of reality is neither complete nor constant

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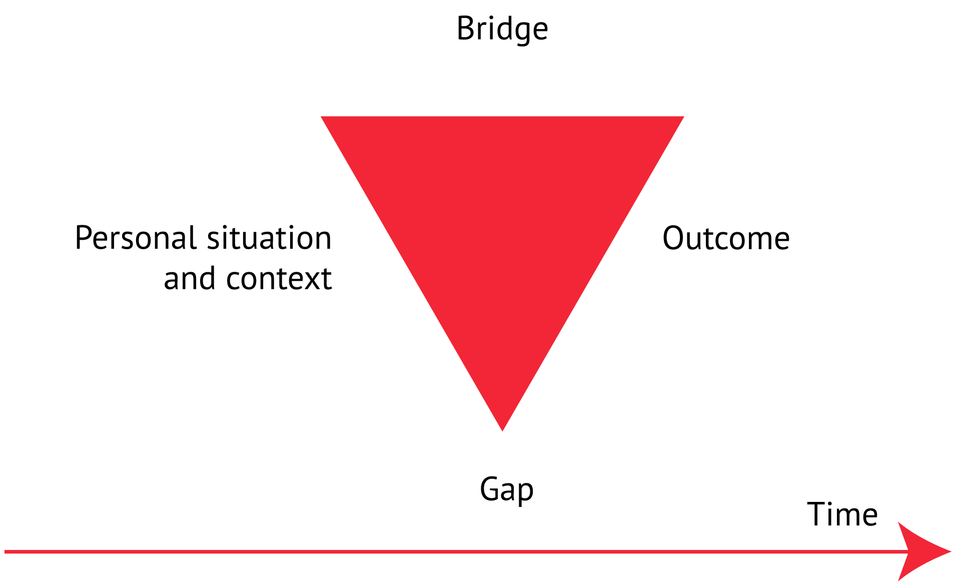
Sensemaking as an approach to research citizens' perceptions of science



Micro-moment triangle illustrating the five dimensions of the sense-making process as represented in the SMM (Sense Making Methodology) (modelled after Reinhard & Dervin, 2011).

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Personal situation trumps information

Importance of the **personal situation** for making sense of science communication (context of COVID-19)

- the own affectedness
- the perceived vulnerability
- social context

Personal situation shapes

- gaps perceived
- bridging strategies employed
- outcomes reached

Implication for the practice of science communication: Personal situation can outweigh information and insights provided by science communicators.

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Understanding the unknown

Kinds of gaps:

- fundamental **uncertainties**

→ participants continuously confronted with new information

- **Ambiguities**

→ interactions with others

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Bridging strategies and sources

1) Different worldviews

- *a priori* beliefs and ideas about institutions (i.e. society, government, experts and the media)
- connected to level of trust in institutions

2) Use of information

- passively or actively received information
- reference to science communication outlets limited,
- personal information (e.g. by friends and family) more important

3) Emotions

- mostly negative emotions: anxiety, anger, frustration
- occasionally positive emotions (for making the situation manageable)

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Outlook: Developing strategies for science communicators to open up sensemaking

A better understanding of sense-making practices can enable the formulation of science communication strategies tailored to various sense-making styles and local contexts and communities, with the overarching aim of contributing to a constructive public dialogue on science.

- Enable science communication to take sensemaking practices of citizens into consideration.
- Facilitate science communicators to connect to citizens' underlying values, emotions and world views of science.
- Develop **reflective practices of science communicators** (Roedema et al., 2021; Schön, 1983).

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Evaluating and Promoting Science Communication Quality Online

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Lecture overview

Background

Objectives and approach

Quality complexity

Quality in context

Quo vadis? Promoting science communication quality in the future

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Background

Opportunities for science communication online and via social media

- lower hurdles for scientists' public engagement, open access and open science

→ scientific knowledge more accessible to those outside science

Threats and challenges to public communication and science communication

- misinformation, strategic misuse of science
- information overload

→ consequences for the **quality** of science communication (cf. Peters 2012; Fähnrich 2021)

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Objectives and approach

How can 'good' science communication be conceptualised in the digital science communication ecosystem?

Are there different standards for different settings of science communication online?

What standards can be applied to assess the quality of science communication online?

How can quality standards of science communication be promoted in an increasingly complex digital media environment?

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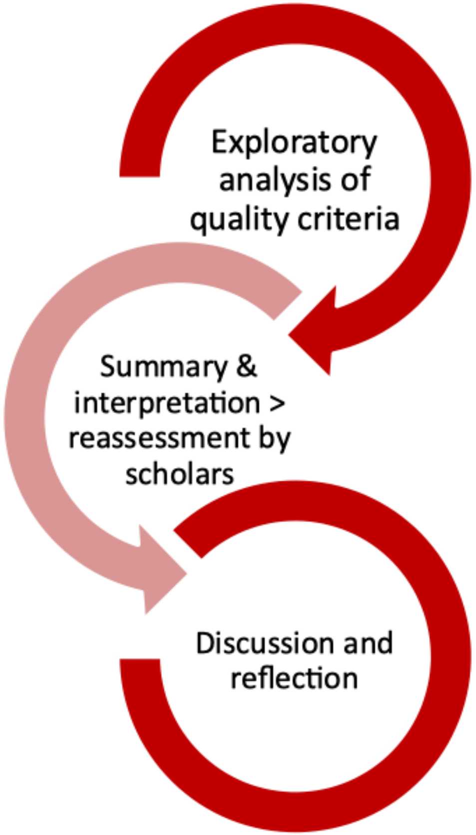
Objectives and approach

Methodological approach:
Delphi study to assess quality criteria and standards for science communication.

- N = 31 science communication scholars.
- Conducted in two waves.
- Experts from 17 different countries.
- Approach that allows a group of experts to deal effectively with a complex problem.
- Iterative and anonymous process (Niederberger & Renn 2019).



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Quality complexity

Meta-Criteria	Description	Most important criteria
Content	What is communicated?	• Relevance • Accuracy
Presentation	How is it communicated?	• Accessible language & style • Comprehensibility • Engaging communication
Technical	How does the infrastructure interact with the communication?	• Opportunities for dialogue and feedback • Technical accessibility
Context	What is the context of communication?	• Transparency • Clear purpose/motivation • Reliability of evidence • Expertise of sources
Process	What precedes/follows the communication?	• Definition of goals • Standards • Evaluation

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Quality in context

Experts highlight that **context** is also important to assess science communication.

- quality cannot be assessed 'objectively'
- dependent on the expectations of certain actors (journalists, scientists, bloggers, users)

Quality is a 'matter of degree. It is not as simple as having or not having quality'. (Lacy & Rosenstiel, 2015)

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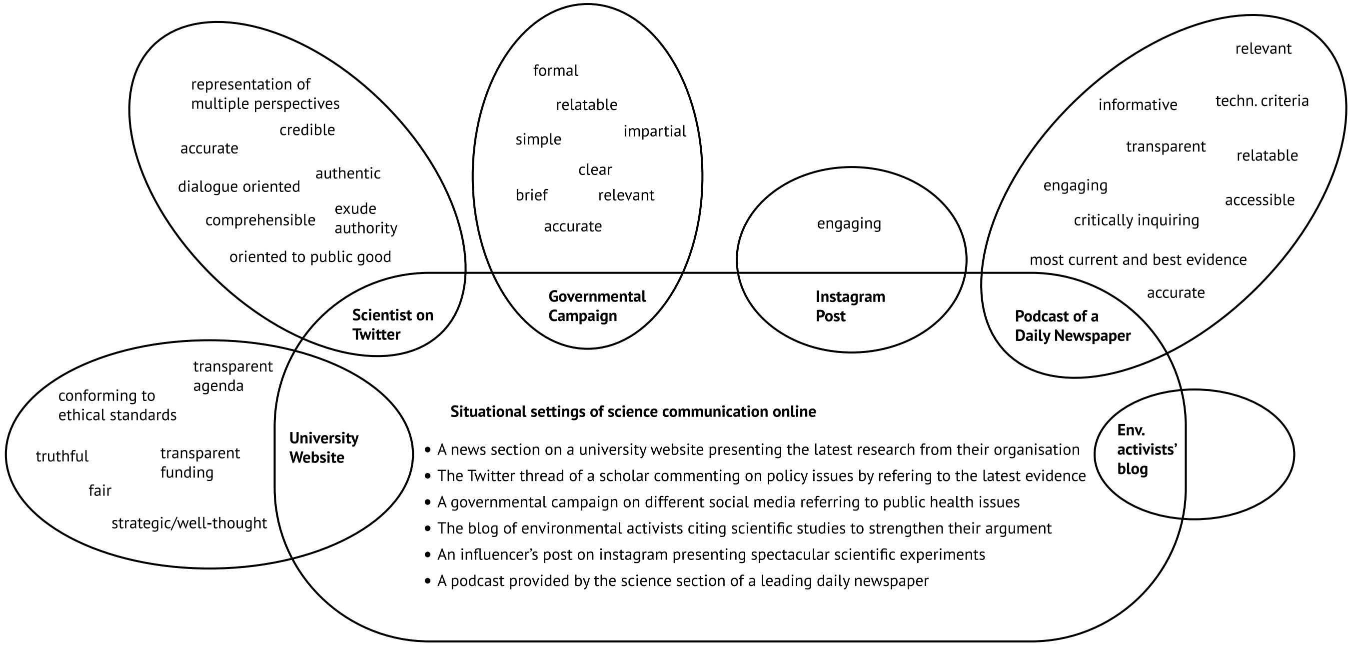
Quality in context

Difficult to rate quality criteria:

A 'matter of relative importance of different criteria in different settings, than a case of some not applying. They all apply, to a greater or lesser extent.' (Participant, Wave 2)



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Promoting science communication quality in the future

	Direct intervention	Incentivisation	Self-regulation
Informal ↓	'Some kind of community assessment, where non-governmental and non-institutional agencies apply critical scrutiny' (p. 6).	'Quality standards should be conveyed and promoted as reflective tools and not as deterministic tools' (p. 21).	'Quality criteria for digital science communication cannot be set top down' (p. 24).
	'Evidence-based countering of [false] claims to try to limit the spread of misinformation' (p. 11).	'Foster a culture in which we can discuss openly and constructively criticize outputs with one another" (p. 7)	'Assessments of quality rest with individual audience members' (p. 23).
	'One might think of a mechanism similar to fact checking/seal of approval' (p. 22).	'With more science communication done on a professional basis, opportunities to promote quality standards increase" (p. 6)	'Quality should be defined and promoted within the specific communities of practice' (p. 19).
	'Partnerships with the major social media platforms to quickly identify problematic content' (p. 11).	'Awards that name role models and provide incentives' (p. 26).	'Starting with the audience to improve media literacy should be prioritized' (p. 25).
	'This can only be effective if policy and funding organisations champion the cause of quality' (p. 10).	'Educational institutions and professional member bodies have a responsibility to promote best practice/professional standards for quality' (p. 17).	'To invest in better education and a critical view of society' (p. 24).
Formal	'Direct blocking of content, and criminalization' (w. 2, p. 7).		

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Promoting science communication quality in the future

- Need for education and reflection to raise awareness within the science communication community.
- Strengthening the collaboration between scientists and practitioners.

→ Evaluate quality discourse.

- FUTURE AIM: Reflecting upon science communication training, students contribute to this challenge.

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Barriers to and Opportunities for Reaching Audiences

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Lecture overview

Background

Objectives and approach

Which audiences and why?

Barriers to science communication

Outlook: Developing science communication roles as an opportunity for science communication

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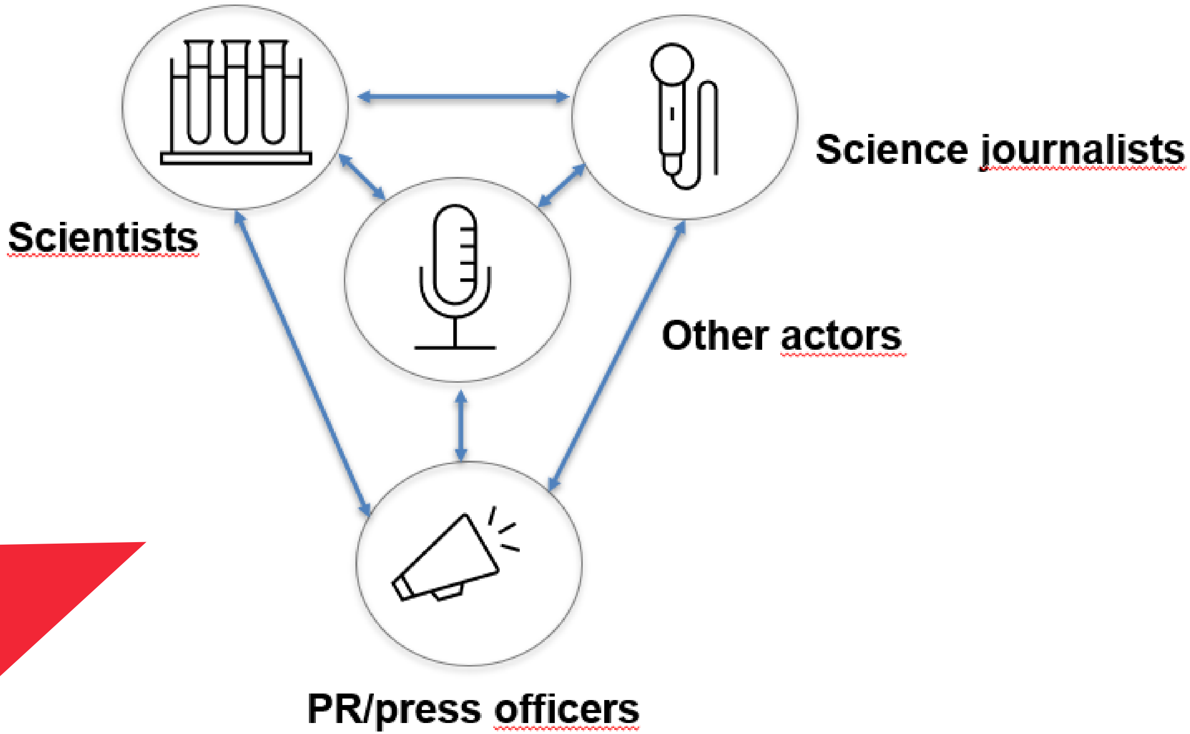
Background

'The new ecosystem will be richer, more diverse and immeasurably more complex because of the number of content producers, the density of the interactions between them and their products, the speed with which actors in this space can communicate with one another and the pace of development made possible by ubiquitous networking' (Naughton, 2006, p.10)



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Objectives and approach

Questions of focus

- How to reach audiences and get them involved in dialogue?
- What enables and hinders dialogue and interaction between science and society in the digital media environment?

Objectives

- Investigate **working practices, motivations of and barriers faced by** actors communicating science, technology and/or health.
- International comparison, focus countries: Italy, the Netherlands, Poland, Portugal, Serbia, Sweden and the UK.

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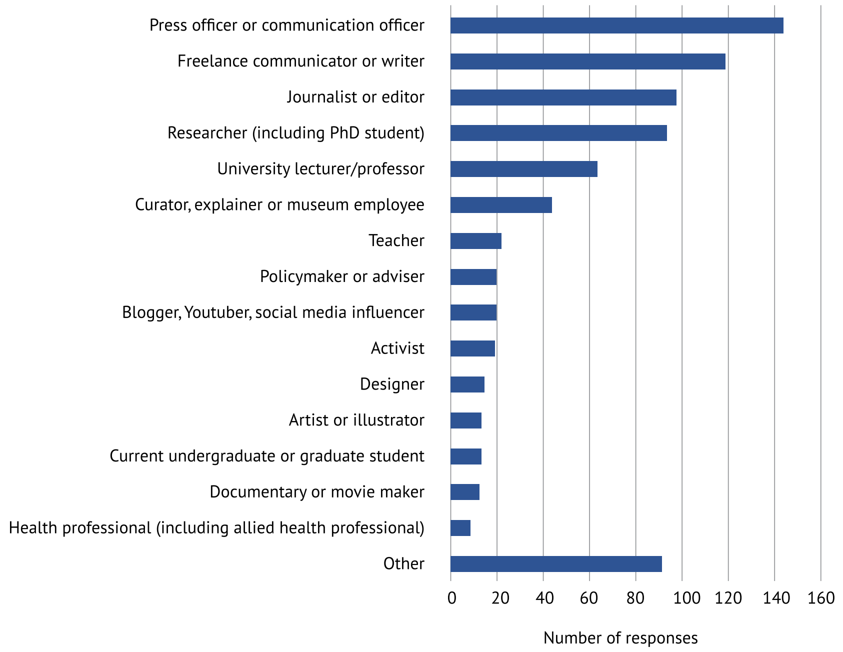
Objectives and approach

Methodological approach:

1) **Survey** of science communicators (n = 778)
   - different actors to map the diversifying landscape

2) **Case studies** with science communication practitioners, including
   - group and plenary discussions
   - activity sheets to characterise communicators' work



Frequency of responses for each category of professional roles. Q) How would you describe yourself? Please, select a maximum of three answers. Milani et al. (2020a), p. 14

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Which audiences, and why?

The term 'audience' is used here in a broad sense to denote all recipients of (science) information, while recognising that they may have played a role in seeking out information or contributing towards its development to varying degrees.

'The term "the audience" can be contentious in itself.'
(Wilkinson & Weitkamp, 2016)

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Which audiences, and why?

Schoolteachers

Students

Scientists

~50%

Policymakers

Local communities

~51%

Businesses

Non-governmental organisations

~31%

Surrounding area or region

~17%

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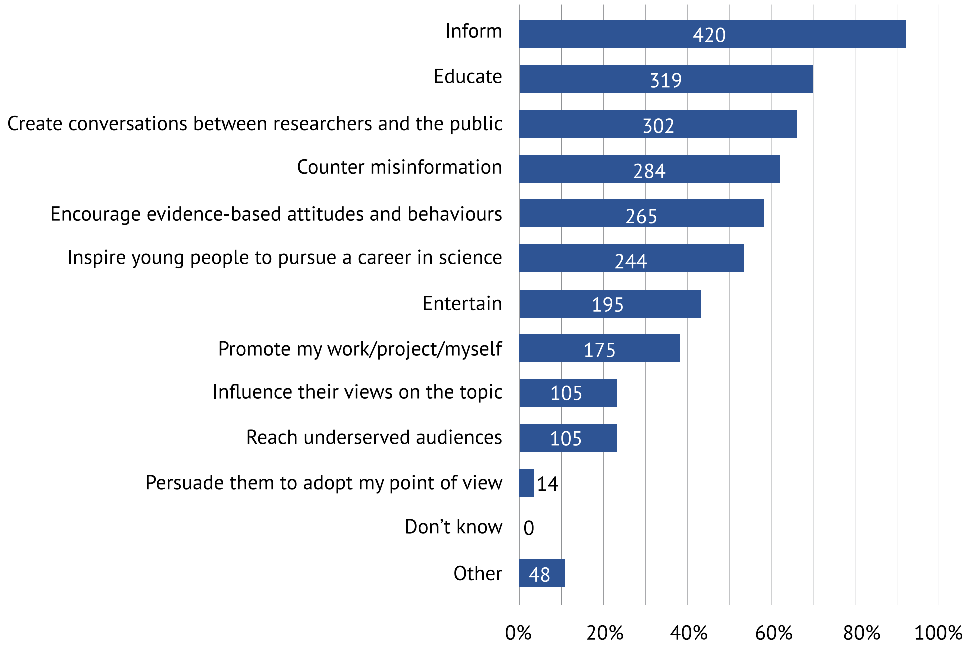
Which audiences, and why?



What the respondents are trying to achieve when they communicate about science, technology and/or health topics. Q) When you communicate about science, technology, and/or health, what are you trying to achieve? Tick all that apply. Total respondents 462. Dark blue bars – percentage of respondents who ticked the choice. The frequency of responses for each category is shown in the labels.

Priority of replies for each country about what the respondents are trying to achieve when they communicate about science, technology and/or health topics.

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Barriers to science communication

1) Barriers to science communication

What are the barriers that stop science communicators communicating?

2) Barriers to communication in general

What are the barriers to communication itself?

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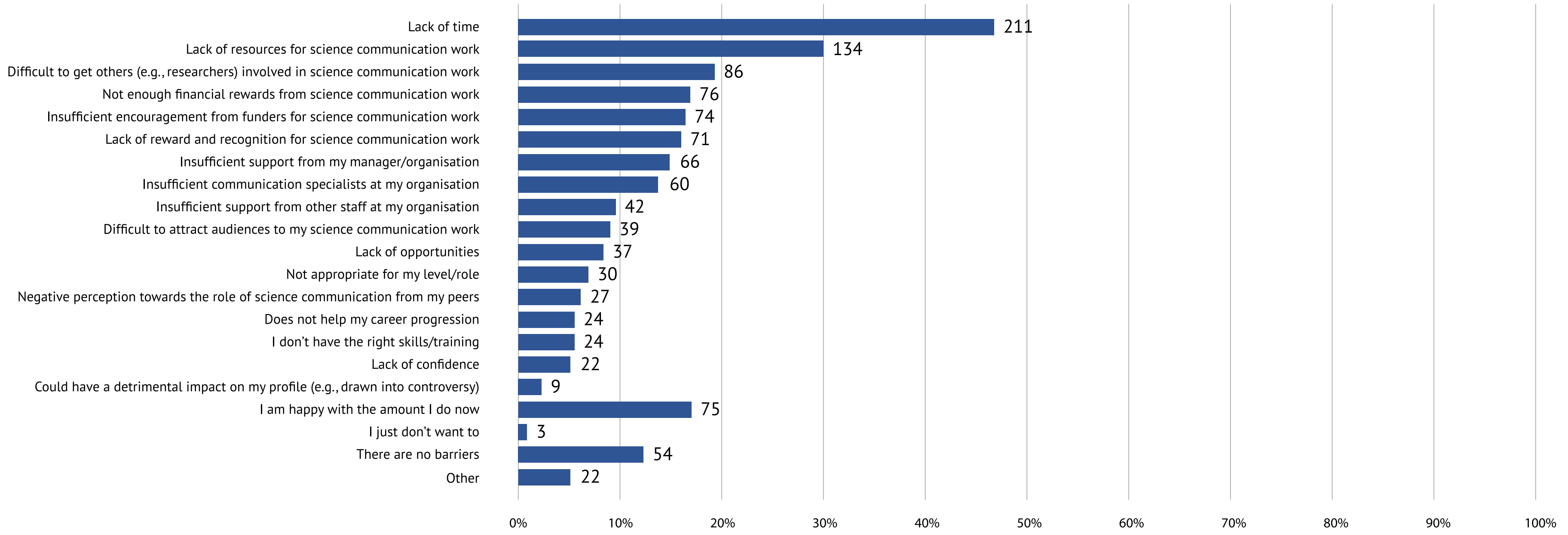
Barriers to science communication



Barriers to communicating science, technology and/or health topics. Q) Which of the following are the most important reasons that prevent you from getting more involved in activities to communicate science, technology and/or health topics? Select a maximum of three choices.
Total respondents: 449. Dark blue bars – percentage of respondents who ticked the choice. The frequency of responses for each category is shown in the labels.
Milani et al., 2020a, p. 24

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Barriers to science communication

Sense of **disconnect with audience.**

In practice, **no two-way interaction** between communicator and audience in digital or social media.

- competition for attention
- audience targeting
- time constraints and speed of online communication
- overall communication habits
- prejudice against science communication, lack of interest

Connections are not equal across all levels of society: A **linear relationship** persists.

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Outlook: Developing science communication roles as an opportunity for science communication

The term 'role' is used to describe a characterisation of the activities of an individual engaged in science communication as they seek to encapsulate several aspects of what they do (Pielke, 2007).

Shifting roles of science communicators (e.g. Fahy & Nisbet, 2011)

- civic educator
- watchdog
- 'bridge builder' (Turnhout et al., 2013)

Developing science communicators' roles as an opportunity to foster mutual exchange between science and society.

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Theme 1: Understanding How Citizens Make Sense of Science

Taking on citizens' perspectives

Today, it is common sense that communicating science effectively and responsibly requires understanding citizens' perspectives and the contexts in which they encounter science (e.g. in climate change, health, AI or nutrition) in their every-day lives.

- Think of the science communication landscape back in the 1980s and compare it to the landscape today. How and where did citizens then and now encounter science?
- When are citizens experiencing gaps in evaluating science content? Reflect upon your sense-making, for instance, in the context of COVID-19 or climate change communication. Please build categories of potential gaps and give examples.
- Which criteria do you think hinder or foster citizens' sense-making of science communication? How could you examine these criteria empirically?
- How could sense-making as a methodology inform professional science communication? How could it be implemented in strategy development?

Theme 2: Science Communication Quality

Assessing and promoting science communication quality in the digital media environment

In the digital media environment, potentially everyone can curate, produce and consume science communication content. In this regard, the relevance of promoting science communication quality has been emphasised.

- Why should science communication conform to certain quality standards?
- Can you give examples of 'good' and 'bad' science communication? Please explain your choices.
- Why is it difficult to define quality and develop quality standards?
- Who should be in charge of developing and setting such standards for the field of science communication?
- Should and could science communication online be regulated to assure quality standards?
- Could approaches to promote science communication quality online be organised (e.g. should there be specific institutions and procedures)?

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Theme 3: Reaching Audiences

Roles of science communicators

In the analogue world, professional science communicators, such as journalists or university spokespersons, were considered to fill specific roles. For instance, the most prominent role of science journalist was as a so-called gate-keeper who decided about the relevance of news and thus contributed to shaping public communication. With the digital transformation, however, the roles of science communicators are changing.

- What different roles do professional science communicators have today that developed in the specific context of the digital media landscape?
- Are there differences between various science communicators' roles (e.g. science journalists, PR people, scientists, science communicators in science centres and museums)?
- Are there roles that science communicators should not take on? If so, why?

Reaching (underserved) audiences

In science communication, the question of how to reach different audiences has been widely discussed in recent years.

- Which criteria can be applied to distinguish different audiences?
- Which audience segments are especially relevant for prospective science communication, and why?
- What does the term 'underserved audiences' imply?
- What are the challenges when addressing these groups?
- Are science communicators facing more barriers today than before the digital transformation?

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Background on the Case Studies

RETHINK has talked to different science communicators to find out which audiences they want to address and which challenges they face when doing so, in not only but also the context of the digital media environment. These descriptions have been summarised as short case studies. These mini case studies give an overview of potential barriers that science communication practitioners are experiencing in their everyday work.

Source: RETHINK Research Report: Investigating the links between science communication actors and between actors and their audiences.

URL: https://www.rethinkscicomm.eu/wp-content/uploads/2020/06/RETHINK_-D1.3-Report-on-links-between-the-different-actors-engaged-in-science-communication-and-how-the-actors-foster-connections-with-their-audiences-1.pdf

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1. The Scientist

A scientist identified school classes among her audiences, stating that connections take the form of visits to her research centre by pupils. In terms of barriers, she said, 'The more "served" schools are more active, hard-to-reach schools/classes are less served.' The hard-to-reach schools are those in which teachers and/or the head teacher does not or cannot respond to offers of visits to the research centre. In some instances, it may be a teacher's lack of time to request or attend these visits due to other responsibilities, such as supporting pupils from disadvantaged backgrounds, that stands in their way. She also stated, 'Time is a huge constraint. One would need longer to build solid interactions.'

This participant also described collaborations with researchers to communicate their research to the public, including schools. In terms of barriers, this group of scientists described a, 'desire of researchers to be very specific versus comprehensibility.' They also stated, 'The researchers don't have enough time' and 'Principle investigators and research group leaders often consider science communication a loss of time and don't like their students/postdocs to do it.'

Citizens in the local community were identified as another audience. Here, the communication takes place through conferences, exhibitions and citizen science projects. In terms of barriers, this participant stated, 'Difficult to get in touch with many social groups. We miss the good channels to involve them. Probably we would need to involve more intermediaries.'

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2. The Press Officer

A press officer listed 'potential future employees' as an audience. She broke this down further into sub-audiences of parents, young people, women and 'harder to reach audiences, e.g. lower earning areas'. The nature of communications with these audiences were described as 'own channels' and 'outside channels'. Own channels includes several digital platforms: Facebook, Instagram, Twitter, website/blog as well as face-to-face connections. Outside channels comprised contributions to blogs run by other organisations, contributions to the media and staff contributions to their own social media channels, such as LinkedIn.

Barriers to communication with these 'potential future employees' were linked to the digital platforms used and listed as 'Getting info back, generating a conversation. Difficult to know what they [the audience] want', and 'How to break out of existing audiences to a broader group.' Some of these potential future employees are those who are qualified to work for the organisation. Here, there is deemed to be a lack of knowledge of the style of content and language that appeals to this audience when jobs are being advertised. Other potential employees targeted are younger; employees of the future. Here, the aim is to encourage young people to study STEM subjects so they may work for the organisation in the future. With these individuals, the challenge is deemed to be around understanding how to segment what is perceived to be a broad audience and knowing what content appeals to which groups. The barriers linked to the outside channels were, 'Hard to make space relatable' and 'Competing with lots of other media'.

The other audience listed by this press officer was 'policymakers/funders' and communications with this audience takes place via Twitter and LinkedIn, as well as face-to-face at events run by her employer or events they take part in. The press officer described barriers to communication as the 'competing priorities faced by policymakers' as well as a perceived need for 'general public support and interest' to get policymakers to act on the science being communicated. Such public support is deemed to be particularly important in securing funding from the policymakers.

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3. The Communicator

A science communication practitioner who works in a venue that hosts science activities and at science events stated that one audience is young people outside of school, and he connects with them through workshops and lectures. The barrier to the audience was 'lack of interest' on the part of the audience. He added, 'It is tremendously difficult to get children aged 11–16 interested in any kind of workshops or lectures.' Participants in our study stated that the primary school and high school systems do not encourage an interest in science and added, 'Therefore, a great deal of effort must be made to bring science closer to children.'

Another audience was researchers, who are reached via social networks. The stated barriers were 'lack of support' and 'hard-to-reach target group'. A final audience is 'teachers/professors'. As with the researchers, the goal in reaching this group is to encourage them to communicate their science and encourage others to do that as well. No connections were described, and 'lack of support' and 'lack of time' were the barriers provided. This lack of support was said to be from the target institutions, such as universities. This participant added, 'Even laboratories at universities are hard to reach, and they play a major role in the effort of researchers who want to advance by presenting their research to a bigger audience.'

Communicators stated that they aimed to create a community of science communication practitioners who will work together to overcome their respective barriers to reaching their audiences.

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4. The Journalist

A freelance journalist indicated that she mainly reaches those already interested in science, but she aims to reach those of lower socio-economic status and less well-educated people as well. She communicates through articles in newspapers and magazines as well as via Twitter. In terms of the less well-educated audience, the barrier mentioned here was, 'They might not read the kind of media I produce, and they are discouraged by the language I use.'

In terms of the more educated readers, this journalist divided them into two broad groups: those who are extremely critical of the mainstream media she writes for, such as newspapers, and those who are not critical of what they read because they identify with the publication. When speaking of the typically more educated readers, she said, 'I wouldn't be able to get to them because they hate mainstream media and are very critical of it'. She said that someone in this group may say something like, 'Well, newspapers; you can't trust them all.'

This freelance journalist also writes for a popular science publication. She said of this, 'The articles included in there are of a different calibre. Some people mainly respond, "Gosh, nice to know," but it ends there. It doesn't make you a very critical citizen. People can browse through the magazine and find nice things in it, but that is not my goal.'

In terms of her goal, she indicated that it is important to her that she enables people to shape their own opinion based on well-balanced and fair information.

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5. The Blogger

A scientist blogger stated they want to reach the 'average Joe' through blogs, Facebook posts and lectures. The barriers stated by this participant were 'inherent fear of science' and 'hard topics', adding that sometimes, just seeing a chemical formula or simple equation induces a panic reaction in the audience.

Another stated barrier is the politicization of topics, like climate or energy, as is 'people wanting clear and fast answers to complicated issues, and you must have time to be able to do that'. In relation to this barrier, this blogger added that they believe these complicated issues are not beyond the capacity of the audience to understand, but it requires time to explain them.

Several persons mentioned not having enough time and money to do science communication properly, especially when aiming to reach out to new or hard-to-reach audiences.

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6. The Podcaster

One participant runs a science podcast and stated that the intended audience is 'listeners'. The barriers to this audience were 'Lack of time to engage with listeners' and '[There are] thousands of podcasts. How to break through and reach out?'

Participants also stated that another barrier is 'Reach[ing] those not used to podcast listening'. This participant also runs live science events and stated that the audience is mostly aged 20–40. The barriers included 'little knowledge of what happens after the shows. Does the knowledge get spread?' Also cited were 'short time to talk about complicated stuff' and 'some academics tend not to want to speak about stuff outside their field.'

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7. The PR Professional

One person who works as a public relations employee stated their intended audience to be policymakers (reached through their support staff), advisors who work with political parties in commissions and committees. Participants in our study stated that some support staff are specialised in specific subjects, and these can be particularly helpful in reaching policymakers. These support staff are usually reached through direct contact (with the ones known to the Rethinkerspace member), by email or social media.

This employee considered policymakers to be a hard audience to reach, due to a 'lack of interest' and a 'lack of forums to meet or discuss'. Participants stated that they have a 'stable connection' with them through teams that support science-based policy and that discussion forums with policymakers would facilitate this interaction. They also suggested science cafes at Parliament and regular debates involving scientists and policymakers.

This participant also aims to reach journalists. The connection here was direct contact, such as through phone calls and email, press releases and social media platforms, such as Twitter. Barriers mentioned here were a lack of time on both sides, little space for science in the media, and the lack of availability of scientists. University students were the third audience that this participant indicated they aimed to reach. Again, social media, such as Twitter, Instagram and Facebook, were indicated to be a connection with this audience. However, this participant indicated that universities themselves formed a barrier to connecting with university students, adding that organising presentations for students and inviting students to participate at events can be a challenge.

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1. The Scientific Advisor

Personal Situation and Social Context

- Female, ca. 30 years old
- Lives in Berlin, Germany
- Works as a scientific advisor in digital education with a background in psychology and social sciences
- Does not come into contact with science critics much
- Her brother is also in science, her parents are engineers

Bridging

- 'I actually have the knowledge [...] that I could completely debunk everything that is being said there by one Google Scholar search'. 'I have the feeling that I actually have a responsibility, as a scientist, to somehow position myself and to do something for [...] the side of science.'
- 'I know that the public opinion is often different from the scientific consensus'; 'But it really went in a conspiracy direction [...] and as soon as I notice that someone talks such nonsense then I have to say ok, sorry, that doesn't work for me.'; 'It makes me so emotionally tired.'
- 'I only had contact with people who think like me'; 'There was this sense of apocalypse. But besides that, there was a focus on the self, which made my everyday life easier, not to interact with strangers on the street every day, but to just keep a distance and have time for myself. It really felt like calming down'; 'It gave me a lot of strength. It was like a gasp of relief and like finding myself again and having a calm anchor in life again.'; 'From conversations I know that many others feel like this.'

Outcomes

- 'My personal conclusion is that I need to have enough resources, to work on it professionally, to not let it break you, it makes me feel upset and helpless that I feel paralyzed by it at times. In my private life - as silly as it sounds - I must not deal so much with people who have those opinions. I consciously turned off Instagram and Twitter and said not today.'
- 'I didn't have the impression that I, as a person, can make a difference, nor that our institute can do much, because to reach 20.000 people, who are also set in their beliefs and channels, is an immense challenge. So, I think it is important to educate the next generation in the scientific method [...] It reassured me in my work.'
- 'If there are people who have those opinions, I cannot convince them otherwise.'
- 'There are so many of these things that I would like to keep forever. That it's not so crowded and loud and extensive [...] We need to rethink as a society. To let go of the consumption and to get away from the wheel that never stops spinning.'

Gaps

- She observed riots on social and official media: 'I see myself caught in a dilemma, what should I do? How much energy can I invest to convince people who think totally different?', 'For whom do we do our job? What is our responsibility?'
- Her friend invited her to a protest but others who would be there were critical of science: 'Should I still go and support my friend?'
- What can we learn from the first shutdown?

Sources and Relevances

- Traditional news, social media, scientific publications
- Respectful and educative information
- Sheds light on all involved perspectives
- Scientific reliability

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2. The Concerned Mother

Personal Situation and Social Context

- Female, middle-aged
- Works in the field of art and culture in Warsaw, Poland
- Has a 5-year-old son who has health problems, coronavirus is a danger for him
- Spent part of the lockdown in Warsaw with family, then left with her husband and son to her parents near Warsaw

Bridging

- 'I started looking for information about how long we have to be at home, what distance we have to keep, information I had no knowledge about, we both started looking for what the chance of infection is.'
- 'At that time, I needed expert knowledge, I searched on websites, not only popular websites in Poland, but I searched for authorities, scientists who talk about specifics in order to know how much I am panicing and how much I have actually created a threat to my family. It was in a situation where we were under terrible stress, I was frustrated. This was a nightmare.'

Outcomes

- With regards to visiting parents: 'we waited further, but only for a week, not so long. I went through the information then, most probably within five days the virus breaks out, so we waited for seven safe days and we felt so mentally tired that we had to leave, but we did not feel that this was a rational decision, but we had a very big need.'
- 'My husband did not go out at all, sometimes for bread, but I sometimes bought supplies for a week and froze them. Today I think of it as absurd, I have the impression that we got used to this reality'
- 'I no longer rely on anything. I have the feeling that the only thing I am basing myself on is that I wash my hands non-stop, disinfect them [...], I wear a mask, and I try to keep a distance and I have the feeling that these things are there and that's the end of it.'
- 'The relief came only when we stopped analyzing it and let it go, but this first phase and the feeling of helplessness was very burdensome.'

Gaps

- How long do I need to quarantine myself before I can visit loved ones without putting them at risk?
- How risky is it that my sister is still hugging my parents?
- How long can the virus survive on surfaces?
- She opened up the door for a courier, without a face mask, and simply let him in and 'forgot what kind of reality she was living in'. Should I panic about this?
- 'Masks were not good and suddenly they became good and needed'

Sources and Relevances

- Looks for authoritative information and multiple sources
- 'I searched on the basis of the following principle: since the four articles gave the same information, I started to believe it.'
- 'When I saw that this is a science portal, it is a doctor and not a celebrity, that served my need for credibility.'

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3. The Skeptical Student

Personal Situation and Social Context

- Male 23 years old
- Lives in Niš, Serbia
- Electrical engineering student
- Regularly exercises in the gym and plays football, eats healthy and takes vitamins and supplements
- Helps grandfather living 30 km away. When public transportation stopped, he could not help him anymore

Bridging

- Believing that experts are serving political interests.
- Actively doing research and getting informed online
- Believes that rhetoric and politics play an important role in communication about the pandemic
- Media are one-sided

Outcomes

- Alarmism about COVID-19 is propaganda.
- The coronavirus is made in a laboratory.
- 'Lifting the lockdown and quarantine measures, and the rest of it, was a political election campaign. Everyone was living as normal, working. There was no talk of the ill, the dead. Once the election passed, suddenly the infection rate increased dramatically. Suddenly, the entire nation came down with COVID-19, and that is politics once again.'
- 'I think that doctors also change their views, to avoid losing their jobs, say what is expected of them, and I also think that the emergency response team in Serbia serves political interests.'
- The Covid-19 crisis is part of a bigger story of how globalists create a problem and then offer to fix it
- 'I believe that newer vaccines are more harmful and inteded to destroy humanity. I often read the Bible. It does not say we need to vaccinate ourselves.'
- Because of their one-sidedness, I cannot trust the media

Gaps

- 'I think it is dangerous, like other genetically-modified viruses. Serious work is being done in that area. We are in the midst of a biological war. I do not know who exactly the target group is.'
- 'As one Croatian politician said, you wear a mask - now you are part of the game. In my view, that is part of a bigger story: what is the bigger story?'
- 'The same is true of the lockdown, which included a curfew here in Serbia, a total movement ban. It is all part of an imposed ideology which holds that we have to act as we are told': what ideology?

Sources and Relevances

- Try to ascertain the truth by viewing it from multiple angles
- The internet is a neutral tool, that you can use to cut tomatoes and pepers, or you can kill someone with it
- Point of concern is that media outlets support liberal ideology
- 'The mainstram media, national broadcasters and such are all voices of politicians and political PR entities.'
- 'Personally, I do not trust anyone who benefits from the government budget, and recieves a salary from the government.'