Deliverable 1.1

D1.1 Scoping Report on the Science Communication Ecosystem

Work package number and title: WP1 – MAP: the ecosystem

Lead-beneficiary: UWE

Work package Leader: Andy Ridgway

Dissemination Level: Public

Due Date (September 2019): M9

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

Document History and Information

VERSION	DATE	DESCRIPTION AND COMMENTS	AUTHOR(S)
0.1	28-08-2019	First Draft	Elena Milani, Andy Ridgway
0.2	02-09-2019	Second Draft	Elena Milani, Andy Ridgway, Clare Wilkinson
0.3	06-09-2019	Third Draft	Elena Milani, Andy Ridgway, Dr Clare Wilkinson, Dr Emma Weitkamp
0.4	26-09-2019	Final Draft	Elena Milani, Andy Ridgway, Dr Clare Wilkinson, Dr Emma Weitkamp

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

Acknowledgments

Data collection conducted by:

Elena Milani, Andy Ridgway – Science Communication Unit, University of the West of England, UK

Tessa F. L. Roedema, Mariël Doedens – Athena Institute, Vrije Universiteit Amsterdam, Netherlands

Marzia Mazzonetto – SISSA Medialab, Italy

Klara Sielicka-Baryłka – Copernicus Science Centre, Poland

Dr Joana Lobo Antunes – Instituto de Tecnologia Química e Biológica António Xavier, Portugal

Slavica Duković, Dr Julia Balla – Center for the Promotion of Science, Serbia

Dr Gustav Bohlin, Dr Martin Bergman – Vetenskap & Allmänhet, Sweden

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

Table of Contents

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

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

Executive summary

The RETHINK project aims to provide a 360° view of the science communication landscape and identify its actors, roles and communication practices in Europe.

The Internet and social media outlets have challenged science communication, but they have also created opportunities to develop new communication practices. Digital media have blurred the distinction between producers and consumers of science content online, and they have allowed audiences to bypass the traditional gatekeepers of information (e.g. journalists) and access a range of sources (including scientists) directly. Since anybody can produce, curate and consume science content and potentially reach broad audiences, new types of actors communicating about science and technology have emerged. These actors do not necessarily represent traditional experts, such as researchers and journalists, but they do contribute to the science discourse online, either by disseminating facts or misinformation.

The RETHINK project aims to explore the diversity of actors and the nature of their digital communication in seven different countries (the UK, the Netherlands, Italy, Portugal, Poland, Sweden and Serbia) by analysing three case studies: climate change, artificial intelligence and healthy diets.

In the case of climate change, the digital landscape was characterised by a wide range of actors, such as advocacy organisations and activists, media organisations and journalists, local and national governments and policymakers, businesses and entrepreneurs, academic institutions and scientists, even non-professional communicators and support communities. Actors appear quite savvy in their communication, choosing digital channels to meet particular goals; for example, advocacy organisations and activists used social media, blogs and websites. Scientists, journalists, entrepreneurs and policymakers used Twitter, while governments used websites.

In the case of artificial intelligence, businesses and media organisations primarily used websites and blogs, whereas non-professional communicators used podcasts and video platforms. Support communities also contribute to the online discourse around artificial intelligence, favouring platforms such as Facebook groups and online forums such as Quora.

The healthy diets digital landscape features primarily health practitioners and non-professional communicators. These actors use Instagram and Facebook, and may seek to counter misinformation. Media organisations and businesses were also present in this landscape. Since healthy diets are visual, they were communicated by using formats, such as photos, selfies, cartoons, infographics, tables, charts and videos.

Depending on the topic, actors adopted different communication strategies and used different digital media. The way they communicate could provide examples or ideas on practices to adopt in communicating science online and also provide a foundation for further research on digital science communication.

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

Chapter 1: Introduction

The internet has revolutionised the way science is communicated. The ability to write and speak about science online has transformed the connection between science and society. This transformation in science communication has been a source of opportunities, but also challenges.

The Wellcome Global Monitor 2018 report, the world's largest study into what people think and feel about science and health issues, illustrates some of the opportunities afforded by online communication. It shows how access to the internet has brought scientific information into more people's homes. Whether they live in Northern Europe, Western Europe, Southern Europe, Eastern Europe or anywhere in the world for that matter, respondents to Wellcome's global survey were more likely to seek out science and health information if they have internet access than if they don't (Gallup, 2019).

Equally, the internet has provided new opportunities for those doing, funding and promoting science to reach a range of publics. Gone are the days when science journalists were the 'principle arbiters of what scientific information enters the public domain and how it does it' (Trench, 2007, p.141). Before the internet, newspapers, magazines and television were the main connections between science and society. Today, scientists, research centres, funding bodies, scientific publishers, science centres and museums, charities and amateur enthusiasts, anyone with an internet connection in fact, is able to communicate directly about science with publics online. Equally, the likes of social media and social news aggregation services have opened up the opportunity for those who were once simply recipients of news and information about science to comment and contribute. It's led to a science media ecosystem that is 'pluralistic, participatory and social' (Fahy and Nisbet, 2011, p.778).

However, there are significant challenges. Sourcing accurate, reliable information about science is far from straightforward. Misinformation online is rife and this has led to disconnects between public opinion and scientific consensus on a diverse range of issues ranging from vaccine safety to climate change (Scheufele and Krause, 2019).

While the internet promises to open up science and enable dialogue between science and wider society, there are many instances where this is not the case. Twitter for example, would seem to be well suited to this two-way conversation. However, studies into the use of Twitter to communicate science have found that dissemination of information from institutions is often evident rather than there being a two-way conversation with the wider world (Lee and VanDyke, 2015; Su, Scheufele and Bell, 2017).

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

The proliferation of internet-based communication is having implications for the journalistic role and concerns that it is being eroded. The sheer volume of science news online means journalists are increasingly 'curating' news content produced by others (Wilkinson and Weitkamp, 2016). The pressure to attract attention of readers also means journalists are encouraged to find entertaining stories quickly, rather than pursuing lengthy investigative research (Frost, 2010).

From the point of view of scientists, there appear to be large differences in their willingness and ability to share their research with non-expert audiences online using social media, blogs and other means. In an international study of scientists' social media use, survey respondents estimated that just 22% of their colleagues were using Twitter (Collins, Shiffman and Rock, 2016). The most common reasons respondents suggested their colleagues were not using the platform was a lack of knowledge about it and a lack of time.

At the same time, little is understood of how people make sense of information online – the moment of consumption as it has been described (Davies and Hara, 2017). How do readers choose what to believe and what not to believe and what are the factors that influence this process?

Finally, there are indications that not all members of society are proactively searching for online science information. In contrast to the Wellcome Global Monitor 2018 report, a Eurobarometer report on scientific research in the media showed that only around a quarter (28%) of EU citizens look at information about science on the internet regularly or occasionally (European Commission, 2007). The majority of EU residents surveyed (57%) said they never look at scientific information online (European Commission, 2007). It means that much online science content only reaches a fraction of society, suggesting science, even in online contexts, does not always reach the wider world.

Such challenges mean that it is time to RETHINK science communication.

Before finding solutions to the challenges, it is important to understand the nature of the complex online science communication ecosystem. It's an ecosystem that has rapidly developed since the mid-1990s and become increasingly complex due to the number of actors involved, platforms used and the forms of communication employed. While we may know how certain aspects of this landscape have developed, we lack a broad overview that captures some of its complexity. We need this knowledge to be able to get a clearer view of what is problematic and then to consider potential solutions.

With this in mind, the RETHINK project started by mapping the digital science communication landscape within seven European countries and the results of that process are presented here.

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

This mapping process involved exploring the actors engaging in science communication online, the nature of what they are communicating and the platforms they are using.

The method used in the RETHINK mapping process shares similarities with scoping studies used in academic research which seek to "systematically map the literature available on a topic" (Grimshaw, 2010) by using an exploratory search process to gain a broad overview. In the RETHINK mapping described here, the subject of the scoping was online science material. As well as similarities in aim, there are also similarities in approach. In both scoping studies and the RETHINK mapping it is important to first determine the extent of the 'terrain' that will be mapped – either the sphere of literature or in this case the nature of the online material (Arksey and O'Malley, 2005). It is also necessary to have a clear process that is carried out in a transparent way to ensure that the search is systematic and can be replicated by others.

The countries across Europe selected for the mapping – Italy, the Netherlands, the UK, Sweden, Poland, Serbia and Portugal - were chosen to be representative socioeconomically and culturally.

The exploratory scoping research into the nature and extent of science communication that has been conducted before has been restricted to specific forms of communication in specific geographic locations. For example, The State of Play: Public Engagement with Research in UK Universities report for Research Councils UK and the Wellcome Trust published in 2016 solely considered public engagement within research institutions in the UK (Owen, Featherstone and Leslie, 2016). The research conducted here allows comparisons of the online science communication landscapes in different European countries and has a broad focus; not only including the work of professional science communicators but also 'alternative' science communicators.

The sheer volume and diversity of online science-related content generated within Europe makes the mapping of science communication challenging. As a reflection of this, this study does not seek to record all forms of online science communication by all the actors involved. That would be an insurmountable task. Instead, this scoping study represents an attempt to map the diversity of actors and the content they produce.

Ultimately, the work conducted within RETHINK will enable new approaches to science communication to be developed. These will seek to foster more open and reflexive connections between science and society and as well as helping to mitigate some of the challenges that exist around access to reliable information about science and differences in engagement with scientific information within society.

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

The next sections of the report are broken down as follows. Chapter 2 describes the development and implementation of the scoping study. In particular, it explains how we determined the extent of the digital 'terrain' in each country to be mapped and how the mapping process or 'protocol' that was developed was operationalised by the research team. Chapter 3 describes the results of the mapping process. It is divided into sections, each looking at the digital science communication landscape for a specific topic (climate change, artificial intelligence or healthy diets). In each case, different actors are considered in terms of the types of communication they produce (e.g. news, blogs) and the platforms they use; with similarities and differences highlighted between countries. Finally, Chapter 4, the conclusion, discusses some of the key findings of the mapping process and how they will be employed elsewhere in RETHINK.

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

Chapter 2: How the scoping study was conducted

Integral to the RETHINK project are groups of individuals such as scientists, journalists, policymakers, professional science communicators as well as those who communicate science in their spare time. These groups, or 'Rethinkerspaces', will meet throughout the project in each of the RETHINK partner countries - Italy, the Netherlands, the UK, Sweden, Poland, Serbia and Portugal. They will inform the research process, provide insights into the issues being considered as well as acting as transformation ambassadors; encouraging the adoption of new science communication techniques that address some of the challenges facing science communication today.

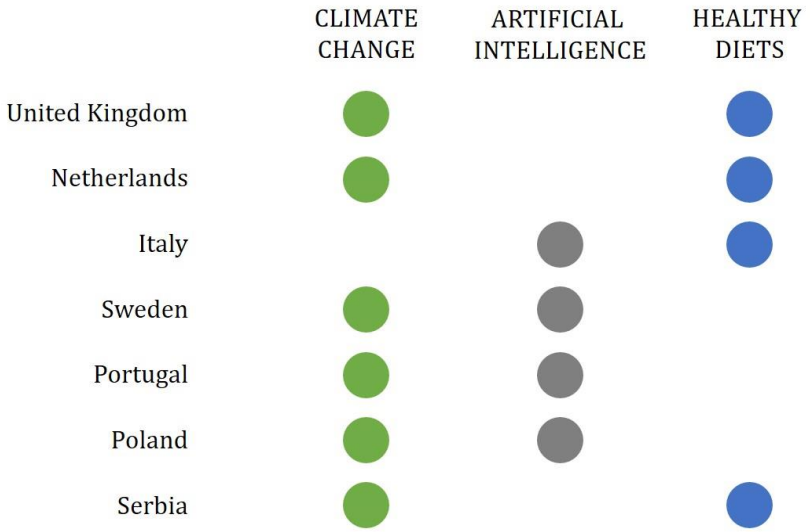
Each Rethinkerspace is led by a coordinator and it was these coordinators who conducted or coordinated the mapping of the digital science communication landscape in each country. The scoping study was conducted by means of an online search for science-content available in each of the partner countries. To enable this exploratory online search to record the diversity of science communication actors and content online, a detailed online search 'protocol', or procedure, was developed by Elena Milani at UWE Bristol, with assistance from other members of the UWE Bristol research team. This data collection protocol describes a step-by-step process for researchers to follow to enable them to explore digital science communication in their own countries and record what they find.

The online search protocol was developed in such a way as to provide clear instructions for researchers in each partner country to implement, while affording them sufficient flexibility to adapt the search method to the digital landscapes in their countries; including the differences in the social media platforms employed (see Appendix 2). This protocol involved researchers developing search terms they could use in Google and social media search tools. Google search was often used because it is a search engine that is employed extensively in European countries and enables searches to be refined by country, language, and domain (e.g. Facebook.com).

Given that the nature of the actors involved in communication online will be influenced by the subject matter involved, three science-related topics – climate change, artificial intelligence and healthy diets - were chosen as case studies. These case studies (or topics) were selected during the RETHINK kick-off meeting because they represent topics that could have a variety of actors involved in the online discussion (e.g. sceptical audiences, communities of enthusiasts, celebrities, dieticians…). Researchers in each country chose two of the three topics and only searched for subject matter relating to their chosen topics online. In this way, each country could select two topics that were likely to be discussed online or to be popular online trends. There was a fairly even spread in the topics chosen, as Figure 1 shows.

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

Figure 1 Science Topics Selected by each Country



With this method, it was possible to find actors who are highly visible online because they ranked highly in Google and social media searches. These actors could be found through an organic search (i.e. online search using keywords, such as 'climate change'), and so could be found by any Internet users searching for a specific topic. There are recognised limitations in this approach, in particular the possibility that Google and social media algorithms filter the search results based on previous searches or web pages visited by the searcher. Moreover, using this method may exclude actors who are well-known to communicate about a topic using traditional media but have not optimised their social media profiles or websites/blogs for search engines. To minimise these limitations, the researchers in each country were asked to follow the protocol (see Appendix 2) but also to add details of known high profile communicators independently of the protocol, if appropriate, to provide a more complete picture of the prominent actors online in each country.

In developing the scoping protocol, the scope of the field of science communication itself that would be the subject of the mapping needed to be defined. In other words, what type of content online is 'science communication' (and so captured here) and what type of science-related material online is not 'science communication' (and so excluded from our data). There have been numerous attempts to define science communication, some of which are described by Burns, O'Connor and Stocklmayer (2003). However, such definitions were often of limited value for the mapping study as they describe certain aspects of science communication, such as its effects and broad categorisations of those involved, but do not provide a clear delineation of what types of content do and do not constitute science communication.

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

Given these challenges, the approach taken was to use a broad working definition of science communication as the communication of science with those who are not experts in a given field. This, for example, excludes research studies published within academic journals. However, further clarification was needed to determine what types of online content would be included in the mapping, and what would not. This was achieved by means of an exercise during the initial 'kick-off' meeting of the RETHINK project in which the project partners were invited to consider which types and forms of content would be included in the mapping process and which would not.

This process allowed the development of collection criteria for the mapping protocol defining what online science content should be included (such as science news articles and blogs aimed at non-experts) and what should be excluded (such as educational material and academic content). The collection criteria are described in full in Appendix 1. As for the actors, we included only those sharing their content with public audiences (non-academic content) on active platform accounts (last used in 2018 at least), and whose posts were predominantly about one of the three selected science topics. Discussions were held between the researchers during the mapping to resolve any questions around specific web content that had been found and whether it fell within our criteria or outside of it.

Researchers in each country selected the digital media platforms to explore before starting their search; they were asked to choose platforms that were popular in their country, thus more likely to be used to discuss climate change, artificial intelligence or healthy diets. Full details of the search protocol they employed are provided in Appendix 2. Most of the countries involved in the project searched the same platforms, in particular websites, blogs, Facebook, and Twitter. Some of them also focused on podcasts, YouTube, Instagram, Vimeo, forums (e.g. Quora), or Reddit since they were considered relevant to their digital landscape (see Figure 2 for details). The research team in the Serbia searched a national platform as well, called Krstarica. This platform is a popular Serbian web portal that includes a search engine, forums and news updates.

Once a team selected the platforms to investigate, they searched each platform for one of their two selected science topics. They collected data only from actors who shared content matching the inclusion criteria (see Figure 3). The data collected included type of actor (e.g. activist or journalist), platform where the actor was found, as well as a brief description of the nature (e.g. news, commentary, debunking) and format of the content they shared (e.g. text, images, videos). The online searches were conducted in each country between 6 May 2019 and 14 June 2019.

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

Figure 2 Platforms searched by each country.

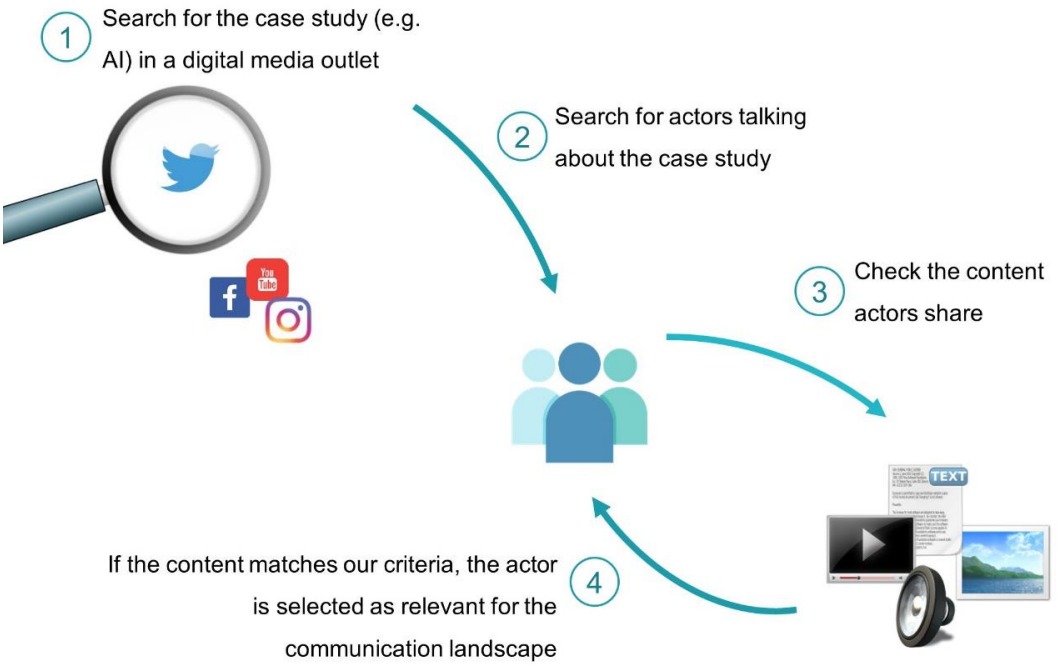
	United Kingdom	Netherlands	Italy	Sweden	Portugal	Poland	Serbia
Websites	■	■	■	■	■	■	■
Blogs	■	■	■	■		■	■
Facebook	■	■	■	■		■	■
Instagram	■	■	■	■		■	■
Twitter	■	■	■	■		■	
YouTube	■	■	■	■		■	■
Vimeo	■		■				
Podcasts	■		■	■			
Reddit		■					
Forums		■	■				
Krstarica							■

Each team was asked to restrict data collection to no more than 10 actors for each category. This favoured an expansive collection of a diverse range of science communicators, both individuals and institutions, rather than extensive data about only a limited range of communicators. This is in line with the aim of the study, which explores and maps the extent of the science communication terrain online rather than seeking to quantify aspects of it. That said, the scoping data do allow some tentative insights to be drawn on the relative proportions of the different actors and the platforms they use.

Some categories of actors were defined a priori, but given the exploratory nature of the scoping process, each research team could add more categories of actors if relevant to the study and the collection criteria. The full list of types of actors, which includes both individuals and organisations, is available in Appendix 3.

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

Figure 3 Overview of scoping study online search process



Given that previous searches on Google could influence the results shown when implementing the protocol, to avoid or at least limit this issue, each team was requested to use a new browser that had not been used for any other searches and kept the search history clean by only using that browser in connection with the scoping study. In this way, previous searches, for either work or personal reasons, should not have influenced the results of the scoping study. During the scoping study the actors were classified into categories based on their self-description.

Researchers were asked to record only content originating in their country. When it was not possible to filter the search by country using search terms, it proved challenging to filter content originating in a specific country. This was particularly the case with content written in English as it is employed extensively online, including by Swedish and Dutch actors as well as actors outside of Europe, and is a limitation of the study.

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

Chapter 3: Scoping Study Results

The following sections describe the results in more detail for each science topic explored. For each science topic, the landscape of actors involved in communicating it online, both individuals and organisations, are described. This description includes differences in the actors involved in generating the online content within different countries. The digital media platforms used by these actors are then explained, followed by a description of how these platforms are used.

3.1 Climate Change

The topic Climate Change was selected by 6 countries: the United Kingdom (UK), the Netherlands, Sweden, Portugal, Poland and Serbia.

Landscape of actors

There has been little research on the type of actors involved in the climate change debate online, and what there is has focused especially on Twitter (Pearce *et al.*, 2019). Newman (2017) found several users communicating climate change on Twitter, such as journalists, the media, governmental agencies, NGOs, environmental or political advocacy organizations, scientists and users that do not have any of the previous affiliations (e.g. bloggers). In this study the online landscape of actors communicating climate change is even more expansive since it considered a range of platforms, and involves a wide range of actor types in each country. In addition to journalists and media organisations, non-governmental organisations (NGOs), foundations, think tanks, businesses, universities and research centres, scientific societies, local and national governments, scientists, non-professional communicators, activists and policy makers[1] are all communicating climate change causes and consequences online. However, the mix of actors differed between countries. In some countries, such as Sweden, Portugal and Serbia, there were more institutions communicating about climate change, such as non-profit organisations, than individuals, such as activists[2]. In the Netherlands and UK, institutions and individuals were present in roughly equal numbers. Poland is the only country studied here where the local

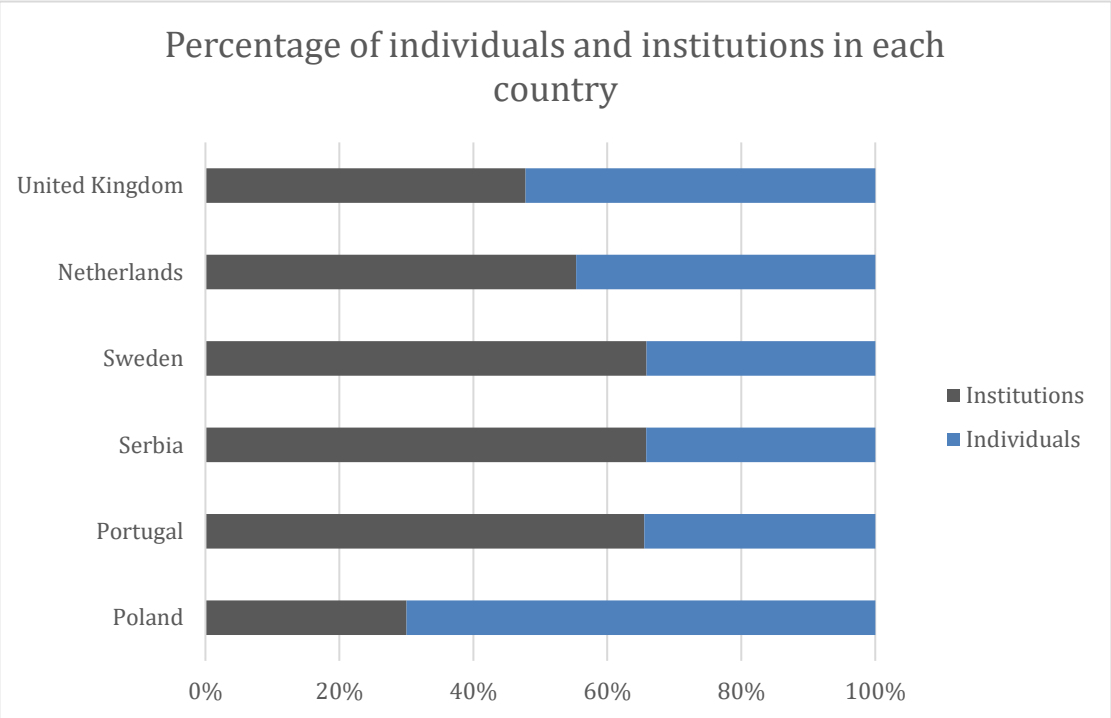
[1] The definition of each type of actor is available in Appendix 3.
[2] Note that we did not distinguish between individuals communicating on behalf of institutions and individuals communicating on their behalf.

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

research team reported more individuals than institutions, however far fewer actors had been recorded in that country, overall (see Figure 4).

Figure 4 The mix of individuals and institutions communicating about climate change online in each country studied.

The percentage of individuals and institutions communicating climate change in the digital landscape of each country is shown. Total number of actors for each country: UK – 90, Netherlands – 94, Sweden – 82, Serbia – 38, Portugal – 29, Poland – 10.



The recurrent actors found in this study tended to have a high profile online, and so were more clearly visible through Google and social media search. Looking at institutions first, NGOs, foundations, charities and think tanks were recurrent in the landscapes of each country, especially in Sweden (30%, n=83[3]), the Netherlands (14%, n=94), the UK (11%, n=90) and Serbia (29%, n=38). Media organisations and local or national governments were also common institutions communicating about climate change in the UK (11% and 8%, respectively; n=90), the Netherlands (13% and 11%, respectively; n=94), Sweden (10% and 14%, respectively; n=83) and Portugal (24% and 28%, respectively; n=29), whereas businesses were more

[3] In this Derivable, 'n' stands for the number of unique actors found. For example, in this case 83 unique actors were found in Sweden, 94 in the Netherlands, 90 in the UK and 38 in Serbia.

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

common in the Netherlands (11%, n=94), and to a lesser extent in the UK (4%, n=90) and Sweden (5%, n=83). Only the Polish research team did not report any of these actors at all, except for three non-profit organisations (n=10). Among the six countries, the Swedish team, and to less extent the British and Dutch ones, reported more NGOs, foundations and activists as well as local or national governments and policy makers than the others.

Research centres communicated about climate change especially in the UK (8%, n=90) and the Netherlands (4%, n=94). Scientific societies[4] were reported only by the British (3%, n=90), Swedish (1%, n=83) and Serbian teams (3%, n=38). Instead, universities that matched the collection criteria were found by most teams, such as those in the UK (2%, n=90), Netherlands (1%, n=94), Sweden (2%, n=83) and Portugal (3%, n=29).

Among individuals, scientists, activists, journalists and non-professional communicators[5] were found to be communicating about climate change online in most countries. Scientists were the most prevalent type of individual found to be communicating about climate change online in the UK (11%, n=90) and Portugal (34%, n=29). Activists and journalists were less prevalent, though they were still common in the UK (11%, n=90), Sweden (4%, n=83) and the Netherlands (7%, n=94). Journalists were found mostly on social media, such as Twitter, where they shared mainly news updates on climate change and climate policy. The Dutch research team reported non-professional communicators as the most frequent type of actors in their landscape (15%, n=94) and they found most of them discussing climate change on Reddit. However, the Dutch team were the only group who searched Reddit, which is often used anonymously and without a professional association.

Among the actors found, there were a few unexpected ones. For example, the Swedish and British scoping teams found the managers of businesses communicating about climate change (2%, n=83; 8%, n=90, respectively). Though science museums and science centres were found to be communicating about climate change in the Swedish and Dutch digital landscapes (2%, n=83; 3%, n=94, respectively), curators never appeared among the results. Press officers and communication officers communicating about climate change online were found only in

[4] Scientific societies are intended as academic societies or associations of scientists that provide fellowships, grants, and/or other forms of support relevant for a science career (e.g. formative courses, networking opportunities, and bureaucratic advice) to their fellow members.

[5] Non-professional communicators are defined here as individuals using digital media for science communication who are not employed as scientists, engineers, curators, activists, journalists, or policy makers. They may have a STEMM background, they may be Bachelor's or Master's students, and they do science communication for personal/professional interest (e.g. as a hobby, or as an effort to make a career in science communication). These individuals can include bloggers, social media influencers, Facebook/Reddit group moderators.

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

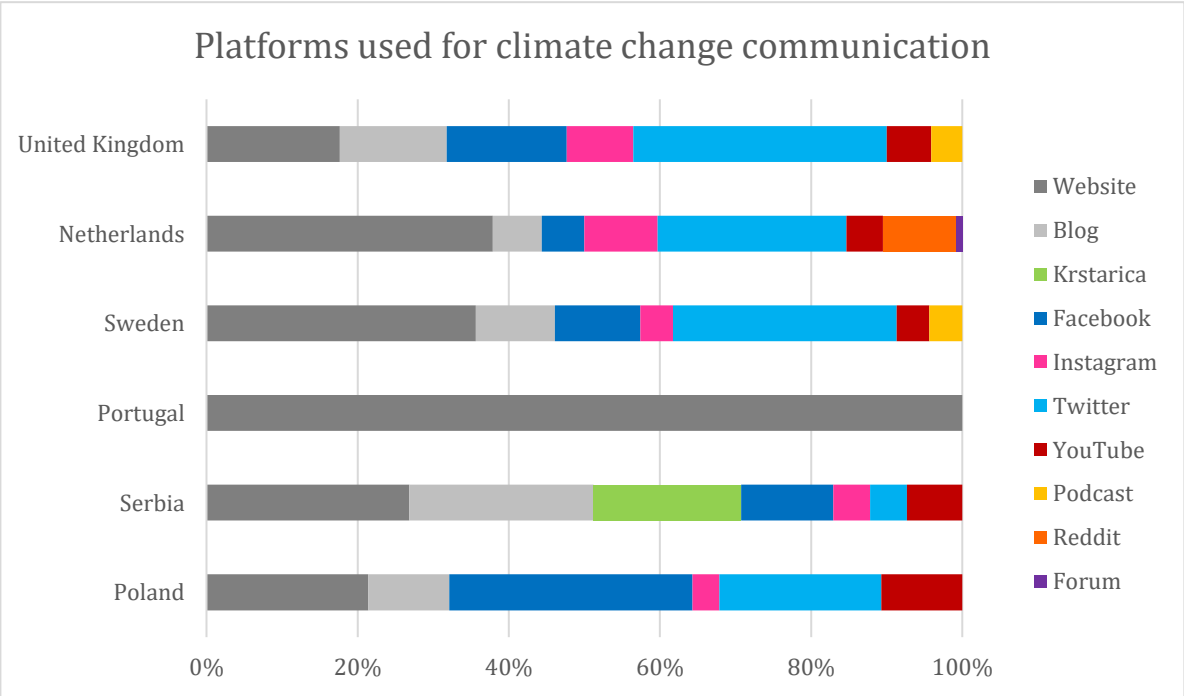
Sweden (4%, n=83) and the Netherlands (1%, n=94). Only the British team identified online video makers[6] communicating about climate change (3%, n=90).

How actors communicate climate change

The actors communicating about climate change in the UK were found on Twitter, especially journalists, scientists and entrepreneurs (Figure 5). Twitter was often a popular platform for climate change communication in Sweden and the Netherlands, though websites seemed to be the most commonly used outlet in those two countries.

Figure 5 The proportion of actors communicating about climate change found on each social media platform in each country.

Percentages of social media accounts/sites are shown for each country. The same actor could have had an account on more than one platform. Total number of accounts found in each country: UK – 170, Netherlands – 123, Sweden – 115, Portugal – 31, Serbia – 41, Poland – 28.



[6] Online video makers are intended as individuals who produce STEMM-related videos and upload them online. These videos can be news, tutorial, and explanatory videos

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

The actors found in the scoping study often used Twitter to share links to news articles, advocate for climate action, tell their stories (often known as narratives[7]), and express their personal or professional opinions on climate change issues. Facebook was used in the same way, though some actors also gave explanations of climate change science. Similar types of content was shared on Instagram, especially narratives and explanations[8]. YouTube videos and podcasts were also used to explain climate change issues. Websites and blogs were mostly used to publish news articles, but websites also feature[9] explanations, while blogs were found to have many feature articles.

Actors not only shared different types of content (e.g. explanation, news) on different platforms, but also used different formats. For example, most of the website and blog articles have a photo, a chart, an infographic (especially for explanations), or a video that accompanies the text. The addition of a visual element in the articles is likely to be related to search engines optimisation practices. Facebook posts used photos or videos, whereas Twitter updates frequently included charts as well. Instagram is suited for sharing images, hence posts with photos, videos, cartoons, drawings, charts, infographics and Internet memes were common.

Academic institutions and academics

The British universities (n=2) and scientific societies (n=3) found in this study mainly published news and feature articles about climate change research on their blogs (2 each), and explained or discussed climate change issues on thematic podcasts (2 each). These podcasts were either interviews with experts (e.g. researchers) or recordings of public talks given by academics. In Sweden and the Netherlands, universities and scientific societies, were found to use only websites to communicate about climate change, where they published news and features articles. Dutch universities also shared articles explaining the science of climate change.

In the UK, research centres (n=7) published content on climate change on websites (4), blogs (4) and Twitter (3). Their content was mainly news articles, especially on Twitter (shared as links), whereas features and comment articles or opinion pieces[10] were included on websites

[7] Content having narrative components is associated to storytelling in this study.
[8] Content that makes science clear by describing it in more details or revealing is defined as 'Explanation' in this study.
[9] Features and long-form writing are similar to news articles, but longer in length.
[10] Comments or opinion articles are defined as opinion-lead articles in this study; they may or may not be time-sensitive.

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

and blogs, especially about research on climate change. On their websites, some research centres also posted articles explaining climate change and its impact on specific environments and/or society. One or two of these research centres used other platforms as well, such Facebook, YouTube and podcasts. The Dutch team found similar results: research centres (n=4) used both websites (2) and Twitter (2) to share news on climate change research. Sweden was the only country where a research funding body was found to be communicating about climate change online, posting features on climate change research on its website.

Scientists used Twitter, especially, and blogs to talk about climate change. In the British digital landscape, 9 out of 10 scientists used Twitter, where they shared mostly links to news articles and provided their personal or professional opinion. They also posted about scientific research on climate change (e.g. links to scientific journal publications, scientific graphs). They embedded photos, charts and tables in their tweets. A few of them used either blogs or Twitter to post opinion articles (or links to) or debunk climate change misinformation. In the Netherlands, 4 out of 5 scientists used Twitter, and they also share explanations; in Sweden 2 out 3 use Twitter and they share comment or opinion articles as well.

Advocacy organisations and activists

British NGOs, foundations, and think tanks (n=10) used a variety of platforms to communicate climate change issues, such as Twitter (9), Facebook (9), websites (7) and blogs (6), Instagram (6) and YouTube (4). While on websites and blogs they regularly posted news, features, opinions or articles that explained climate change, they advocated for taking action against climate change and promoted protests on Twitter, Facebook and, to lesser extent, Instagram. On social media, these institutions occasionally posted stories about their volunteers and staff members, or they used humour to provoke reactions and mock politicians. In addition to text, NGOs and foundation employed a variety of content formats, such as photos, videos (especially of protests), charts, drawings and Internet memes. One of the foundations found by the British team advocate climate change was not human-made, and criticised the official reports by the Committee on Climate Change (CCC) and the Intergovernmental Panel on Climate Change (IPCC) on all the platforms mentioned above, and used photos, charts and videos to support their claims.

Advocacy organisations found in Sweden (n=25) and the Netherlands (n=13) shared news articles, features, and/or explanations on websites (14 and 8, respectively), blogs (7 and 2), Facebook (11 and 5), Twitter (12 and 5), Instagram (4 each), and YouTube (4 and 3). In the Netherlands, many of these types of actors advocated climate action and posted updates on their protests and activities, especially on social media. In Sweden, only a few of advocacy

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

organisations and non-profits posted about their protests or activities, while many shared comments and opinion articles on climate change. Moreover, two Swedish NGOs and foundations hosted a podcast, one of which debunked misinformation about climate change. In Serbia, non-profit organisations (n=11) mostly shared articles explaining the scientific aspects of climate change on websites (5), Facebook (3) and blogs (3), and advocated for climate action on the last two.

Unlike advocacy and non-profit organisations, British activists and pressure groups (n=6) found in this study used Twitter (5), Instagram (4) and Facebook (5) more than blogs and websites (one each). They used different techniques to communicate climate change on social media, such as sharing news, their personal stories, calls to action, calls to join a protest, explanations, personal comments, humour (e.g. mocking climate change deniers or politicians), and even music playlists. They also shared different formats of content; for example, photos and videos of protests, screenshots, charts - to show climate change facts - and drawings. Websites and blogs mainly hosted information about grassroots movements, such as aims, achievements, protest updates, and how to join. In the Netherlands (n=5) and Serbia (n=3), the activists and pressure groups found used Twitter (3 and 1, respectively), Instagram (2 and 1), and Facebook (1 each) as well, while in Sweden (n=7) they mostly used Twitter (4). Two activists found by the Swedish team were climate deniers and used Facebook (2) and blogs to share news, comment articles and express their scepticisms (2). In the Netherlands, activists also shared explanations, stories, and updates on protest or activities.

Governments and policy makers

The local and national governments found in this study have a section on their website dedicated to climate change, where they explained what climate change is, how it impacts their country or region and how they were tackling the issue. Their articles often had infographics to facilitate the understanding of their message. In Sweden and in the Netherlands, these actors also shared news, features and/or comment articles with images.

In this study, policy makers used Twitter to share links to news articles, often commenting on them, or advocated climate action. In the UK, all of the policy makers found (n=4) used Twitter and two of them used Facebook. These actors were politicians and they also had blogs or used Instagram but they used them for personal branding and political campaigning. In Sweden, policy makers shared comment articles and explanations on Twitter (8 out of 8) and one on Instagram. In the Netherlands, 5 out 5 policy makers used Twitter while one blogged; they accompanied their messages not only with photos, but infographics and videos. The Dutch team

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

also found a political party that used Twitter to share videos, images and infographics to try to prove that climate change is a hoax.

Businesses and entrepreneurs

Businesses in Sweden (n=4), the Netherlands (n=10) and the UK (n=4) were found to publish news articles, features and/or explanations on their blogs (2, 1 and 2, respectively) or websites (1, 7 and 2, respectively) that addressed different aspects of climate change, often related to the industry they were in (e.g. sustainable energy). In the UK, most of these actors used Twitter and Facebook to promote their products rather than communicating about climate change, but two of them used these platforms to share links to news articles (1 for each, n=4). In the Netherlands, some businesses used Twitter and Facebook (4 and 2, respectively; n=10), and a few of them also encouraged action on climate change.

All of the British and Swedish entrepreneurs found used Twitter to share news articles and their personal or professional opinions about climate change issues and policies. One of them, found in the British digital landscape, communicated about climate change, as well as the responsibilities of companies to become environmentally sustainable, on Twitter, Instagram and their blog. This actor also ran a podcast where they interviewed experts (journalists, policy makers, researchers) on different aspects of climate change.

Media organisations and journalists

Media organisations in the UK (9, n=10), the Netherlands (10, n=12), Sweden (8, n=8) and Serbia (3, n=10) shared news articles, features and comment or opinion pieces on climate change issues on their websites. The media organisations found in Sweden did not post on any other platforms. Those in the Netherlands, instead, also published content explaining the science of climate change on Instagram or YouTube (2 each, n=12), and one of them hosted a forum to discuss the topic with its readers. In Serbia, the media organisations found (n=10) also shared their news articles on blogs (2). These organisations also used YouTube (2), Twitter (1) or Facebook (1). In the UK, most of these actors used social media accounts to share articles they publish. However, a few of them publish online magazines or newspaper issues themed on the environment and climate change, and they share their articles on Twitter (4, n=10) and/or Facebook (3, n=10). The web articles posted by these organisations always had at least one image or video embedded; the images included photos, charts, infographics or even screenshots of tweets and Facebook posts. Some actors, not only posted text-based articles, but they also occasionally shared news through videos.

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

The journalists found in this study shared mainly news on Twitter in the UK (10, n=10), Sweden (3, n=3) and the Netherlands (3, n=7), while in Serbia they published news articles or features on the national web portal Krstarica (5, n=6) and blogs (1, n=6). Twitter is a platform where they could share not only articles from their respective media organisations or others, but also their personal or professional opinions on climate change and climate change policies. Journalists did not share only textual messages and links when they tweet, but also screenshots of photos, videos, social media posts, charts, and drawings or cartoons. In the Netherlands, 4 journalists were found publishing news and features on websites (n=7).

Press officers and communication officers

Only the Swedish and Dutch research teams found press or communication officers communicating climate change that matched the inclusion criteria. In Sweden, two of these actors, working for either industry or NGOs, shared news or opinion articles on Twitter, and one ran their own podcast where they explained climate change issues (n=3). In the Netherlands, the researchers found one press officer that shared news on climate change impacts on the non-profit organisation's website where s/he worked.

Science museums and centres

Only the Swedish and Dutch researchers found museums and science centres communicating about climate change online (n=2 and 3, respectively). In both countries, these actors shared explanations, news, and features on their websites. One Dutch science centre used Instagram, and accompanied the pictures with captions about climate change and the need for sustainable buildings. Another museum used Twitter to share the features on climate change published on its website.

Non-professional communicators, support communities and online video makers

In the British digital landscape, the non-professional communicators found (n=5) posted mostly news, comment and opinion articles on climate change, but also stories, humorous content or features. Most of these actors used Facebook (3) and Twitter (3), and a few curate blogs (1), podcasts (1) or Instagram accounts (1). In Sweden, the two non-professional communicators found by the researchers shared only content explaining climate change science on either podcasts or YouTube. In Serbia, the researchers found two non-professional communicators on the forum of Krstarica, one on Instagram and one on YouTube (n=4). Non-professional communicators were often found to post text and links, but they also enriched

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

their messages with cartoons, comics, charts, photos, videos and even Internet memes. The Dutch research team classified several actors on Reddit as non-professional communicators (10, n=14) or support communities[11] (2, n=4). The non-professional communicators discussed news or comment articles on Reddit and their personal or professional opinion on the topic. The Dutch team also identified non-professional communicators (n=14) on Twitter (2), Instagram (1) and blogs (1). The blogger criticised the IPCC reports on their blog and used charts and images to show how, in their opinion, these reports are wrong.

The support communities found by the Dutch team did not share the same variety of content and formats on Reddit as the non-professional communicators, but they focused the discussion on explanations and news articles about climate change. Support communities (n=4) and non-professional communicators (n=14) were found on Instagram (1 each), blogs (2 and 1, respectively), and Twitter (2 non-professional communicators only). In the UK, the only support community found used Facebook to mock climate change activists and their cause by using photos, cartoons and Internet memes.

Only the British research team found online video makers, all of them on YouTube (n=3). One of these video makers combined storytelling techniques and humour to explain climate change facts and science in their videos, and used Twitter to promote their YouTube channel. The other two actors were climate change sceptics; they used YouTube only to promote sceptical views of climate change or that it is not human-made. Both used images, charts and tables to support their claims or show how media coverage of global warming exaggerates the facts.

Summary

The digital landscape of climate change communication was characterised by a broad and diverse range of actors. Both institutions and individuals, academics and non-academics, traditional gatekeepers (e.g. journalists) and non-traditional ones (e.g. non-professional communicators), shared content on climate change to publics. All these actors, found in the scoping study, constituted traditional and alternative sources of information competing for public attention. Moreover, their social media accounts, blogs and websites were optimised for

[11] Individuals with similar interests that form an online community, where they exchange information, news, and emotional support. The community is regulated by moderators or administrators (e.g. of a Facebook Page), who curate the posts shared by the community and share content as well.

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

search engines, meaning that they were highly visible online and relatively easy to find by Internet users.

All these actors communicated about climate change using different platforms to share different types of content. For example, academic institutions, advocacy organisations, and businesses published news articles and features on climate change on their websites and blogs, and also articles explaining the scientific aspects of this topic. Local and national government also posted news articles and features, mostly discussing climate change causes and impacts on the territory and the policies or strategies in place to tackle the problem. Media organisations published content on websites too; they did not post only news and features but comments and opinion articles about climate change as well. A few of them also used Facebook and/or Twitter specifically for sharing news updates on the environment and climate change.

While website and blogs were suited for publishing articles, Twitter and Facebook were regularly used for sharing news, event updates and advocacy campaigning (see Gerbaudo, 2012; Kwak et al., 2010). In particular, scientists, entrepreneurs, journalists, and policy makers used Twitter more than any other platforms, and they posted links to news articles, features or comment/opinion articles. Activists, advocacy organisations and a few Dutch businesses, used both Twitter and Facebook for sharing news and advocating for action against climate change. Scientists also used Twitter to debunk false claims about climate change.

Unlike the other types of actors, advocacy organisations, activists and non-professional communicators posted several different kinds of content, especially on social media. These actors shared their personal stories and experiences, real-time coverage of their protesting activities (except non-professional communicators), explanations of scientific facts on climate change, and even humorous content. The content and the platforms that characterised these actors' communication about climate change were slightly different across countries. For example, activists found in the UK communicated via Instagram more than Facebook and Twitter, and NGOs and foundations in Serbia campaigned on blogs and Facebook. Non-professional communicators found in Sweden and the UK curated YouTube channels or podcasts on climate change, while those found in Serbia (and journalists too) posted articles about the topic on the national web portal Krstarica. Many non-professional communicators and support communities discussed climate change news and issues on Reddit in the Dutch digital landscape[12].

[12] The scoping team in the Netherlands was the only that explored Reddit.

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

Non-professional communicators, activists, advocacy organisations, media organisations and journalists shared the widest range of formats. Unlike most of the institutions and individuals that posted only photos, videos and a few infographics or charts, these actors shared drawings, cartoons, screenshots of social media posts or articles and/or humorous Internet memes as well. The use of several formats might help compete against other sources of information online and raise visibility.

The digital landscape relating to climate change was characterised by a variety of actors (i.e. sources of information), perspectives (e.g. business' point of view), types of content (e.g. news) and formats. This variety potentially allows Internet users to encounter different opinions and pieces of information about the topic, but at the same time, allowed misinformation and misinterpretation of climate change issues to be disseminated online.

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

3.2 Artificial Intelligence

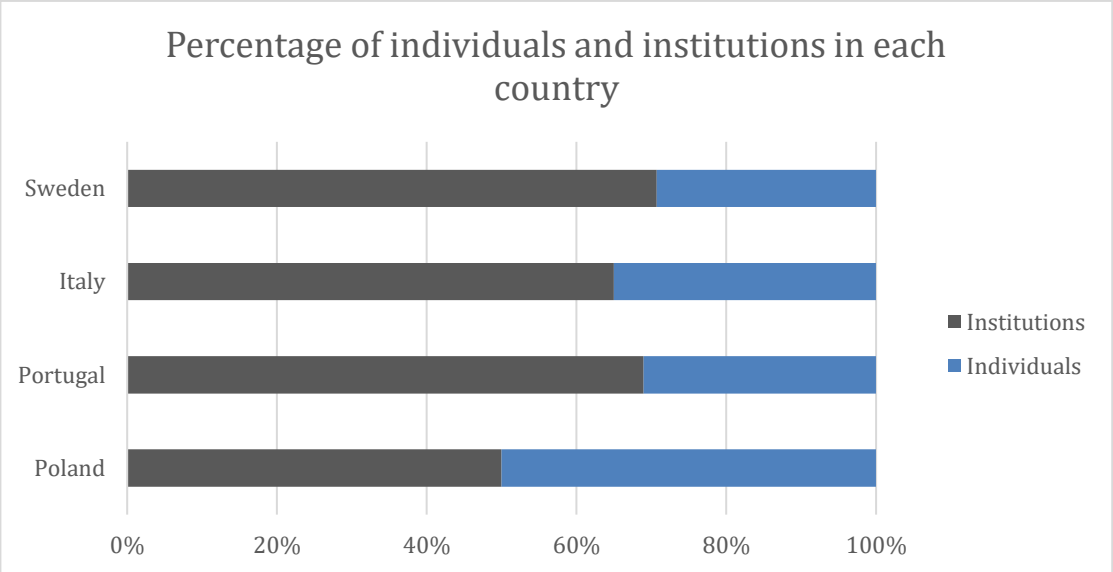
The research teams in Sweden, Italy, Portugal, and Poland chose Artificial Intelligence as a topic to explore.

Landscape of actors

The research teams in Sweden, Italy and Portugal found more institutions than individuals communicating about artificial intelligence online, whereas the team in Poland reported they were in equal proportion (see Figure 6). This finding is similar to the climate change case study, especially for the Swedish and Portuguese digital landscapes where more institutions than individuals were found.

Figure 6 The mix of individuals and institutions communicating about artificial intelligence online in each country studied.

Percentage of individuals and institutions communicating climate change in the digital landscape of each country. Total number of actors for each country: Sweden – 41, Italy – 40, Portugal – 29, Poland – 10.



Though several types of actors were found communicating about artificial intelligence online, they were not as diverse in type as in the climate change online communication landscape. For example, while NGOs, think tanks and foundations were part of both climate change and artificial intelligence digital landscapes (7%, n=41 in Sweden; 10%, n=40 in Italy), activists and pressure groups were almost absent in communications about artificial intelligence (only 1 in

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

Italy). Media organisations and businesses communicating about artificial intelligence were highly visible in Italy (24% and 17% respectively, n=40), Sweden (30% and 25% n=41), and Portugal (28% and 14%, n=29). Instead, journalists and business managers, who were recurrent in the climate change conversation, were not as common in the artificial intelligence landscapes: only two journalists were found by the Italian team, while none of the countries reported business managers. Only the team in Portugal identified scientists (28%, n=29) and research centres (24%, n=29) communicating about artificial intelligence. In comparison with the climate change digital landscape, there were fewer local and national governments and policy makers, with these groups found only in Sweden (7% and 2% respectively, n=41), and more non-professional communicators and support communities (12% and 10% respectively in Sweden, n=41; 8% and 15% in Italy, n=40). Again, curators of museums and exhibitions were not producing content about artificial intelligence online that matched the collection criteria, and only two Swedish science museums and centres regularly communicated about artificial intelligence to the online public (n=41).

How actors communicate artificial intelligence

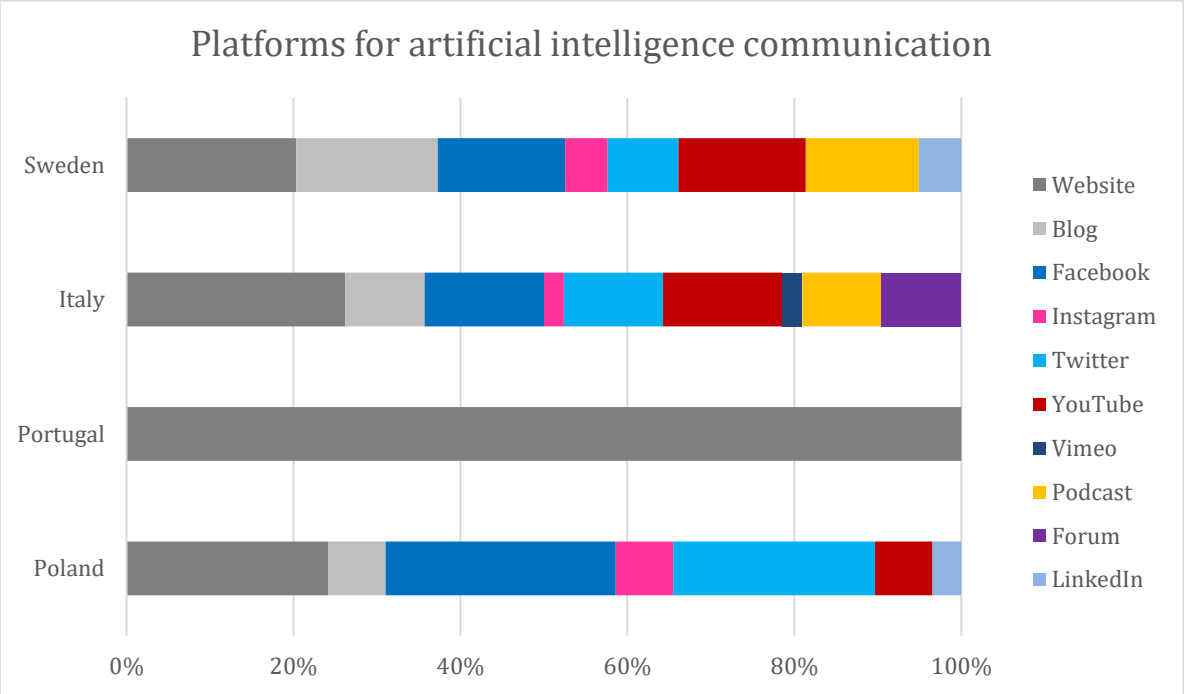
While Twitter was used frequently for climate change communication, it did not appear as a popular tool for communications about artificial intelligence. In Italy and Sweden, actors used websites, Facebook and YouTube more often than Twitter (see Figure 7). Poland was the only country where there were not striking differences between the climate change and artificial intelligence landscapes; this could be due to small number of actors they reported for each study (10 each for climate change and artificial intelligence).

The content about artificial intelligence was often business-oriented, especially in the Italian landscape. As with climate change, news was frequently shared on a range of platforms, features were published on websites and blogs, and explanations were provided on podcasts and YouTube. Facebook, LinkedIn and Quora were used to discuss news on issues about artificial intelligence.

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

Figure 7 The proportion of actors communicating about artificial intelligence found on each social media platform in each country.

Percentage of social media accounts/sites found in each country. The same actor could have had an account in more than one platform. Total number of accounts found in each country: Sweden – 59, Italy – 42, Portugal – 29, Poland – 29.



Academic institutions and academics

The Swedish research team found one research funding body, which shared features on current research on artificial intelligence on its websites. The Swedish universities identified (n=3) used websites (2), blogs (1) and podcasts (1) to publish features, news articles and/or content explaining artificial intelligence. The only scientist identified used Twitter for sharing news and opinion articles on the topic. The Italian team found a scientist that used YouTube, to post videos explaining artificial intelligence.

Advocacy organisations and activists

The researchers in Sweden found that NGOs, foundations and think tanks (n=3) used Facebook (2), Twitter (1), YouTube (2), websites (1) and blogs (1), as in the case of climate change. These actors posted news, features and comment articles on most of the platforms, and explanatory videos on YouTube. LinkedIn (2) and Facebook were used as spaces for discussions of artificial

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

intelligence issues and to share news updates with followers. These actors did not call for action as in the case of climate change; rather, they seemed to promote awareness and discussion about artificial intelligence.

In the Italian digital landscape, the NGOs, foundations and think tanks found (n=4) used only Facebook (3), Twitter (1) and YouTube (1) to share news updates on artificial intelligence. Moreover, the research team also found one activist that posted news on the topic on their website. None of the other countries found activists or pressure groups communicating about artificial intelligence that matched the inclusion criteria.

Governments and policy makers

Only the research team in Sweden found local or national governments and policy makers communicating about artificial intelligence, though there were not as many as in the climate change digital landscape (3 and 1, respectively). One of the governments found shared news articles and features on artificial intelligence on Facebook, another one posted videos on YouTube, and the last one offered a glossary about artificial intelligence on its website. The policy maker used Facebook (not Twitter) to share news articles and features.

Businesses and entrepreneurs

In the Swedish digital landscape, the actors identified as businesses published news articles and features on their blogs (6, n=8). They did not use Twitter (as in the topic climate change). In contrast, in the Italian digital landscape, the businesses found (n=10) used Twitter (3) and websites (3) to share news updates or explanations on artificial intelligence. One of these actors also ran a podcast on the topic: in each episode, the same data scientist (an employee) explained a different issue relating to artificial intelligence and talked about his personal experience of working in the field. The podcast episodes were shared on YouTube as well.

Media organisations and journalists

Media organisations found in Sweden (n=10) and Italy (n=12) mainly used websites to communicate about artificial intelligence (7 and 8, respectively), but also used blogs (2 each), podcasts (1 each) and YouTube (1 each). Italian podcasts tended to use storytelling techniques to discuss artificial intelligence issues, whereas the Swedish ones often focused on explaining the topic or news. Only the Italian research team found journalists communicating about

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

artificial intelligence (2 of them). These actors shared news articles on Facebook and/or Twitter.

Non-professional communicators, support communities and online video makers

All the non-professional communicators found in the Swedish digital landscape curated a podcast (n=5). One of them also used Facebook, Instagram, Twitter and YouTube to share their explanations about artificial intelligence issues. In the Italian digital landscape, the non-professional communicators found (n=3) explained these issues and talked about their personal experience or opinions on Vimeo, YouTube and podcasts (one each).

In the Swedish landscape, the four support communities found shared and discussed news and issues relating to artificial intelligence on Facebook. One of them also curated a website and posted news updates on Twitter. In the Italian landscape, the support communities (n=6) tended to discuss artificial intelligence issues and news on Quora (4) rather than Facebook (2).

Both the research teams in Sweden and Italy found online video makers in their digital landscapes (one each). These actors shared videos on YouTube about news or issues relating to artificial intelligence.

Summary

The digital communication landscape featuring artificial intelligence was not as diverse as that of climate change, and was dominated by institutions. Media organisations, businesses, non-professional communicators and support communities were the most common actors. Unlike in the case of climate change, journalists, entrepreneurs and policy makers were almost absent from this landscape. If there were advocacy organisations or activists campaigning against artificial intelligence, they were not visible in this mapping. Visible actors raised awareness about artificial intelligence issues by sharing news articles on websites, blogs and social media, or encouraging question and answers, debates, on Facebook and LinkedIn. Support communities also communicated about artificial intelligence by discussing it with their members, especially on Facebook and Quora.

Non-professional communicators did not employ the wide range of formats and types of content seen in the climate change landscape. Instead, they combined narratives and personal stories with scientific explanations of the topic. These actors used fewer digital outlets, such as podcasts and online video platforms.

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

Academic institutions communicated about artificial intelligence as they did with climate change: they shared news articles, features, and text explaining the scientific aspects of the topic. They also used the same platforms, such websites, blogs and to a lesser extent podcasts. Scientists also did not change their way of communicating online based on the topic, and as in the case of climate change, they shared links to news, features and comments on Twitter. However, in the Italian digital landscape, they also explained artificial intelligence in videos on YouTube.

Local and national governments, businesses, and media organisations communicated about artificial intelligence in both similar and different ways to the ways in which they communicated about climate change. These differences also depended on the country. For example, governments still shared articles explaining artificial intelligence issues and policies, but they also shared news on Facebook. Businesses found in the Swedish digital landscape posted news articles and features, as they did about climate change, whereas those in the Italian landscape posted explanatory articles on their websites and news updates on Twitter. Media organisations published news, features, comments and opinion articles on their website, as in the previous case study, but some of them also curated podcasts. These podcasts tended to focus on explaining scientific concepts in Sweden, whereas they had a strong narrative component in the Italy.

The platforms were used in the same way to communicate both climate change and artificial intelligence; for example, articles explaining scientific concepts were posted on websites, and news updates were commonly shared on Twitter. However, there were some differences in what platforms the actors used and in where these actors were from. While in the case of climate change advocacy campaigns were frequent, with respect to artificial intelligence, news (especially from a business perspective), explanatory articles and discussion were common.

The smaller number and diversity of actors in the artificial intelligence landscape could be due to the relative novelty of this topic. This would also explain the lack of advocacy campaigns and the presence of online support communities as well as NGOs.

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

3.3 Healthy Diets

The research teams in the UK, the Netherlands, Italy and Serbia searched for actors communicating about healthy diets and nutrition online.

Landscape of actors

Previous studies on actors communicating about healthy diets online mostly focus on specific platforms, especially Instagram and Facebook, and/or specific actors, such as health professionals or food industry (Pilgrim and Bohnet-Joschko, 2019; Klassen *et al.*, 2018; Saboia *et al.*, 2018). In this research, a broader range of platforms was consider and several different actors were found communicating about nutrition. The teams in the UK, the Netherlands and Serbia found a variety of actors communicating about healthy diets, including health practitioners[13] and healthcare organisations (e.g. hospitals, public health services). In Italy, researchers found fewer types of actors than the other countries. Institutions and individuals communicating about healthy diets were more or less in the same proportions in the British, Dutch and Italian digital landscapes. Only in Serbia were there more institutions than individuals communicating about this topic (see Figure 8). These distributions were very similar to those of the climate change case study.

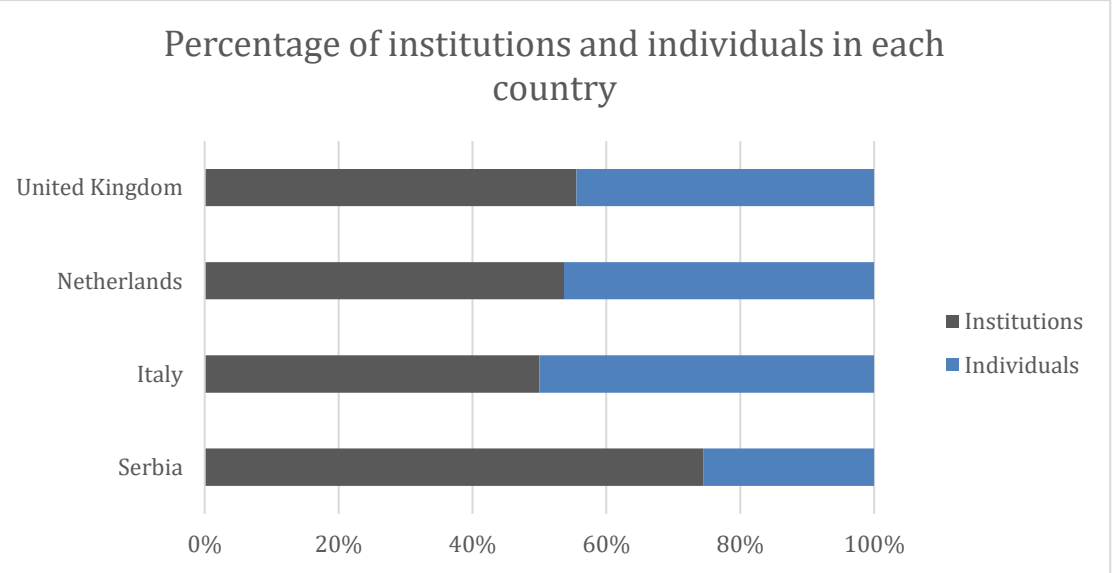
Among the different types of actors, curators of museums and exhibitions that matched the collection criteria were missing, as well as press officers and communication officers. NGOs, foundations and think tanks were not as numerous as in the case of climate change in the UK (8%, n=63), the Netherlands (15%, n=82), Serbia (13%, n=47) and Italy (1, n=42), and activists and pressure groups were even fewer (only 26% in Italy, n=42, and 1 in the Netherlands, n=82). Media organisations were a common type of actor in the UK (16%, n=63), in the Netherlands (11%, n=82), in Italy (31%, n=42) and in Serbia (28%, n=47); hence, they tended to have a high visibility in the healthy diets digital landscapes. Few journalists communicated about nutrition and of those that did, they mainly shared recipes rather than information on nutrition (1 out of 63 in the UK, and 2 out of 82 in the Netherlands). Health practitioners discussing healthy eating were common in the UK (16%, n=63), the Netherlands (9%, n=82), and Serbia (6%, n=47), and non-professional communicators (e.g. fitness coaches) were even more visible in the online healthy diet discourse than those communicating about climate change (16% in the UK, 20% in the Netherlands, and 13% in Serbia).

[13] I.e. physicians, nurses, General Practitioners, surgeons, allied health professionals, midwives, and pharmacists that use digital media to communicate medicine and health.

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

Figure 8 The mix of individuals and institutions communicating about healthy diets online in each country.

Percentage of individuals and institutions communicating climate change in the digital landscape of each country. Total number of actors for each country: UK – 63, Netherlands – 82, Italy – 42, Serbia – 47.



How actors communicate healthy diets

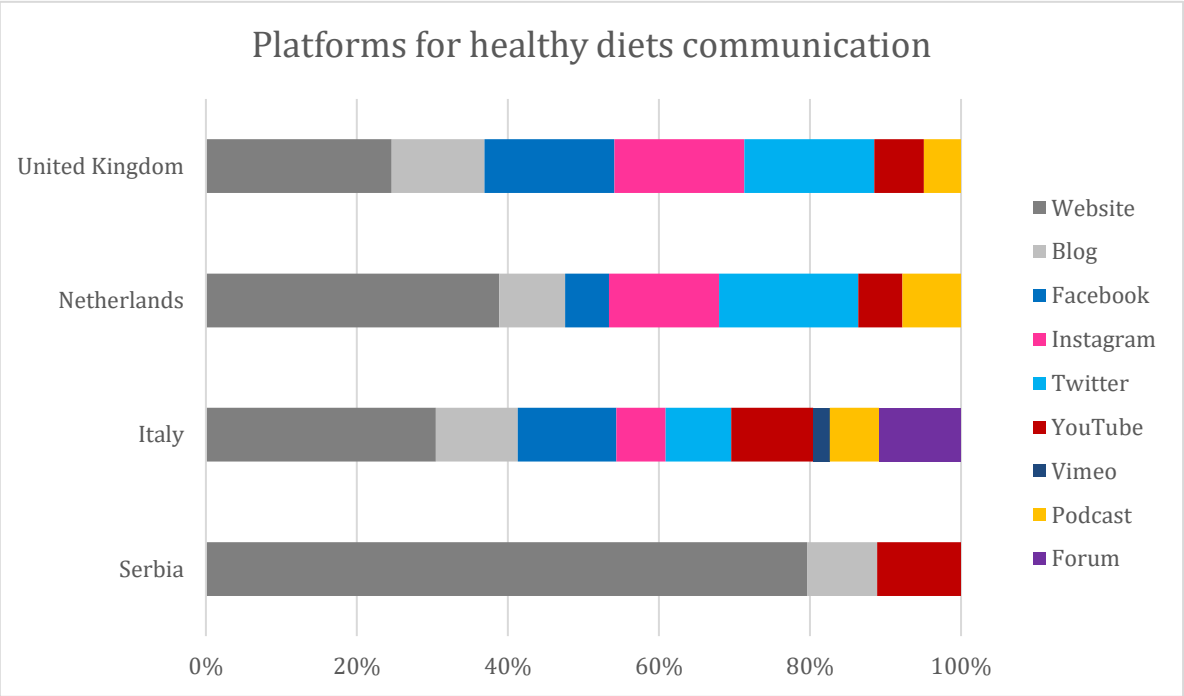
While Twitter was the most frequently used platform to communicate about climate change, Instagram and/or Facebook were used regularly for discussing healthy diets, especially in the UK, Italy and the Netherlands (see Figure 9). In the case of the British digital landscape, actors (especially health practitioners and non-professional communicators) often used Instagram to post photos of food or themselves (often selfies). Their posts were often personal, full of emojis, and provided tips, pieces of advice, tutorials or explanations about nutrition and healthy eating. Many of these actors reposted their Instagram messages on Facebook and Twitter rather than editing the content specifically for these platforms. These types of messages were common in the Dutch and Italian digital landscapes as well. Moreover, social media and websites were also used for self-promotion, selling products or services, or promoting podcasts.

The content about healthy diets was sometimes framed for specific medical conditions (e.g. diabetes) or age (e.g. children or older people). While news articles and advocacy messages were common content in climate change communication, storytelling and explanations dominated the communication about healthy diets, and they were mixed with recipes, personal stories, and motivational messages. Moreover, there were more actors debunking diet myths than actors debunking climate change misinformation.

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

Figure 9 The proportion of actors communicating about healthy diets found on each social media platform in each country.

Percentage of social media accounts/sites found in each country. The same actor could have had an account on more than one platform. Total number of accounts found in each country: UK – 122, Netherlands – 103, Italy – 46, Serbia – 54.



Health organisations and practitioners

In the Dutch digital landscape, the health practitioners found (n=7) shared explanations, news articles, tutorials and medical advice on websites (2) and blogs (2), and a few of them used Twitter, Instagram (1) or YouTube (1). In the UK, health practitioners (n=10) were mostly on Instagram (9), Facebook (6) and/or Twitter (5). Some of them shared news articles and features on blogs (3) or websites (1), and/or curated a podcast where they interviewed other experts on different aspects of nutrition (4). A few of these actors also had a YouTube channel, where they vlogged or shared tutorials about healthy eating (2). Twitter was not used as often as Instagram or Facebook: these actors used it for personal branding or reposted the content from their Instagram account without adapting it for Twitter. On Instagram and Facebook, health practitioners tended to share photos of food, their daily life, selfies, or videos of recipes. They also shared screenshots of news articles or social media posts that they wanted to comment on, or drawings and Internet memes about a particular aspect of nutrition or a myth they wanted to debunk. On these two platforms and on blogs, health practitioners often talked about news or aspects of nutrition often mentioning their personal experience.

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

Only the research team in the UK found health organisations (e.g. hospitals, public health services) in their scoping search (n=3). These actors shared explanations on nutrition and healthy diets on their websites and they used images of food or infographics. They often referred to the Public Health England *Eatwell* guide.

Academic institutions and academics

The Dutch research team found universities (n=2), scientific societies (n=1), research centres (n=2) and research funding bodies (n=1) that posted articles explaining healthy eating on their websites. The scientific society also shared news on nutrition research on Twitter, and one of the research centres used Twitter and Instagram to share explanations. One of the universities did not communicate about healthy diets on its website, but it curates a podcast where they interviewed experts on the subject. In the British landscape, the scientific society found in the scoping study communicated on websites in the same way as the Dutch one, and included images and infographics on healthy food and diets. The research centre shared mostly news rather than explanations.

In the Netherlands, the scientists found mostly used Twitter and they shared news articles as well as their personal or professional opinions on the subject (5, n=7). One of them curated a podcast and YouTube channel as well, where they explained nutrition and healthy eating. In the UK, scientists used Twitter (3, n=4). They did not post only news articles but also debunked misinformation and explained nutrition facts. One of these actors, blogged and used Instagram to share recipes, pieces of advice, their daily life nutrition habits and information about healthy eating.

Advocacy organisations and activists

In the Dutch digital landscape, the actors identified as NGOs, foundations and think tanks (n=12) used mainly websites (8), Twitter (6), and to lesser extent Instagram (2), YouTube (1) and Facebook (1). They debunked misinformation on diets, explained nutrition facts and shared news more or less on all these platforms, but they advocated for healthy eating only on websites, Twitter and Instagram. The British NGOs, foundations and think tanks found (n=5) mostly posted explanations, features and news articles on websites (5) and blogs (2), and shared images, infographics, videos and charts. One of these actors ran its campaigns on YouTube, Twitter and Instagram, and offered tips, explanations and interactive quizzes on its website.

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

The Dutch research team found one activist in their landscape, who shared news on Twitter to increase awareness of healthy nutrition. The Italian team found some activists as well (n=11), who shared information about nutrition on websites (4), Instagram (3), Facebook (2) or blogs (2).

Governments and policy makers

The local and national governments found in this study had a section on their websites about healthy eating. The British ones (n=4) often repeated the *Eatwell* guidelines provided by Public Health England, accompanied by the same pie charts or infographics about the recommended intake of nutrients. Unlike their UK counterparts, the Dutch governments (n=4) share explanations, but also news articles about nutrition. Only one policy maker was found, sharing news updates on healthy eating on Twitter in the Dutch digital landscape.

Businesses and entrepreneurs

Businesses tended to use different platforms depending on the country. In the Dutch digital landscape, businesses (n=12) mainly used websites (6), Instagram (5) and blogs (3). They provided news updates, advice and tutorials on healthy eating, and debunked food myths. Only one of these actors also used YouTube and Facebook for communicating about nutrition. In Italy, these actors used mostly Twitter, and shared news articles (4, n=7). Only a few of them shared news or explanations on blogs, websites, Facebook, YouTube or Vimeo (one each). In the British landscape, businesses (n=11) used blogs (6), but also websites (3), Facebook (3) and Instagram (3), and to lesser extent Twitter (2), YouTube (1) or podcasts (1). These actors shared infographics only in the explanations published on their websites, while they posted tutorial videos on social media. Business accounts often published news, features, and articles debunking diet myths or explaining healthy eating. On Instagram and Facebook, they tended to write narrative captions rather than explanations.

Only the British scoping team identified entrepreneurs as actors in the digital landscape, who owned gyms or companies selling supplements for fitness. These two actors debunked misinformation and shared news updates on nutrition. One of them used Twitter whereas the other used Instagram and Facebook, where they hosted a live Question & Answer session on healthy eating with their followers.

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

Media organisations and journalists

Media organisations mostly shared news and features articles with photos or videos of food. In the Italian digital landscape, most of those found posted articles on their websites (9), while others curated blogs (2), podcasts (3), or YouTube channels (1) about healthy diets (n=13). One of the podcasts used storytelling to communicate healthy eating. In the Netherlands, some media organisations had a website (5) and/or a podcast (4), and only two of them had either a Facebook page or a blog (n=9). These actors shared news and features as well as explanations, and one of them managed a forum where readers could discuss the topic. In the British digital landscape, media organisations tended to use websites (10 out of 10). Some of them had accounts on Facebook and/or Twitter (2 each, n=10), where they shared their articles. On Instagram, these actors shared mostly recipes or photos of food, but no information on nutrition.

Only in the scoping teams in the UK and the Netherlands were journalists found communicating about healthy diets (1 and 2, respectively) in this mapping. The two Dutch journalists curated a podcast each, where they explained about nutrition; the British one shared news on healthy eating on Twitter. There were more journalists talking about food on Twitter in the British digital landscape, but their posts focus only on either recipes or the food industry; therefore, they were not included in the results.

Non-professional communicators, support communities and online video makers

In the Dutch digital landscape, the non-professional communicators found (e.g. fitness coaches; n=16) communicated about healthy diets on websites (7), Instagram (5), Facebook (3), Twitter (3) and/or blogs (2). They mostly shared explanations and advice, but also personal or professional opinions, features, and news articles on healthy diets. In the UK, non-professional communicators (n=10) tended to use Facebook (9) and Instagram (6) more than those in the Netherlands. Some of them used Twitter (6) but often for self-promotion or they reposted the content shared on Instagram. A few of them had a websites (2), blog (3) and/or YouTube channel (3) as well (n=10). Only one of the non-professional communicators found curated a podcast, where they interviewed experts on a specific topic or give advice on certain aspect of healthy diets. On Instagram and Facebook, these actors frequently shared photos, videos, drawings, infographics, charts and screenshots of articles or social media posts. Photos and videos were often of food or themselves, and their posts covered personal stories and their everyday eating, explanations and tips on healthy eating, comments to news articles, debunking and/or making fun of (mis)information. Some non-professional communicators also shared features and news articles on their website or blog. One actor debunked misinformation on

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

nutrition on Twitter, instead of Facebook and Instagram, and even hosted a regular poll on the 'best' food/diet myth for their followers to make fun of.

In Italy, the support communities found (n=8) either shared news and personal/professional opinion on healthy diets on Facebook (3) or discussed news on nutrition on the forum Quora (5). In the Netherlands, support communities tended to explain facts and shared tutorials about healthy diets on either websites or blogs (one each, n=2).

The actors identified as online video makers shared videos on YouTube, where they vlogged explaining facts on nutrition or giving pieces of advice on healthy eating (1 in the UK, 2 in the Netherlands and 2 in Italy).

Summary

The healthy diets communication landscape was diverse in the types of actors and types of content. As in the case of climate change, both institutions and individuals, and traditional and non-traditional experts (e.g. health practitioners and non-professional communicators) were common. In this landscape, media organisations and businesses were as common as in the artificial intelligence digital landscape. Among individuals, health practitioners and non-professional communicators had the highest visibility online.

The type of shared content differed from the two previous case studies. Narratives and personal stories were recurrent whereas news and features were less frequent. Unlike climate change communication where Twitter was the most common platform, for healthy diets, Instagram and Facebook were. YouTube was used to communicate about this topic more often than in climate change as well, especially by health practitioners and non-professional communicators who curated a vlog on healthy eating.

As in the climate change and artificial intelligence landscapes, academic institutions, local and national governments, and health organisations posted news and articles explaining nutrition on their websites. Media organisations also did not change the way they communicate about the topic: they published news and features on their websites, and in the Italian digital landscapes, they curated podcasts. Journalists and scientists used Twitter to share links to news, especially those found in the British digital landscape. As in the case of climate change, scientists also debunked misinformation on healthy eating and explained nutrition. Support communities discussed facts about healthy diets and news in the same platforms that were used to converse about artificial intelligence, such as Facebook and Quora.

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

Advocacy organisations, businesses, non-professional communicators and health practitioners were the only actors who shared several different types of content and formats. Especially health practitioners and non-professional communicators who debunked misinformation, explained nutrition facts, gave advice and tutorials on eating a healthy diet, shared news and features, personal stories, personal and professional opinions, and even their eating habits. These actors shared a broad range of formats, in particular on Instagram and Facebook, such photos, videos, drawings, infographics, selfies, charts, screenshots of articles or posts and even Internet memes. More than websites and blogs, they used social media and podcasts to explain nutrition through their everyday life. All these formats enriched the communication about healthy diets, and competed to catch the attention of publics.

Even more than in the climate change digital landscape, in the online communication about nutrition experts and non-professional communicators compete to reach online audiences. Both claimed to debunk misinformation about healthy diets, and showed their everyday lives and eating habits as examples to follows. Narratives and personal stories are suited for the platforms used (Instagram and Facebook), and they can also influence public intentions to eat a healthy diet (Perrier and Martin Ginis, 2018). The way health practitioners and non-professional communicators communicate about nutrition is similar, but the quality of information or the impact on their audiences may be different.

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

Chapter 4: Conclusions

The scoping study shows how complex the online science communication landscape is: there were large differences in the actors, platforms used and shared content between science subjects, though there was less diversity amongst the seven countries studied.

The breadth of actors involved in communicating climate change was the widest across case studies. Among these actors, NGOs, foundations, think tanks, scientists, journalists, activists and local or national governments were particularly dominant in the digital landscape in most countries. Businesses and support communities were common in the artificial intelligence digital landscape, whereas health practitioners and non-professional communicators dominated the online communication about healthy diets. Media organisations were the only actors highly visible in each case study.

Different actors shared different content. For example, NGOs and non-profit organisations focused on news and advocacy campaigns oriented toward taking action against climate change, whereas governments explained climate change impact on the territory and the actions taken to tackle the problem. In some cases, the nature of communication varied with the topic as well: non-profit organisations raised awareness and hosted informative discussions in artificial intelligence rather than campaigning in favour or against it.

Each digital platform has its own social environment and dynamics, thus actors applied different communication strategies depending on the platform (Plume, Dwivedi and Slade, 2016). It was apparent in this mapping that communicators appeared to be aware of and were planning their communication efforts differently, depending on the communication platform used. For example, Twitter is suited for the dissemination of news updates (Kwak *et al.*, 2010), especially about climate change research findings and policies. Instagram, instead, is an image-based platform where eye-catching photos of food or the actors' daily life and narrative captions can convey information on healthy diets (Saboia *et al.*, 2018). Platforms such as Quora and Facebook offer a space for discussing artificial intelligence. Finally, independent of the topic, websites and blogs are tailored to sharing features, comments and news articles whereas podcast and YouTube are suited for explanations, narratives and tutorials. However, there were also examples of communicators sharing content over multiple platforms, with little adaptation, for example around healthy eating.

The variety of actors changed across case studies, with climate change offering the most diverse landscape of sources of information. Artificial intelligence was the only one with fewer actors and also more institutions than individuals communicating about the topic. This could be due to the relative novelty of artificial intelligence. Healthy diets had many different sources of

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

information, but it was more difficult to define whether the information they shared was accurate or not.

The diversity of actors and content about climate change, artificial intelligence and healthy diets implies a diversity of sources of information. These actors were not only traditional experts (e.g. scientists, health practitioners) or mediators (e.g. journalists), but alternative sources of information as well (e.g. non-professional communicators, support communities). Since both traditional and alternative sources of information were visible online, it is likely that online publics consult both when seeking news or facts about climate change, artificial intelligence or healthy diets. Moreover, the broad range of platforms and formats used especially by advocacy organisations, activists, and non-professional communicators could allow these actors to reach a wider audience online.

Having a diverse and rich digital landscape could enrich the communication and conversation about climate change, artificial intelligence and healthy diets. However, without the expertise needed to distinguish factual information from misinformation, and by trusting any sources of information, misinformation and misconception could potentially be common and be disseminated online (ALLEA, 2019).

The mapping research has limitations but is foundational to the RETHINK project and its findings will help to inform future phases of it. The mapping points to the need to involve the true breadth of science communicators that inhabit the digital realm in these future phases. This includes the RETHINK research investigating the barriers and opportunities faced by communicators and the connections they forge with their audiences. With this in mind, the digital mapping provides a useful resource of science communication actors, both individuals and institutions that can be employed in RETHINK as well as other research projects. The results of the mapping process also demonstrate the need to explore how the opportunities afforded by specific online platforms can be harnessed to benefit the communication of science.

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

References

ALLEA (2019) Trust in Science and Changing Landscapes of Communication [online] p. 20. Available from: https://www.allea.org/working-groups/overview/truth-trust-expertise/ [Accessed 21 February 2019].

Arksey, H., and O'Malley, L. (2005) Scoping Studies: Towards a Methodological Framework. International Journal of Social Research Methodology. 8 (1). Pp.19-32.

Burns, T.W., O'Connor, D.J., Stocklmayer, S.M. (2003) Science Communication: A Contemporary Definition. Public Understanding of Science. 12 (2). Pp. 183-202.

Collins, K., Shiffman, D., Rock, J. (2016) How Are Scientists Using Social Media in the Workplace? PLoS ONE. 11 (10). Available at: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0162680

Davies, S.R. and Hara, N. (2017) Public Science in a Wired World: How Online Media Are Shaping Science Communication. Science Communication. 39 (5). Pp. 563-568.

European Commission (2007) Special Eurobarometer report: Scientific Research in the Media. Brussels: European Commission.

Fahy, D., Nisbet, M.C. (2011) The Science Journalist Online: Shifting Roles and Emerging Practices. Journalism. 12(7). Pp. 778-793.

Frost, C. (2010). *Reporting for Journalists.* London: Routledge.

Gallup (2019), Wellcome Global Monitor – First Wave Findings. Available at: https://wellcome.ac.uk/sites/default/files/wellcome-global-monitor-2018.pdf

Gerbaudo, P. (2012) Tweets and the Streets: Social Media and Contemporary Activism. London: Pluto Press.

Grimshaw, J. (2019) A Guide to Knowledge Synthesis. Canadian Institutes of Research Health. Available online: http://www.cihr-irsc.gc.ca/e/41382.html [Accessed on 20/09/19]

Ipsos MORI (2014) Public Attitudes to Science 2014. Available at: https://www.ipsos.com/sites/default/files/migrations/en-uk/files/Assets/Docs/Polls/pas-2014-main-report.pdf

Klassen, K.M., Borleis, E.S., Brennan, L., Reid, M., McCaffrey, T.A. and Lim, M.S. (2018) What People "Like": Analysis of Social Media Strategies Used by Food Industry Brands, Lifestyle

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

Brands, and Health Promotion Organizations on Facebook and Instagram. *Journal of Medical Internet Research*. 20 (6), pp. e10227. doi:10.2196/10227.

Kwak, H., Lee, C., Park, H. and Moon, S. (2010) What is Twitter, a Social Network or a News Media? In: Proceedings of the 19th International Conference on World Wide Web WWW '10 [online]. 2010 New York, NY, USA: ACM. pp. 591–600. Available from: http://doi.acm.org/10.1145/1772690.1772751doi:10.1145/1772690.1772751.Lee, N.M., VanDyke, M.S. (2015) Set It and Forget It: the One Way Use of Social Media By Government Agencies Communicating Science. *Science Communication.* 37 (4). Pp. 533-541.

Newman, T.P. (2017) Tracking the release of IPCC AR5 on Twitter: Users, comments, and sources following the release of the Working Group I Summary for Policymakers. *Public Understanding of Science*. 26 (7), pp. 815–825. doi:10.1177/0963662516628477.

Owen, D., Featherstone, H., Leslie, K. (2016) The State of Play: Public Engagement with Research in UK Universities. Research Councils UK and Wellcome Trust.

Pearce, W., Niederer, S., Özkula, S.M. and Querubín, N.S. (2019) The social media life of climate change: Platforms, publics, and future imaginaries. *Wiley Interdisciplinary Reviews: Climate Change*. 10 (2), pp. e569. doi:10.1002/wcc.569.

Perrier, M.-J. and Martin Ginis, K.A. (2018) Changing health-promoting behaviours through narrative interventions: A systematic review. Journal of Health Psychology. 23 (11), pp. 1499–1517. doi:10.1177/1359105316656243.

Pilgrim, K. and Bohnet-Joschko, S. (2019) Selling health and happiness how influencers communicate on Instagram about dieting and exercise: mixed methods research. *BMC Public Health*. 19 (1), pp. 1054. doi:10.1186/s12889-019-7387-8.

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

Su, L.Y-F., Scheufele, D.A., Bell, L. (2017) Information-Sharing and Community Building: Exploring the Use of Twitter in Science Public Relations. *Science Communication*. 39(5), Pp. 569-597.

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

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

Plume, C.J., Dwivedi, Y.K. and Slade, E.L. (2016) *Social Media in the Marketing Context: A State of the Art Analysis and Future Directions*. Waltham, MA: Chandos Publishing.

Saboia, I., Pisco Almeida, A.M., Sousa, P. and Pernencar, C. (2018) I am with you: a netnographic analysis of the Instagram opinion leaders on eating behavior change. *Procedia Computer Science*. 138 pp. 97–104. doi:10.1016/j.procs.2018.10.014.

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

Appendix 1

Inclusion/Exclusion criteria for the landscape mapping

Inclusion criteria

- Include only digital content: Internet users can find and interact with this content online (e.g. by sharing, commenting, liking, downloading, etc.).
- Include content and Internet users (institutions and individuals) that are relevant to one of the topics of the project (i.e. Climate Change, Artificial Intelligence, or diets/nutrition). These users communicate the relevant topics online, not *how* to communicate them.
- Content that is factually incorrect but covering science should be INCLUDED.
- Include content that can be found through a search engine (e.g. Google, Yahoo) or by searching one of the listed platforms (see Glossary, *Platforms* section).

Exclusion criteria

- Exclude content written by those commenting on how science should be communicated (e.g. content on science of science communication, or research in science communication).
- Exclude content written by scholars for scholars. Exclude content related to academic lectures, conferences, and publications (e.g. scientific papers, postgraduate dissertations).
- Exclude content aimed at an audience of children.
- Exclude content from institutions that is not communicating research – so incidental mentions of science-related topics such as climate change would be excluded, as would the pages of institutions that describe the types of research they and their research centres do and the biographical pages of researchers. Also excluded is political commentary that may be science related and protests.
- Exclude content that is not expressly aiming to communicate research/information related to one of the topics of the study.
- For each country undertaking the mapping, identify communicators (institutions and individuals) that are based within that country. Include only communicators who undertake at least some communication in the local language. For example: in the case

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

of Serbia, only include science communicators who are based in Serbia and undertake at least some of their science communication activities in Serbian. In the case of the UK, only content written in English and published in the UK will be considered.

- Exclude content that can be found only by using specific tools and software packages. These tools and packages can retrieve online data easily and efficiently, but they are often very expensive or difficult to use without high technical skills.
- Exclude content that would require a subscription to view or must be purchased to view (e.g. news that is behind a newspaper paywall, apps which must be purchased).
- Exclude content that would require a download to view (e.g. apps) and cannot be accessed through a Search engine.

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

Appendix 2

Mapping Protocol

Each of the following steps should be taken for each topic (i.e. case study). Please, follow the protocol step by step so that all of us will carry out the scoping study in the same manner. This is particularly important to make the scoping study systematic.

If you find an individual or institution in a way that is not included in the protocol (e.g. you know them through your contact network or you found them through a web link), please do not include them and send us a note.

At the Kick-Off meeting in February 2019 we decided to explore three topics: **Artificial Intelligence**, **Climate Change**, and **Healthy Diet**. You can choose two of these topics that are best suited to your context.

You will need to run through the scoping study protocol for each of the topics you choose. Every time you do this, please follow each step of this protocol. The diagram below provides an overview of the several steps you will need to take.

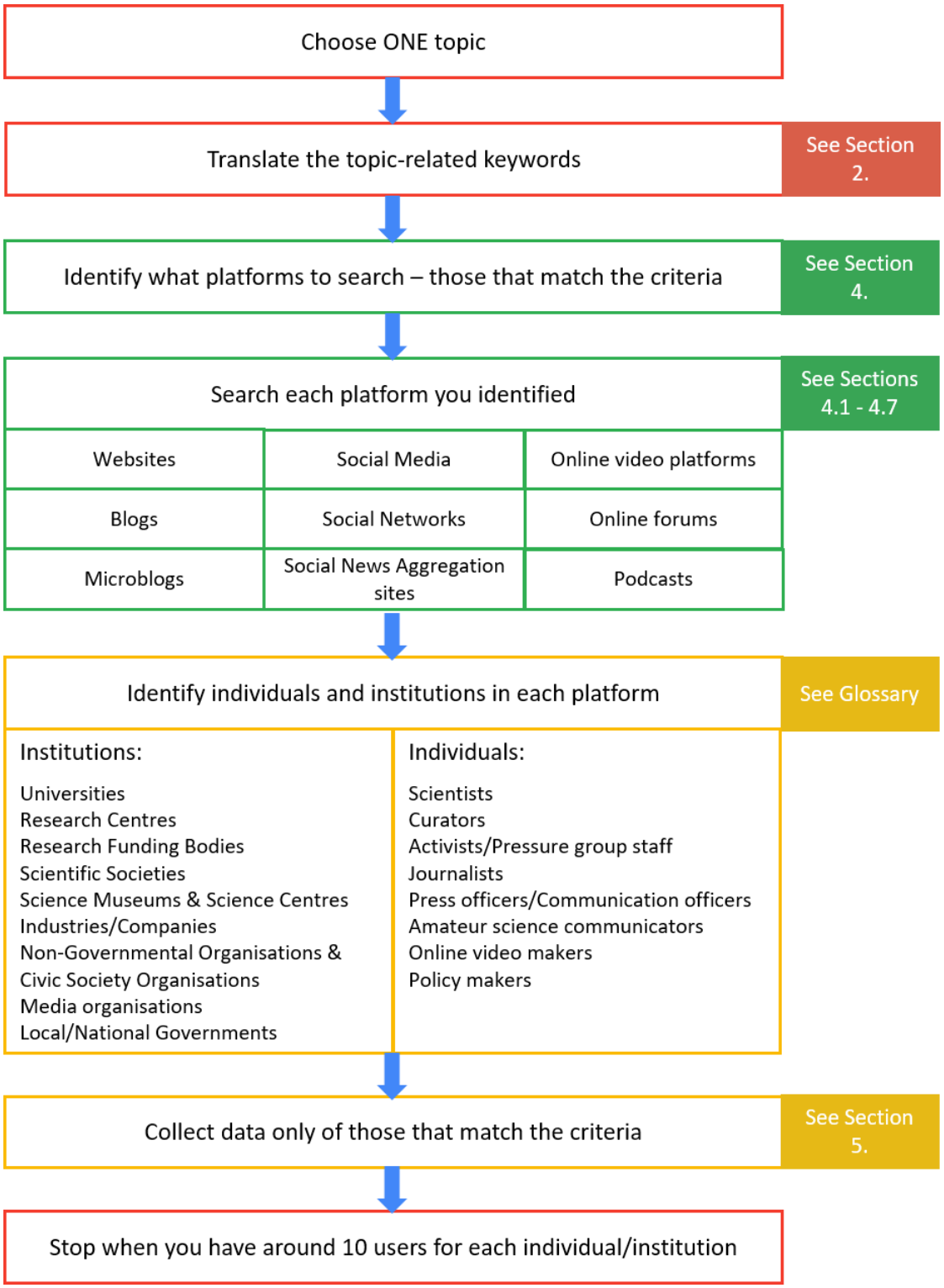
1. Data collection period

The scoping study will be carried **from the 6th of May to the 14th of June**. During this time, search for each topic on different platforms (see Section 4) and identify the potential individuals and influencers that communicate the topic online (see Section 5). You can include data generated before the collection period (e.g. users' accounts or websites/blogs launched before 2019).

Because the scoping study period does not include holidays (e.g. Easter, summer), it should not be influenced by these events. However, the amount of content shared may vary depending on the occurrence of topic-related events (e.g. approval of a new environmental policy to tackle climate change, AI summit, etc.). Hence, users that do not usually talk about the three topics may publish content on them. If an event or issue happens within your country, which is likely to have a significant impact on the data collected, please report this back to us as a research note.

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

Overview of scoping study process



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

2. Select the keywords

Choose a topic, and then translate the provided **keywords** into your language. If you already know a keyword that is often used in your country to communicate about a topic online, but it is not listed, you can add it to your set. If you do so, please send us a note with the keyword and its English translation.

Keywords for the topic *Climate Change*:

- Climate change
- Global warming

Include any content that considers the causes or implications of climate change on the environment, the economy, policies and society. Including content that disputes the causes.

Exclude content that mentions climate change incidentally, but does not focus on the science of climate change. For example, content that criticises a government's environmental policies but does not provide any information on the processes behind climate change should be excluded. As should content that discusses the fossil fuel industry or green energy development without mentioning their role in climate change.

Keywords for the topic *Artificial Intelligence:*

- Artificial Intelligence

Artificial Intelligence is broadly defined as the study and development of computer systems that have the ability to perform tasks commonly requiring human intelligence, such as interpreting the content of photographs, language understanding, translating between languages, decision-making and problem-solving.

When mapping, include content that discusses what Artificial Intelligence is, its implications and how the technology is developing.

Include content about the applications of Artificial Intelligence only if the role of Artificial Intelligence is discussed and not just mentioned.

Include content on the implications of Artificial Intelligence on society, the economy, relevant policies and the implications for privacy only if the role of Artificial Intelligence is discussed and not just mentioned.

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

Exclude content that does not focus on Artificial Intelligence or that mention Artificial Intelligence incidentally (e.g. content that talks about how robots will take people's jobs without mentioning artificial intelligence).

Exclude online courses, university courses and webinars on Artificial Intelligence.

Keywords for the topic *Healthy Diet:*

- *Healthy eating*
- *Healthy diet*
- *Healthy nutrition*

Include content that discusses healthy nutrition and eating healthy.

Exclude content related to eating disorders, food safety and regulations, the food industry, farming and fresh food.

3. Before starting the search

Before carrying out your search, go to your browser's settings, and clean your search history. It would be even better if you could use a browser that you have not used before and that does not have any bookmarks (e.g. webpage saved). This step is particularly important because Google and other search engines use your previous searches and visited websites, blogs and social media sites to refine your future searches. For example, if you already visited or bookmarked websites on *climate change*, Google would show those websites first when you search for information on climate change. So if your search history isn't cleared, it would mean that your results would be influenced by what you have searched for previously rather than purely the key words you are using now.

You should clear your history before starting the search for any new topic. To clean your search history, follow the steps below.

If you use Explorer:

1) Click on the icon "Tools" on the top right (the one that looks like a cog)
2) Select "Safety" from the menu
3) Select "Delete browser history"
4) Tick all the boxes and then click on "Delete"

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

If you use The Edge:

1) Click on the icon with three dots "…" on the top right
2) Select "History" from the menu
3) Click on the "clean history", on the top right
4) Tick all the boxes and then click on "Clear"

If you use Firefox:

1) Click on the icon with three horizontal lines "≡" on the top right
2) Select "Library" from the menu
3) Select "History"
4) Select "Clear recent history…"
5) Tick all the boxes and select "Everything" on the top bar
6) Click on "Clear now"

If you use Chrome:

1) Click on the icon with the three dots (like this one "⋮") on the top right
2) Select "History" from the menu and then select "History" again; Chrome will open a new tab
3) Click on the icon with three horizontal lines "≡" on the top left
4) Select "Clear browsing data"; Chrome will show a pop up window
5) Select "Advance" on the top right of the pop up window
6) Tick all the boxes and then click on "Clear data"

If you use Safari:

1) Click on "History" on the top bar
2) Select "Clear History"
3) Select "Clear all history" from the menu

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

4. Select the platforms to map

You should search for Websites, Blogs, Online video platforms, Social Media, Social Networks, Social News aggregation sites, Microblogs, Online forums, and Podcasts related to the investigated topic. These outlets and sites are described in the Glossary, under the category *Platforms*. You should think about the potential platforms to search and check if they satisfy the inclusion criteria (see below) before conducting the scoping study.

You do not need to search all **platforms** available online for the topic. The platforms you should consider should satisfy the following inclusion criteria[14]:

- **Geographical reach**
  Include platforms that are known in your country. These platforms should be widely used by the people from your country.
  You can test the suitability of a platform as follows: pick one of the keywords and search the platform for that keyword. See whether it returns many results and whether those results seem to be relevant. If you struggle to find content in your language, then that platform may not be used in your language to discuss this topic and you should exclude it.

- **Type of facilitated communication**

  Include any platform that facilitates communication from one user to many, from many users to many other users (big networks), or from few users to few users (small groups).

- **Type of users**

  The users using the platform can have any background, social class, education level, ethnicity and gender. The platform should not exclude any group (though some groups may not use one medium and prefer another instead).
  The users can either have an interest in Science, Technology Engineering, Mathematics and Medicine (STEMM) or not. The platform can be focused on STEMM content sharing and discussion or not.

- **Format and content characteristics**

  Include platforms that facilitate sharing of textual, visual and audio content.

[14] These criteria are based on those for media selection stated in the chapter 'Content Analysis', from Hansen A, Cottle S, Negrine R, Newbold C (1998) *Mass Communication Research Methods*.

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

Exclude platforms that are educational channels (e.g. YouTube education) or strictly academic sites (e.g. ResearchGate, Google Scholar).

- **Accessibility and availability**

  Select platforms that allow you to search for their content and users for research purposes. If you cannot access and search the platform without having an account or, if you cannot find content written in your language or users from your country, do not include that platform. However, it would be useful if you reported this to us as a research note, even if it is not included in the data.
  It would be better if the platform offers an advanced search function. An advanced search offers the possibility to filter the search results and display only those that match specific criteria, such as language, country, etc. Google and Twitter have an advance search function.

4.1 Searching for websites

To search for websites, use Google advanced search.

You can access Google advanced search through this link. Otherwise, search Google for any word related to the topic; then go to "Settings" under the search bar (see Figure 1) and select the option "advanced search".

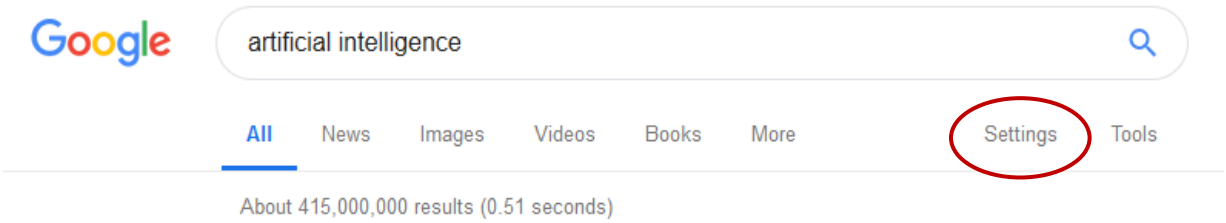


Figure 10

In the advanced search, fill the search box 'Any of these words' with the keywords you selected. Put the keywords formed by more than one word in quotation marks, for example "climate change".

Select your language under the search box 'Language' and your country under the search box 'Region'.

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

Figure 2 shows an example of how to complete the advanced search form. Once you have filled the form, begin the search.You may find results such as those in Figure 3. In the Figure, you can see that Google returned results such as a company's website, a governmental department's website, a scientific society's webpage, and two universities' webpages.

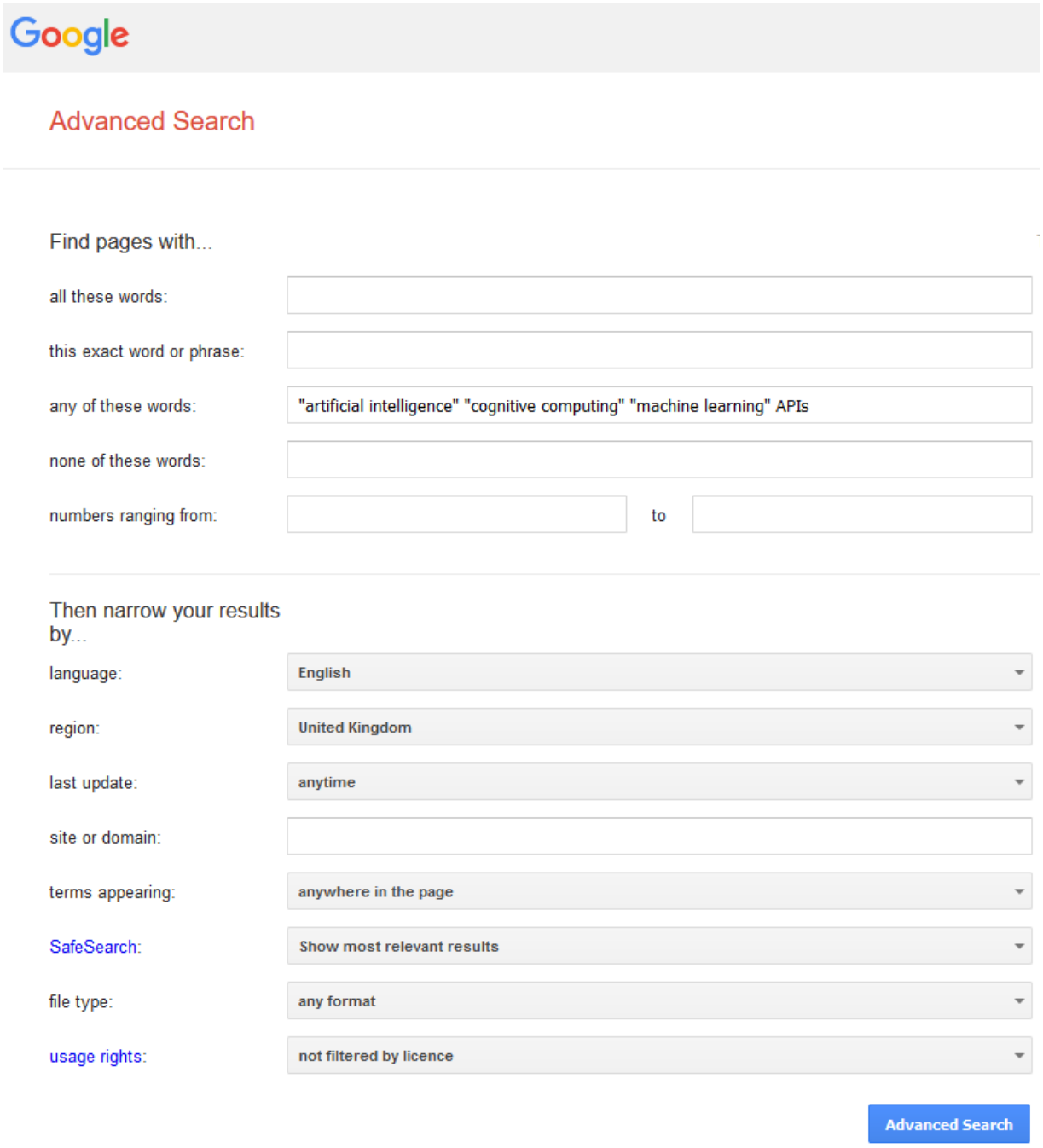


Figure 11

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

You will need to look at the first 10 pages at least. Look at the description of the webpages under the URLs, and click on the links when they are relevant to the topic. Check the webpage and see if the user (individual or institution) matches the criteria explained in Section 5.

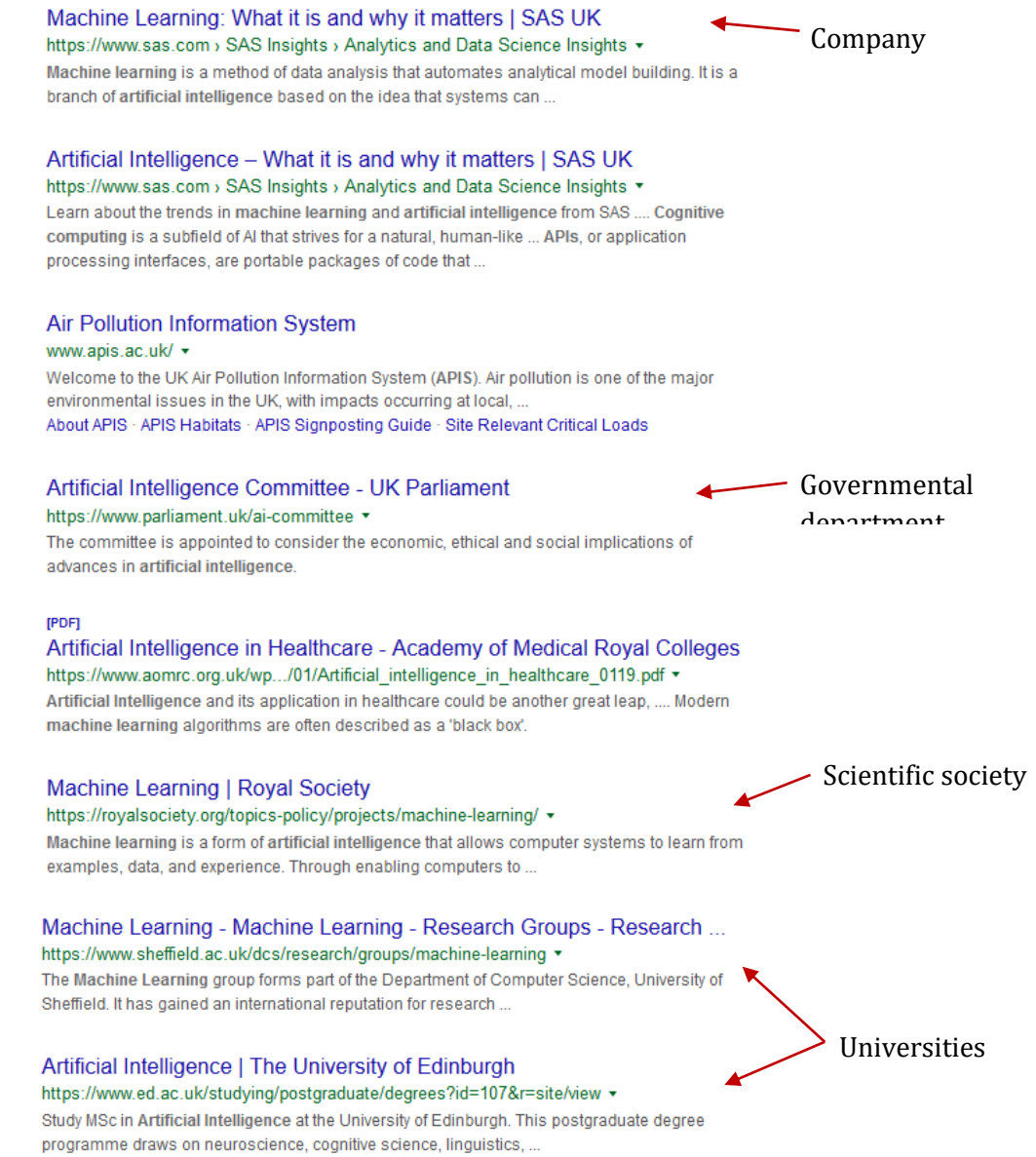


Figure 12

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

If your result stream shows only companies, shops, and enterprises in the first 10 pages, you can amend the search criteria to exclude these types of businesses. In this way, you will be able to find websites curated by individuals and other types of institutions. However, if you decide to run the search again excluding companies, please report this back to us as a research note.

To exclude companies, you need to set the search as it was before, and fill the search box 'none of these words' with all the terms that may indicate company or enterprise. Figure 4 shows an example of this type of advanced search. The asterisk "*" at the end of the word (e.g. enterprise* or compan*) tells Google to search for variations of the same word (e.g. enterprise and enterpriseS, or companY and companIES).

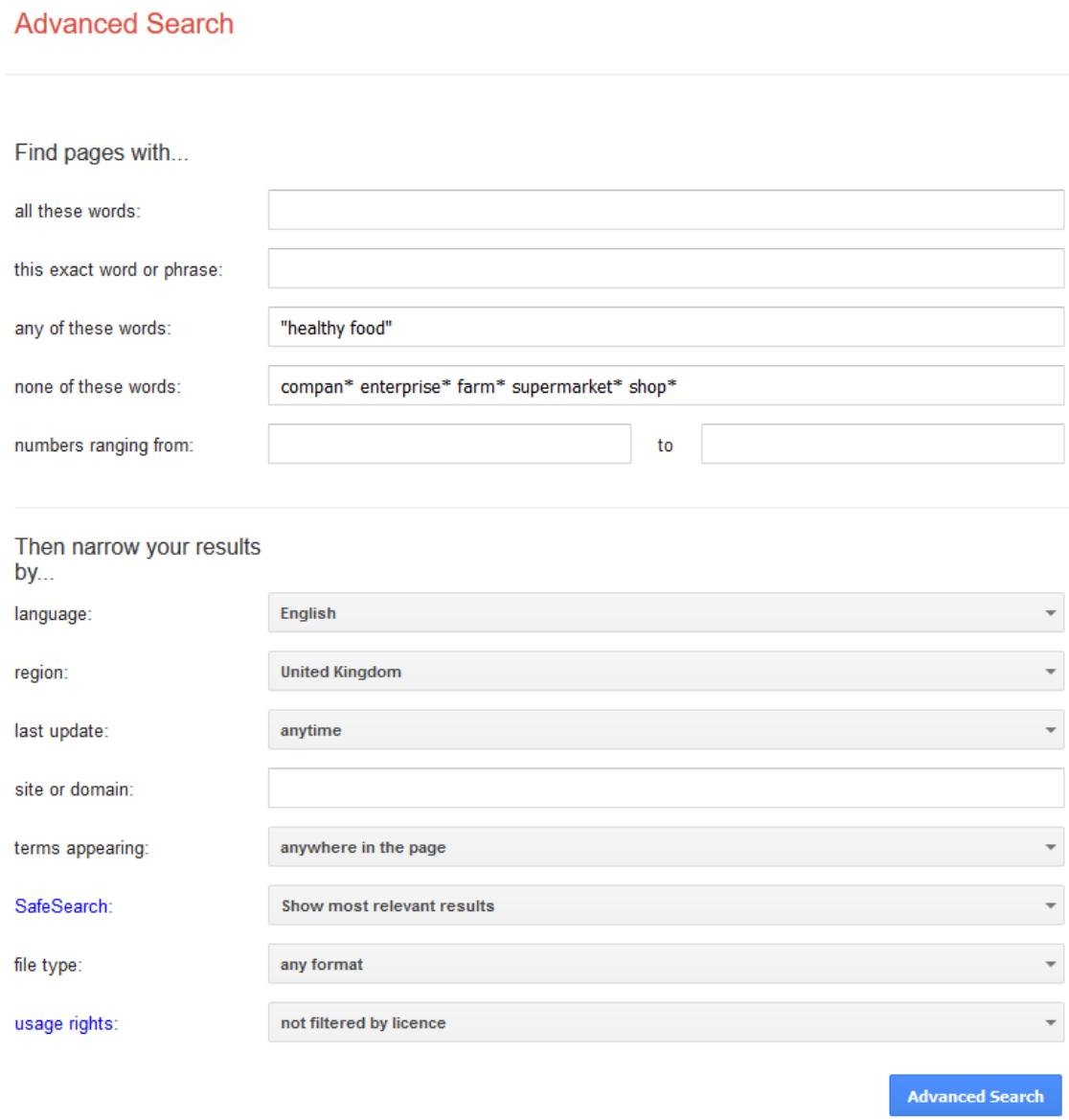


Figure 13

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

4.2. Searching for blogs

Use Google advanced search to search for blogs, and follow the steps below:

1) Fill the search box 'All these words' with the word "blog"
2) Fill the search box 'Any of these words' with the keywords you selected
3) Select your language under the search box 'Language'
4) Select your country under the search box 'Region'.

Figure 5 shows an example of how to complete the advanced search form. Once you have filled the form, run the search.

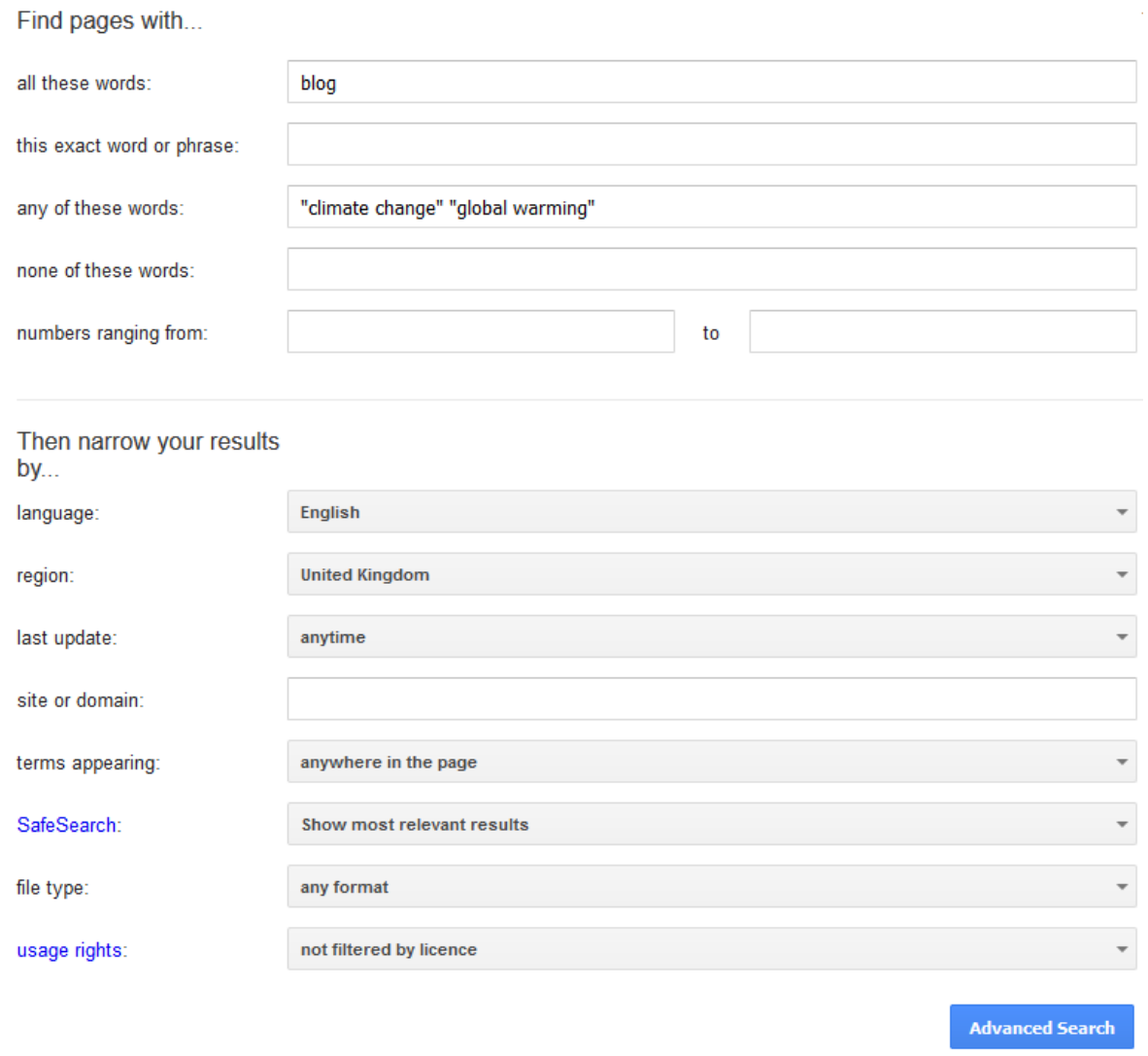


Figure 14

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

4.3. Searching social networks, social media and microblogging sites

To find individuals and institutions that share content on the chosen platforms, you can search these platforms or run a Google advanced search. Below, different types of searches are shown for Facebook, Instagram and Twitter.

These processes can be adapted to other platforms as well, and they all have the same three steps:

1) Search for the selected keywords
2) Set your language
3) Set the site or domain (see below).

Facebook

For example, to search Facebook content, you can run and Google advanced search as before (see Section 4.1) with a few adjustments. Fill the search box 'Any of these words' with the **keywords** you selected, then select **your language** and **your country**, and add "**Facebook.com/pages**" in the search box 'site or domain'.

Figure 6 shows the last part of the filled form.

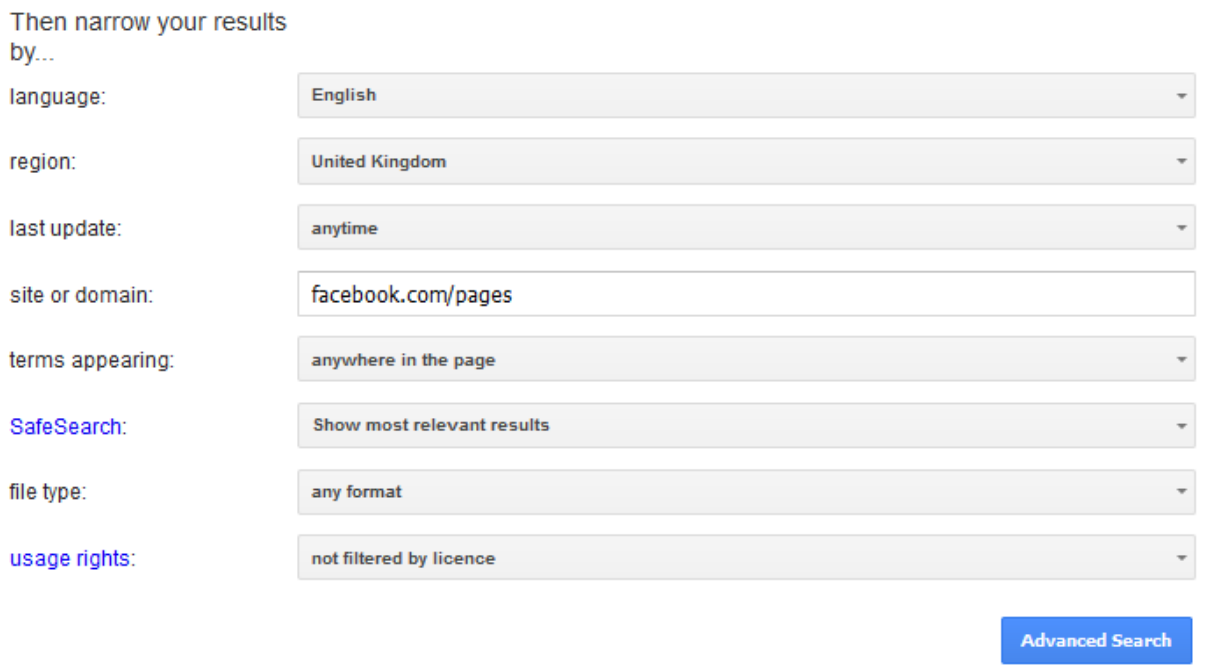


Figure 15

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

Searching for Facebook Pages will exclude events, groups and careers or advertising. However, it will also exclude profiles. Therefore, this search should be compensated by other types of search, such as trying to search Facebook itself (though this social network returns only profiles that have the queries in the title, not in the description or in other places).

If the Google search returns only Facebook pages related to companies and other businesses, modify the advanced search as followed:

1) Think about words that may mean 'shop', 'company', 'selling', 'enterprise' etc.
2) Add these words in the search box 'none of these words'
3) Run the search again (see Figure 7).

In this way, you will be able to remove commercial pages from your search, and to find other types of users.

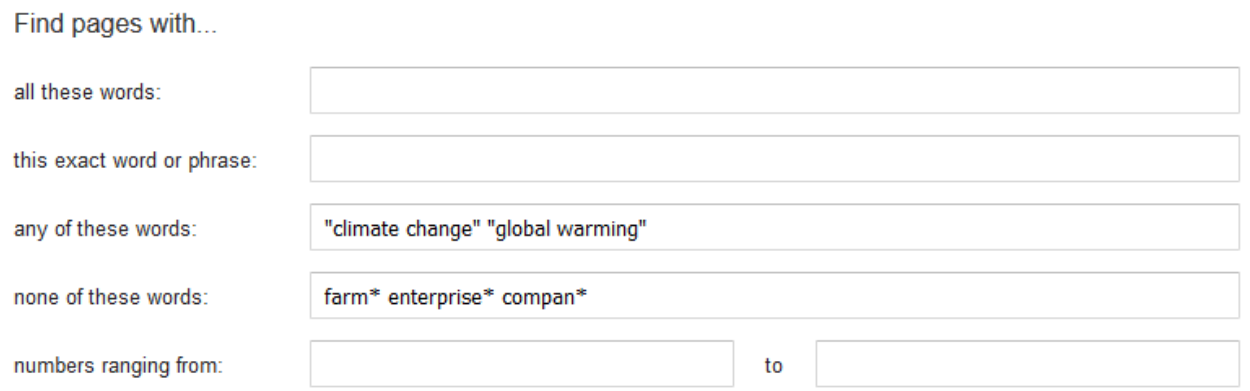


Figure 16

Instagram

Instagram has poor search settings, hence you should conduct your search on Google advanced search.

To search for Instagram users, follow these steps:

- Fill the search box 'This exact phrase' with "Instagram photos and videos"
- Fill the search box 'Any of these words' with the keywords you selected
- Write "inurl:explore" in the search box 'None of these words'
- Select your language
- Write "Instagram.com" in the search box 'site or domain'
- DO NOT select your country (see Figure 8).

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

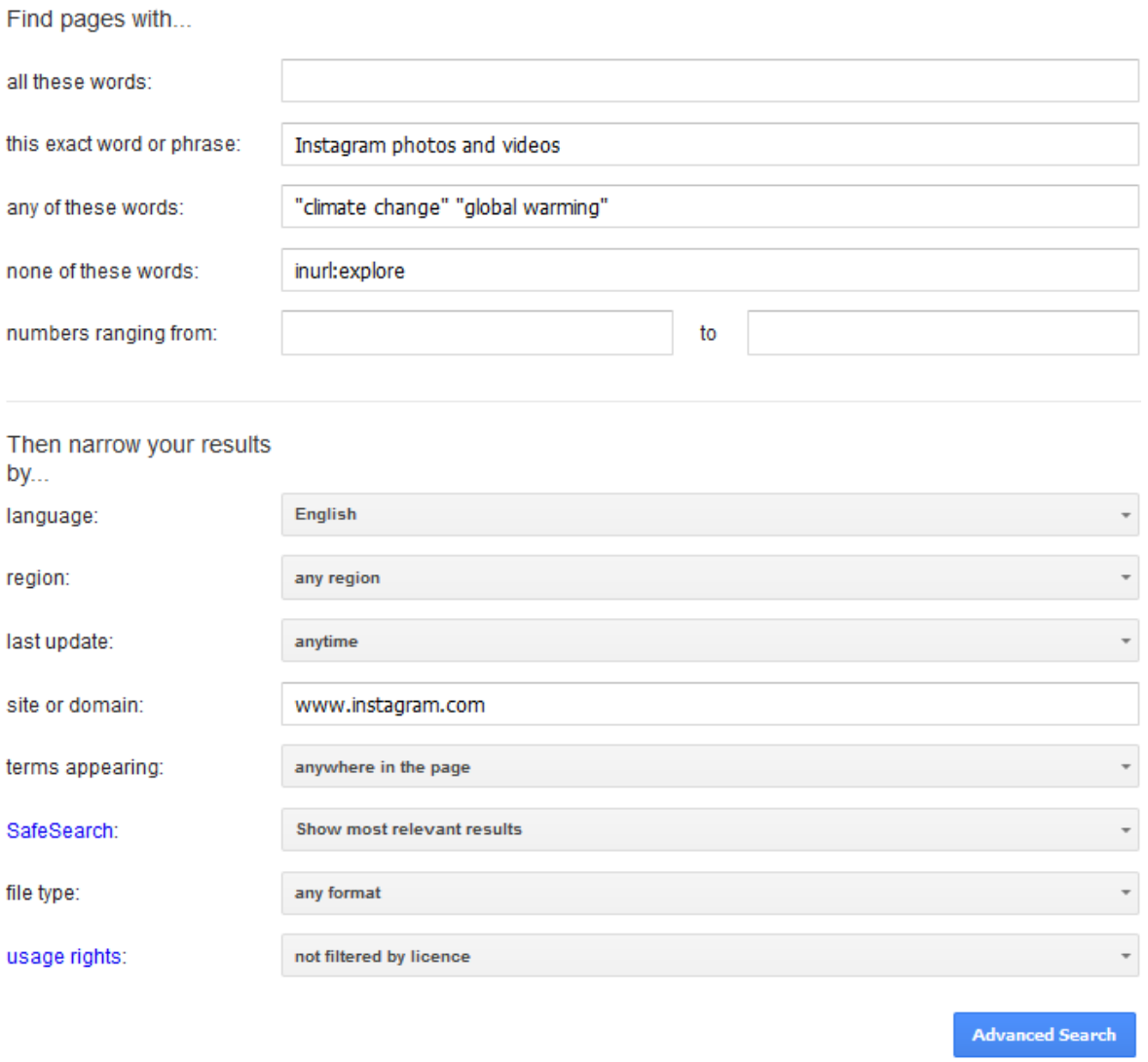


Figure 17

The phrase "Instagram photos and videos" is common on Instagram profile pages, and it will filter the results in order to display only the users' profiles, not the singles photos and videos they share.

By excluding the term "inurl:explore" you will exclude the suggestions offered by the function *Explore* on Instagram. This function shows the posts and profiles that could match the interests of the user conducting the search; hence it could show results that are out of topic.

Instagram does not have a version of the website for each country, like Facebook; hence, it is not possible to filter the results by country. For this reason, it is important to filter the results by language at least, and verify the location of the user (if available).

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

This search will return Instagram accounts that have the keywords in their name. Hence, it may exclude users who do not have these keywords in their name, but communicate about the topic

Using similar settings for the search, it is possible to search for Instagram posts on the topic. From these, you can explore the users that post them and decide whether to consider it a potential individual/institution for the mapping or not (see the criteria discussed at Section 5 for guidance).

To search for Instagram users, follow these steps:

- Fill the search box 'Any of these words' with the keywords you selected
- Write "inurl:p inurl:explore" in the search box 'none of these words'
- Select your language
- Write "Instagram.com" in the search box 'site or domain'
- DO NOT select your country (see Figure 9).

As mentioned before, Instagram does not have a version of the website for each country; hence, it is not possible to filter the results by country. For this reason, it is important to filter the results by language at least, and verify the location of the user (if available).

By excluding the terms "inurl:p" and "inurl:explore", you will exclude Instagram profile pages and posts shows in the Explore page, respectively. In this way, only Instagram posts are displayed in the results.

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

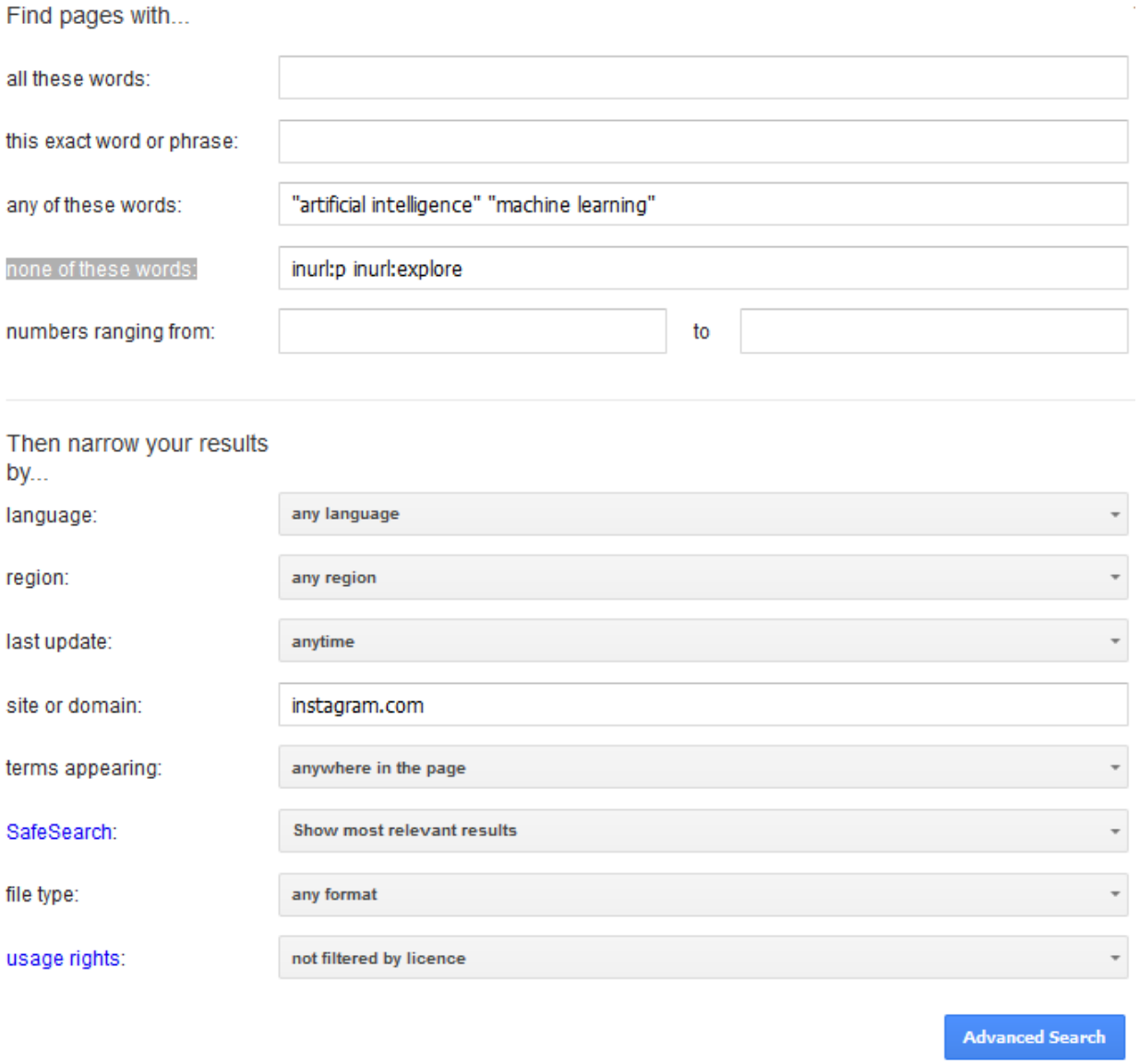


Figure 18

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

Twitter

There are two ways to find users on Twitter that should be combined. The first one includes the Twitter search, the second includes Google advanced search.

Before searching Twitter, write your query in a text file (e.g. Word document):

1) Write the keywords you selected and include in quotation marks those longer than one word. Separate each keyword with the operator "OR". You may want to use specific hashtags; for example, some English hashtags are #ArtificialIntelligence and #MachineLearning
2) At the end of the query, write lang: followed by the ISO 639-1 code of your language. You can find your code at this link. This operator filters the tweets returning only those written in your language
3) Copy and paste your query in the Twitter search bar and run the search.

An example query is the following: "artificial intelligence" OR #artificialintelligence OR #machinelearning OR "machine learning" lang:en

Some users may add specific words (e.g. artificial intelligence expert) or hashtags (e.g. #artificialintelligence expert) in their biography. Hence, by combining hashtags and key words in the search query you will be able to find either type of users.

After launching the search, select the option "People" from the bar on the top to see Twitter users tweeting about the topic specifically (see Figure 10).

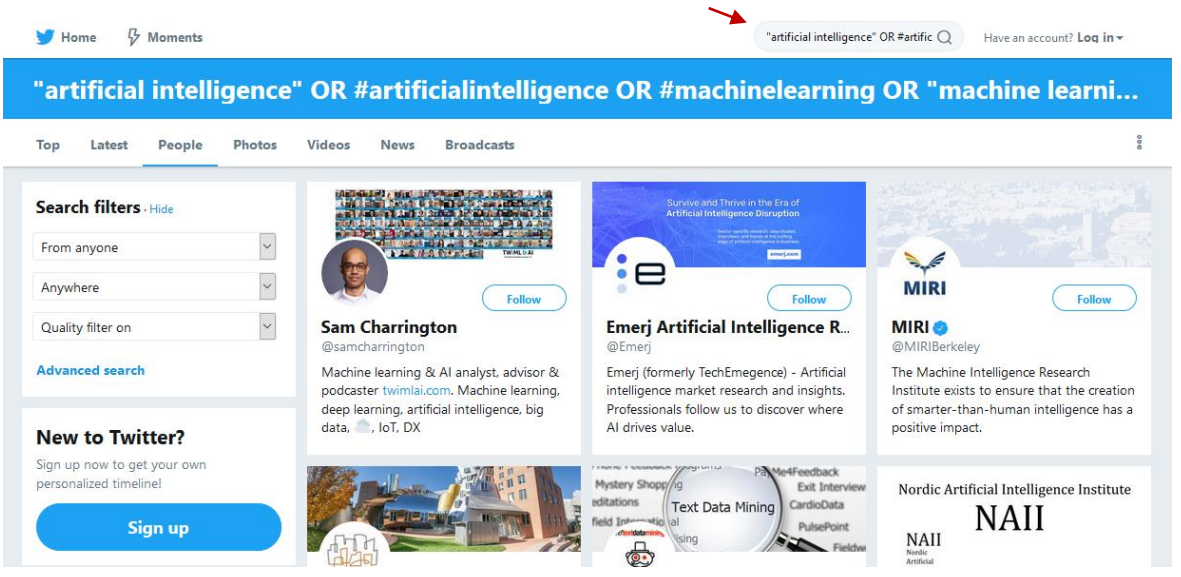


Figure 19

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

Not all users will have these keywords in their biography; hence, it may be difficult to find them in this way. Searching for a Twitter list can solve this issue.

Twitter lists are lists of actors posting content about a certain topic, and they are created by other users. To search for lists, go to Google advanced search, fill the search box 'Any of these words' with the **keywords** you selected, select **your language**, and add "**Twitter.com/*/lists**" in the search box 'site or domain' (see Figure 11). DO NOT select your country.

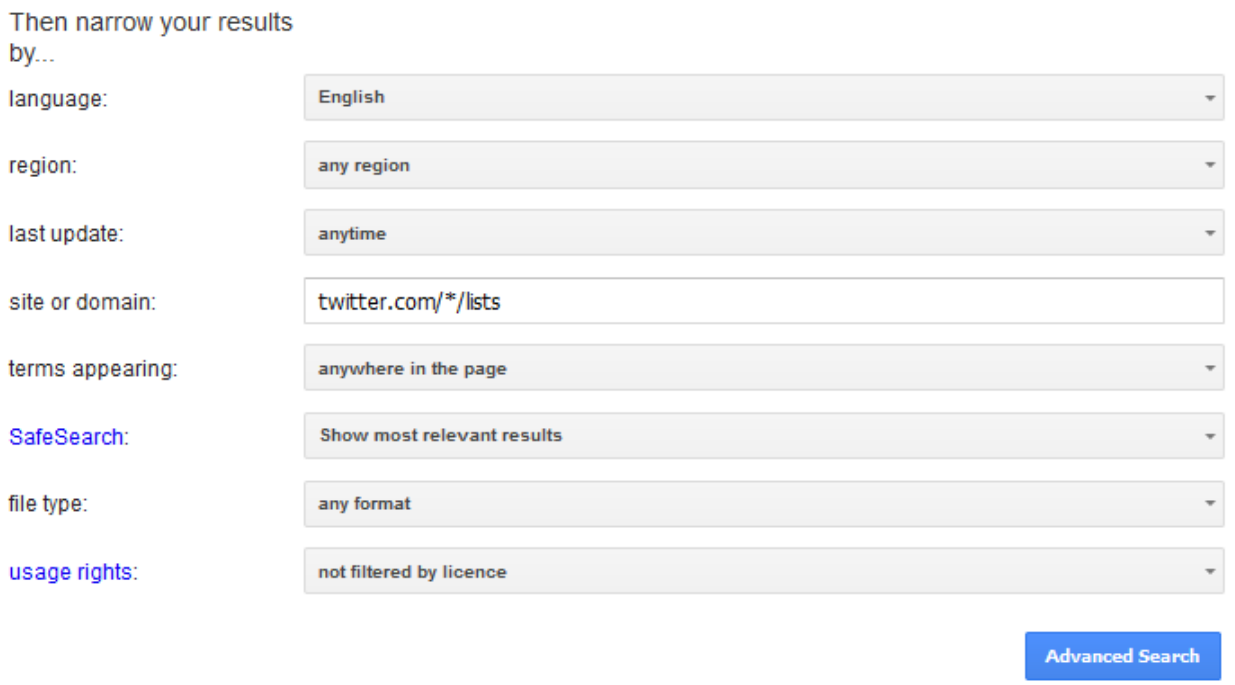


Figure 20

This search will return Twitter lists that you can explore. When you click on a list, then click on "members" to see the users that are included. Remember to select only users that tweet in your language. Figure 12 shows an example of a Twitter list found through this process.

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

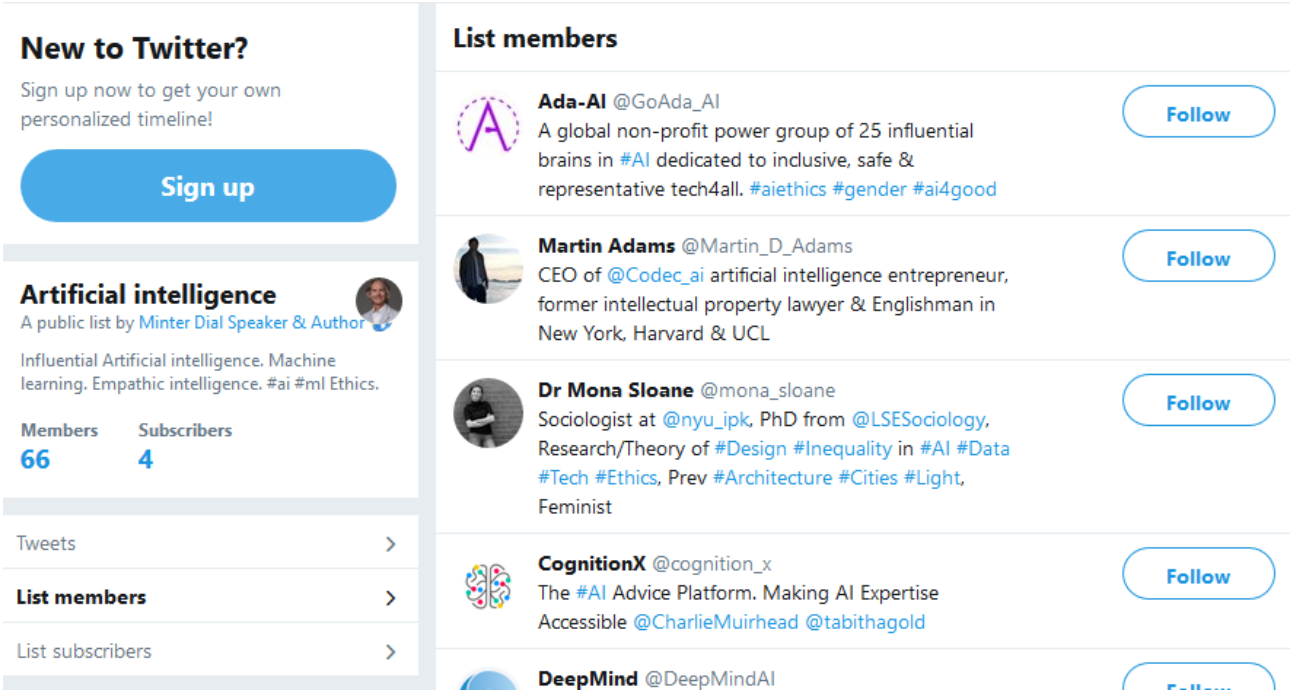


Figure 21

4.4. Searching online video platforms

To search for video platforms users there are two options. One is to search the platform itself and the other one is to use Google advanced search.

YouTube

On YouTube, write your keywords in the search bar, then click on filters. Select the search box "Channel" under 'Type', and "View count" under 'Relevance' (see Figure 13). In this way YouTube will visualise only channels (i.e. users) that have uploaded many videos and have many subscribers (followers).

You should type one or two keywords at time and run the search on YouTube. You can open more than one browser tab, each on YouTube, and run several different searches at the same time.

Figure 14 shows an example of the results found using this search.

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

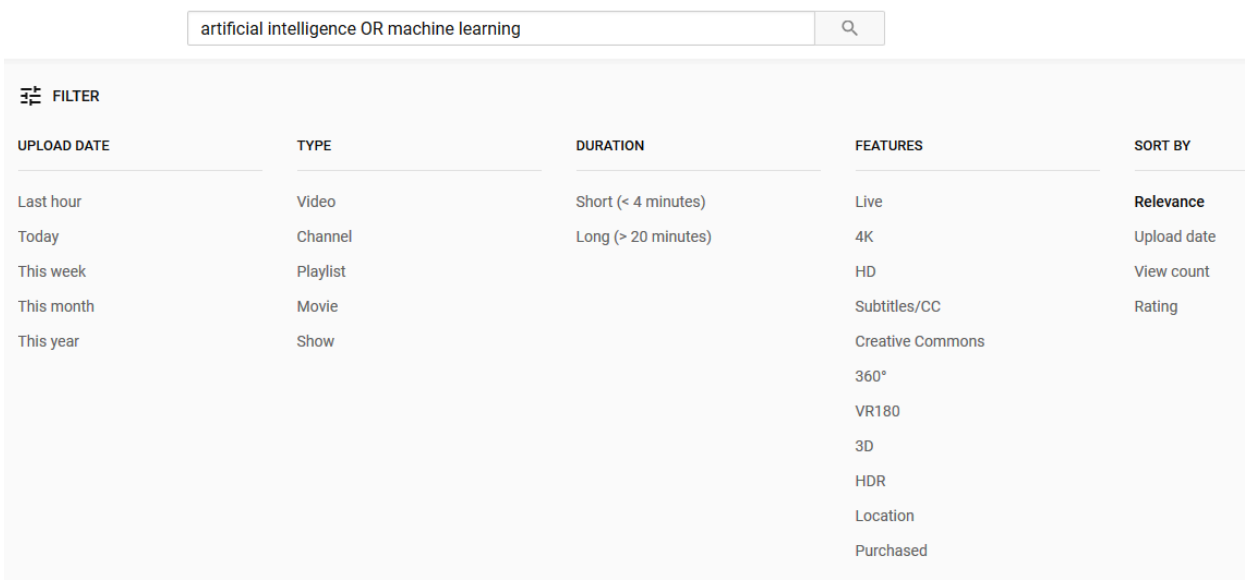


Figure 23

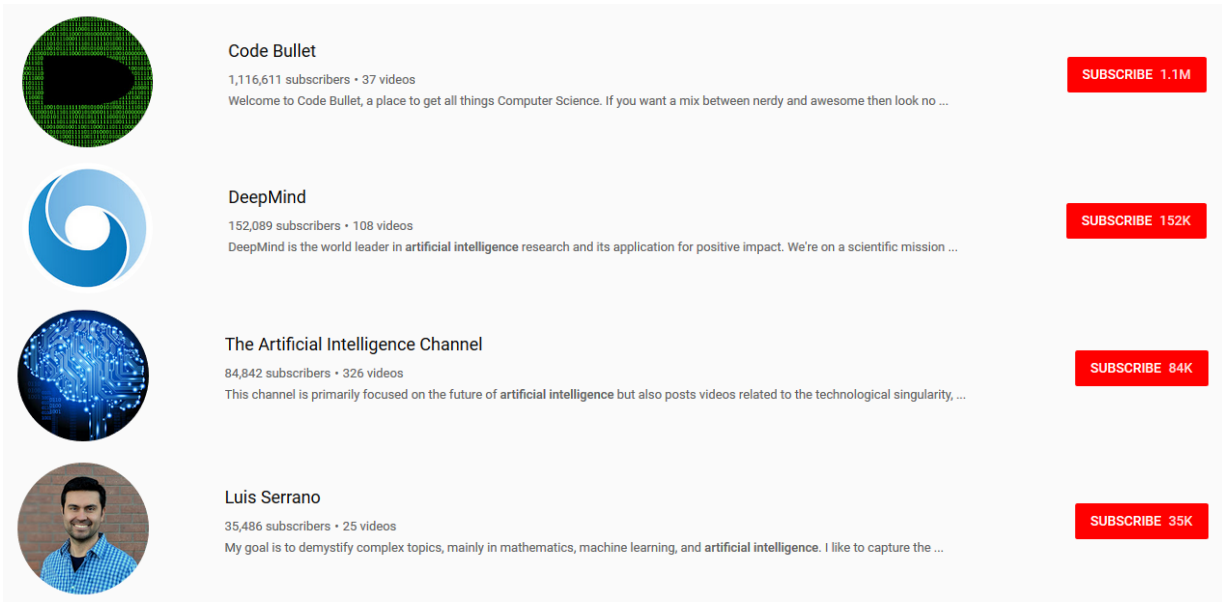


Figure 22

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

YouTube search can be limited, hence it would be worth combining its results with those of a Google advanced search. Go to Google advanced search, fill the search box 'Any of these words' with the **keywords** you selected, select **your language**, and add "**YouTube.com/user**" in the search box 'site or domain' (see Figure 14). DO NOT select your country because YouTube does not have a version for each country.

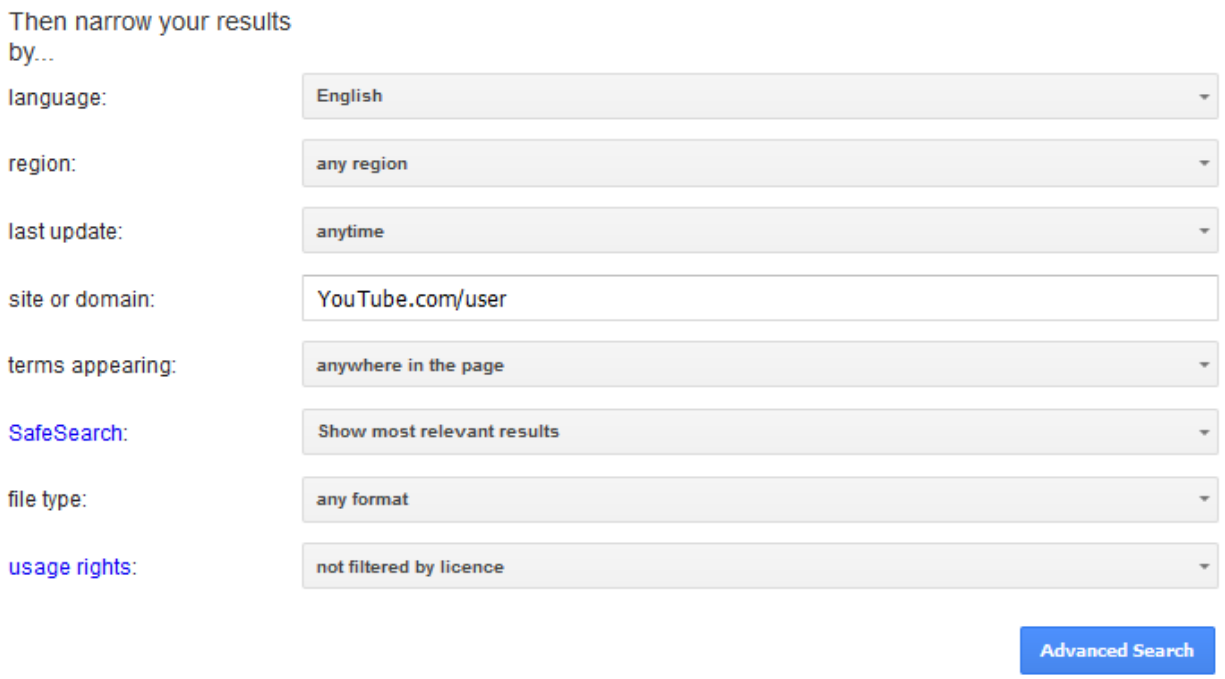


Figure 24

Vimeo

To search for users on Vimeo, type one keyword at a time on the Vimeo search bar on the top right (as you did on YouTube).

Then, select the option "Channels" from the Menu 'Show results for' on the left (see Figure 16). Channels are similar to YouTube Playlists, they are a collection of topical videos.

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

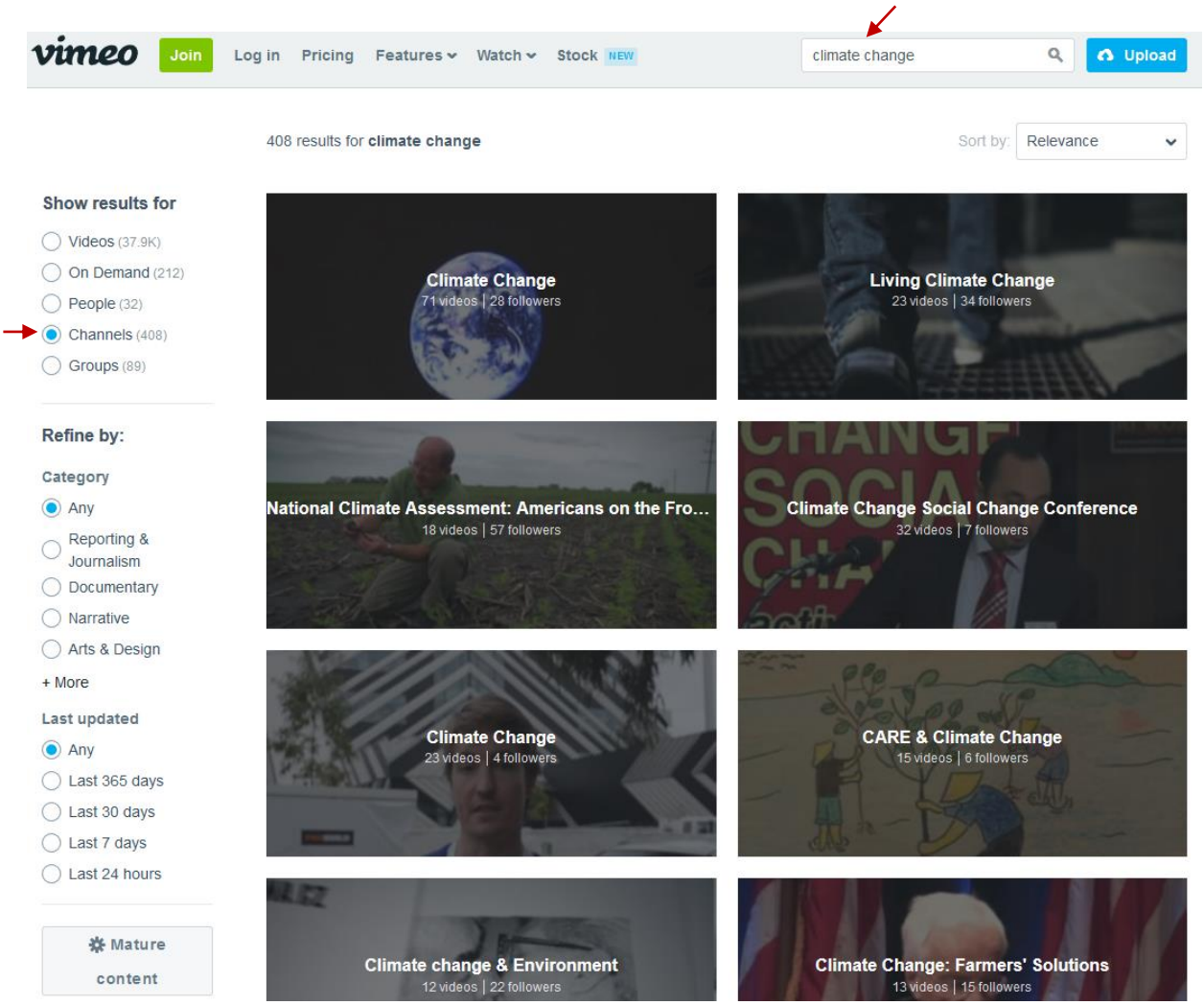


Figure 25

Click on a relevant channel and then on the user that created it (see Figure 17). Check if the shared videos and the user match the criteria defined in Section 5 and those defined in the *Inclusion Criteria* file.

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

Figure 26

As YouTube, Vimeo search can be limited, hence it would be worth combining its results with those of a Google advanced search. Go to Google advanced search, fill the search box 'Any of these words' with the **keywords** you selected, select **your language**, and add "**Vimeo.com/channels**" in the search box 'site or domain' (see Figure 18). DO NOT select your country.

Remember to collect data only from the users who speak your language and are from your country.

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

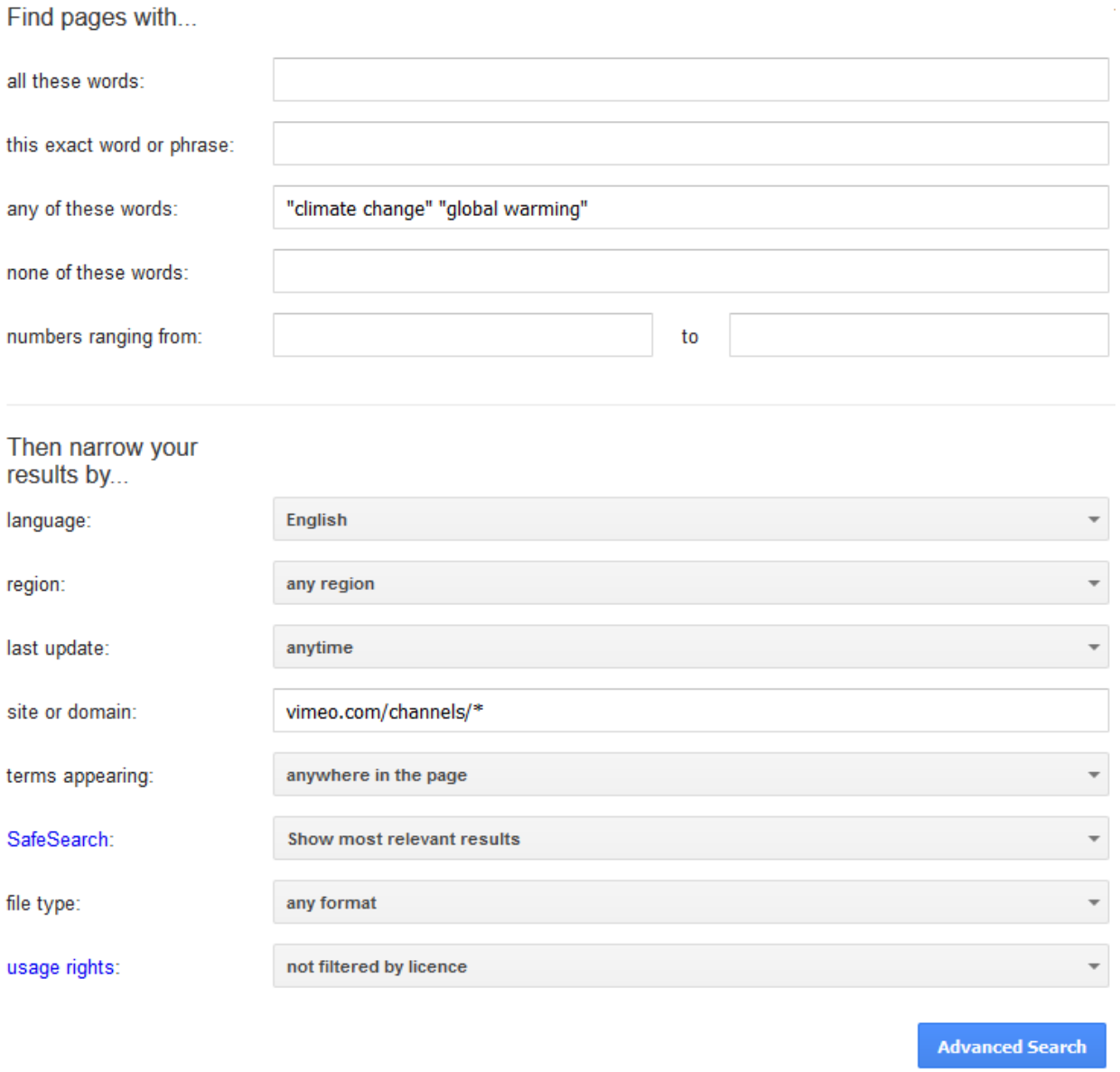


Figure 27

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

4.6. Searching online forums

To search for online forums, use again Google advanced search.
You can complete the form as you did for Facebook, adding in the search box "site or domain" the URL of the forum you want to explore (e.g. Quora.com). Follow the steps below:

- Fill the search box 'Any of these words' with the keywords you selected
- Fill the search box 'site or domain' with the URL of the forum
- Select your language under the search box 'Language'

Figure 19 shows an example on how to fill the advanced search for Quora.

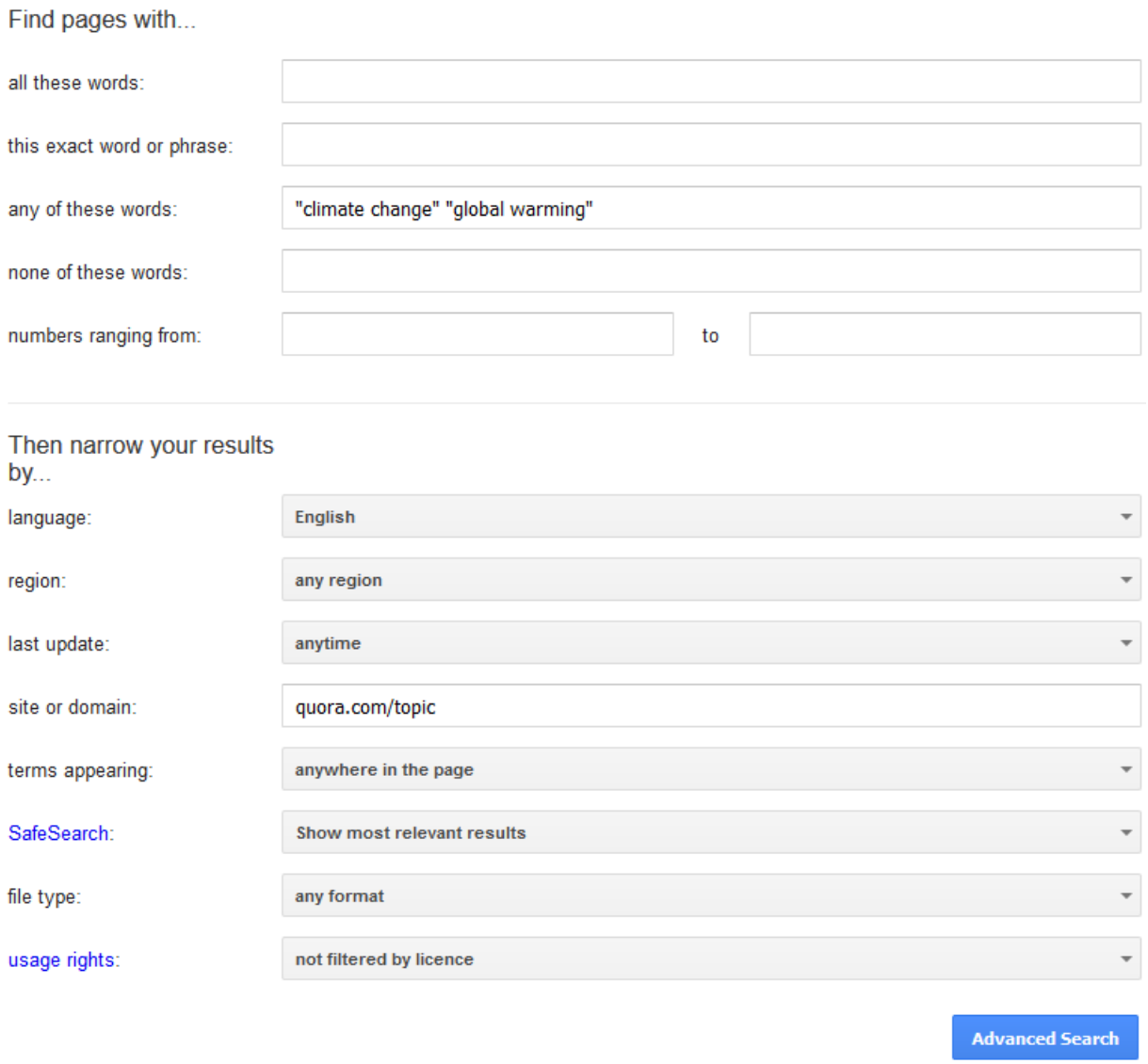


Figure 28

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

In the case of Quora, it is better to write "Quora.com/topic" in the search box 'site or domain'. In Quora, topics are aggregations of conversations on the same theme.

Click on a conversation that seems relevant, than on the users that live in the country (you should see this detail in their biography). Then check who the users are and what their expertise is. Their expertise is defined in the menu 'Knows about' on the left, which shows the topics they answered and how often their contributed to these topics (see Figure 20).

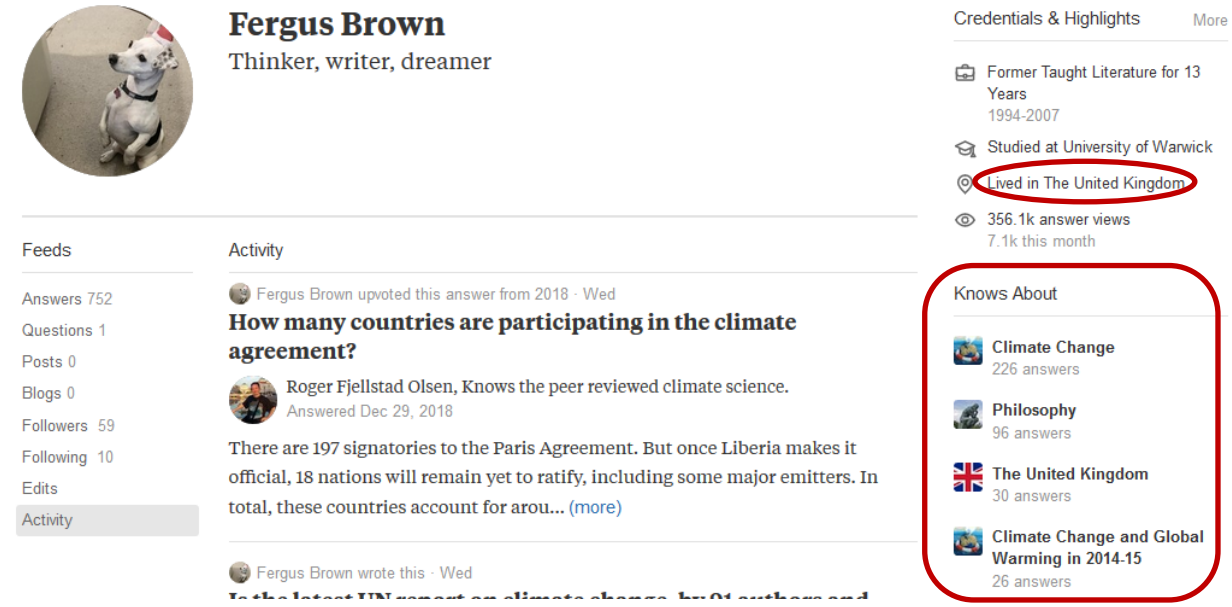


Figure 29

4.7 Searching podcasts

To search for podcasts, use Google advanced search and fill the search boxes as follow:

- Fill the search box 'All these words' with the word "podcast"
- Fill the search box 'Any of these words' with the keywords you selected
- Select your language under the search box 'Language'
- Select your country under the search box 'Region'.

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

Figure 23 shows an example of how to complete the form.

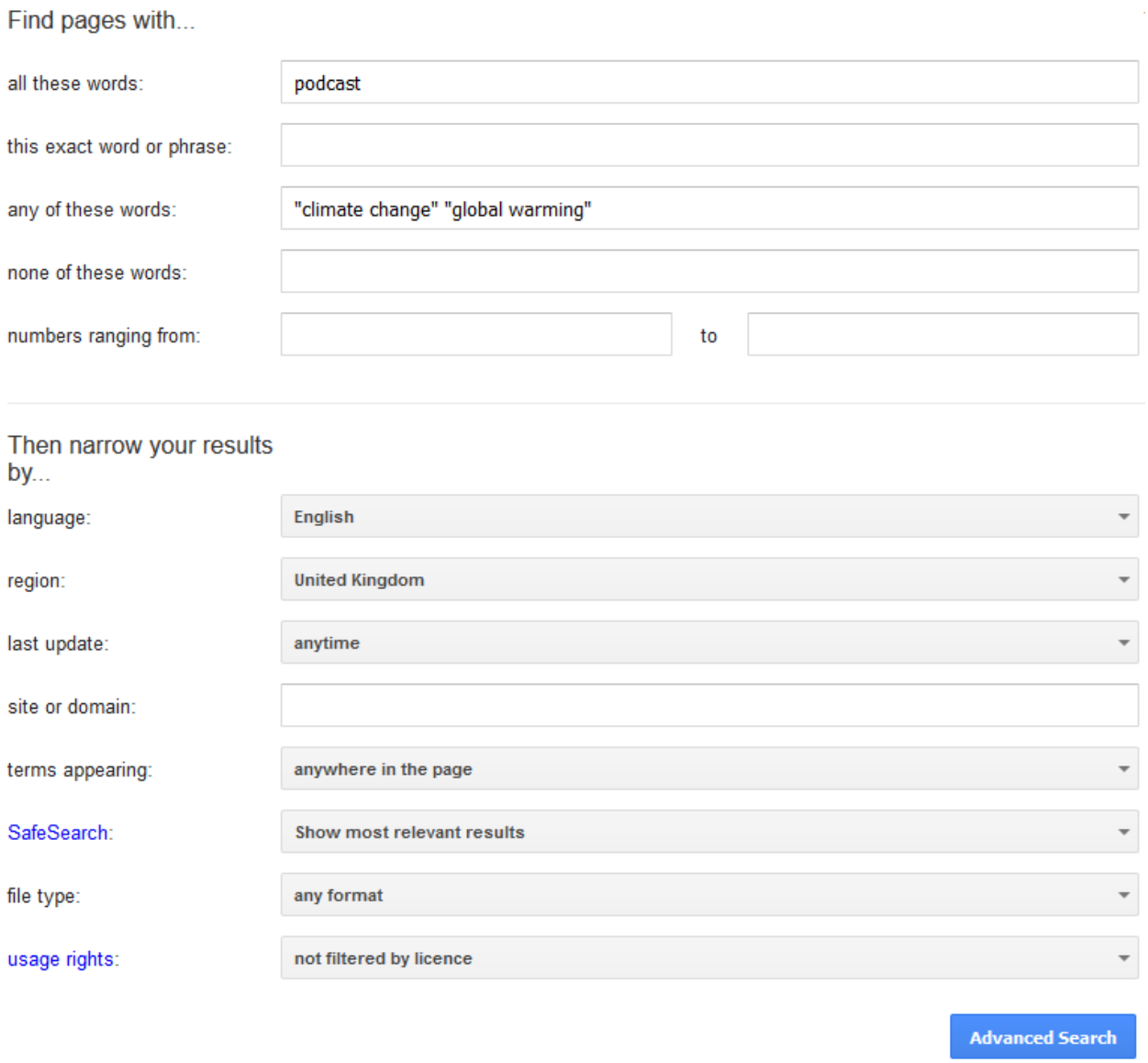


Figure 30

In this way, it is possible to search for podcasts uploaded on any publicly accessible platform. Some platforms, such as Spotify.com, allow access to the podcasts only to their subscribers and they will not appear in the results of this type of search.

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

5. Selection of the users (individuals/institutions)

When you search a platform, you will find many **users** that share content on the topic. Among these users, select those that are identifiable (i.e. provide a biography or description of who they are) and satisfy the following criteria:

- **Geographical reach**
  Select users that communicate in your language.
  It would be better if these users are based in your country as well. You can find this information if they share their location on the account profile.

- **Active accounts**
  Include users who have an active account or website. You can find this information on the bottom of the webpage of a website, or by looking at the last post published on a social media account or blog. If the user has not used the platform since April 2018, do not include them.

- **Content characteristics**
  Include users that share content on one of the three topics, in a way that's freely available and public. The topic must be the *central element* of the content, it should not be an introduction to other content, a metaphor or an analogy.
  Exclude users that publish content on *how* to communicate the topics or STEMM, or on science communication research.
  Include users that share textual, visual and/or audio content, digital collections, comics, or infographics. Exclude users that share movies or documentaries. See the Glossary to see the type of content that users to include should share.
  Exclude users that clearly share only educational or academic content (e.g. a video lecture, the link to the live-streaming of a conference, the screenshot of a paper, an academic publication).

- **Account popularity/engagement**
  Aim to include users that engage with their audience over than ones that do not.
  A user sharing a high number of posts/articles, having a high number of readers/followers, likes/favourites, shares, and comments, is more likely to have a regular and/or engaged audience than one with a low number. For example, a user that rarely publishes and does not receive any comments or shared on their post, is unlikely to have a regular audience and to engage with them.

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

- **Audience**
  Users can communicate to audiences of any size, either broad audiences or niche audiences. However, it is more likely that you will find users with broad audiences than those reaching small ones because the APIs of the media tend to favour the former.
  The audiences of these users may have any background, social class, education level, ethnicity and gender, and they should be interested in at least one the three topics (climate change, artificial intelligence, healthy diets), but not necessarily in STEMM.

- **Accessibility and availability**
  Select only users with a public account or website/blog that you can find by searching a search engine or the platform.
  If the users have a public account, they consciously share content to everybody with access to the platform or the Internet. If they have a private account, they may share confidential content and it would not be ethical to collect data on them.

When you identify a user that satisfies the criteria above, record their data in the Excel document *Mapping template*. You may find many users that satisfy those criteria but aim to select maximum 10 of them for each category of *Individuals* and *Institutions*. These categories are:

- Institutions
  - Universities
  - Research Centres
  - Research Funding Bodies
  - Scientific Societies
  - Science Museums & Science Centres
  - Industries/Companies
  - Non-Governmental Organisations, Civic Society Organisations, Think Tanks and Foundations
  - Media organisations
  - Local/National Governments
- Individuals
  - Scientists
  - Health practitioners
  - Curators
  - Activists/Pressure group staff
  - Journalists
  - Press officers/Communication officers (also public engagement officers)
  - Amateur science communicators

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

- Online video makers
- Policy makers
- Support communities

See the *Individuals* and *Institutions* sections in the Glossary for a detailed description of each of these categories. If there are not one or more of those categories in your country (e.g. there are not scientific societies in your country), you can avoid searching for them. If that happens, please send us a note about it. Focus on the *Individuals* and *Institutions* that are present in your country. If you are not sure whether a user fits the description of a category, please contact us.

Choose a maximum 10 top users for each category, i.e. the users you came across first during your search. Exclude any promoted users from your selection, whose content or profile show the tag "promoted" or "ad". These users pay the platform to have their content or profile displayed at the top of the search results.

If you cannot find 10 users for one category, select only those you have found. This situation can arise, and it is not a problem. Select only users that satisfy the criteria above.

To help you collect data on the users, we developed a template in Excel (see *Mapping template*). You will need to complete following data about each user you select:

- **User Name** – the real name of the individual or institution you selected; if the real name is not available, you can consider their moniker (nickname)
- **Individual/Institution**- the category to which your user belongs (see Glossary, *Individuals* and *Institutions* sections)
- **Platform** – the platform where you found the user (e.g. Twitter, Website, YouTube)
- **URL** – web link of the profile account or website/blog of the user
- **Number of readers** – how many readers or followers the users have (if provided)
- **Topic** – what topic the user communicates (i.e. Climate Change, Artificial Intelligence, Healthy Diet)
- **Email address** – email address of the user (if provided)
- **Date collection** – when you collected the data about this user
- **Description of the nature of content** – provide a brief description (maximum 50 words) of the nature and format of the content shared by the user (see Glossary).

Section 6 provides an example of how to fill the *Mapping template*.

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

When you identify a potential individual/institution to include in the mapping, check if they have any other accounts. For example, if the user has a website, they may also have a Twitter or Facebook account connected to it. Explore each link and see if these accounts are active. If they are, you can include these data in the spreadsheet.

You can find if a user has connected other accounts to the platform in the following ways:

- If the platform is a website, you will find the icons of the connected social media on a corner on the top or at the bottom of the home page. You may also find them at the page "Contact".
- If the platform is a social media or social network, you will find the links to the other accounts on the page "About" (e.g. on Facebook), or as a link on the bottom of the profile biography (e.g. Twitter and Instagram), or as icons on the banner (e.g. YouTube)

Do not make a note of those accounts or sites that do not meet the inclusion criteria. Sometimes the same individual/institution can share different content depending on the platform.

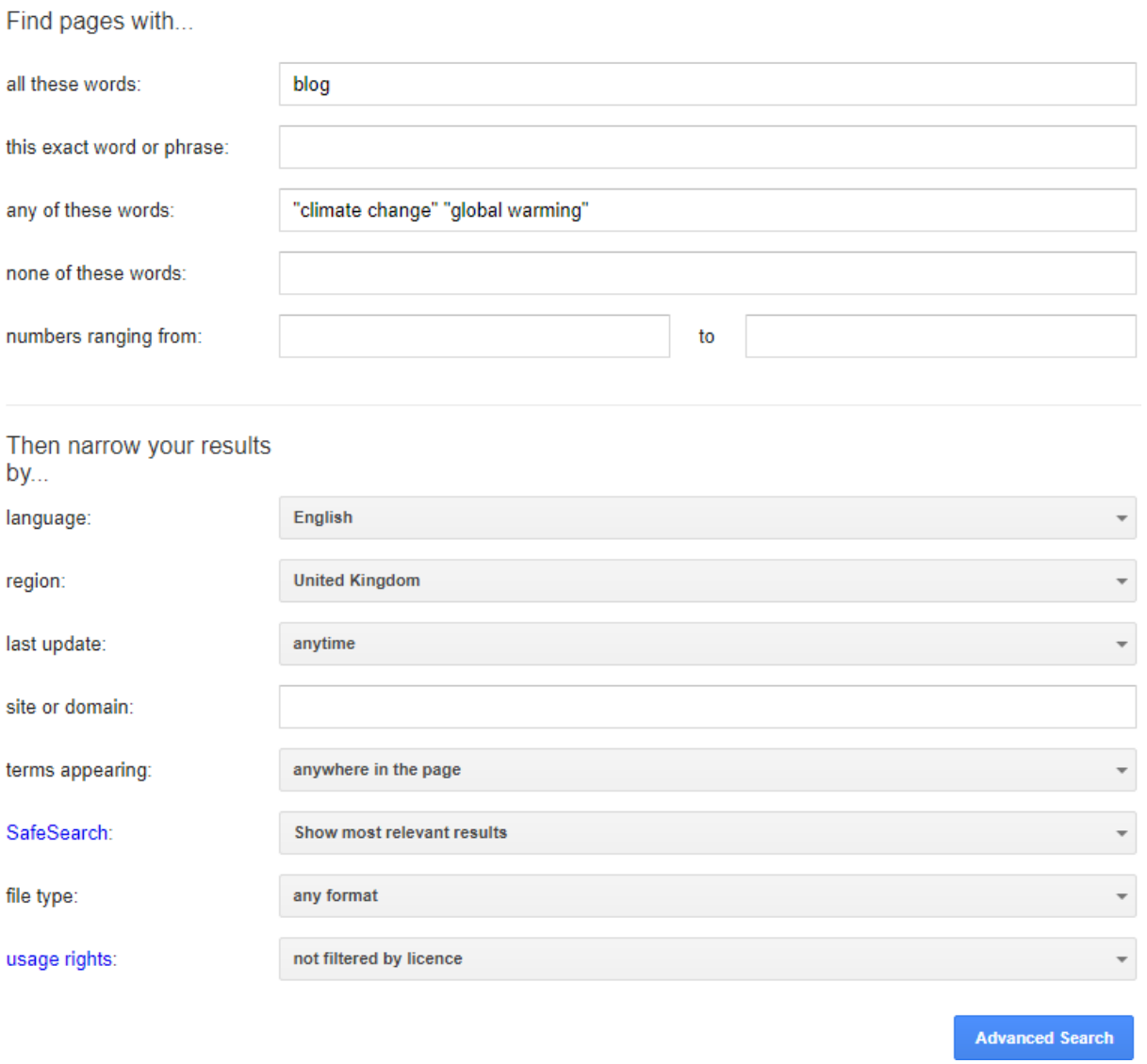
6. Example

In the section, I will show an example of how I applied the protocol.

First, I opened a browser I had not used before (you can use the same browser you normally use, but you should clean the browsing history at least). Then, I decided to search for British blogs about climate change and I followed the steps described in Section 4.2. I opened Google advanced search and I filled the search boxes as shown below.

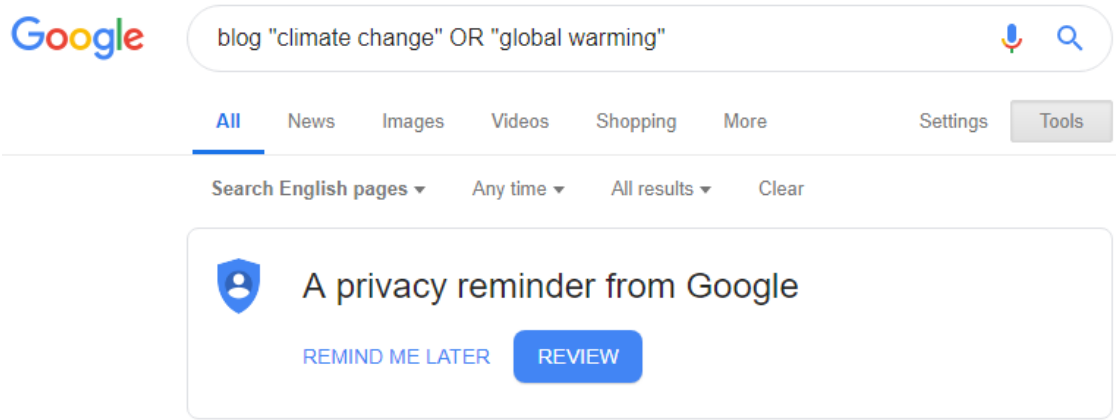
You can run parallel searches of different platforms or focus on one and when you cannot find material, move to next one. For clarity, here I will describe how to search only one platform.

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



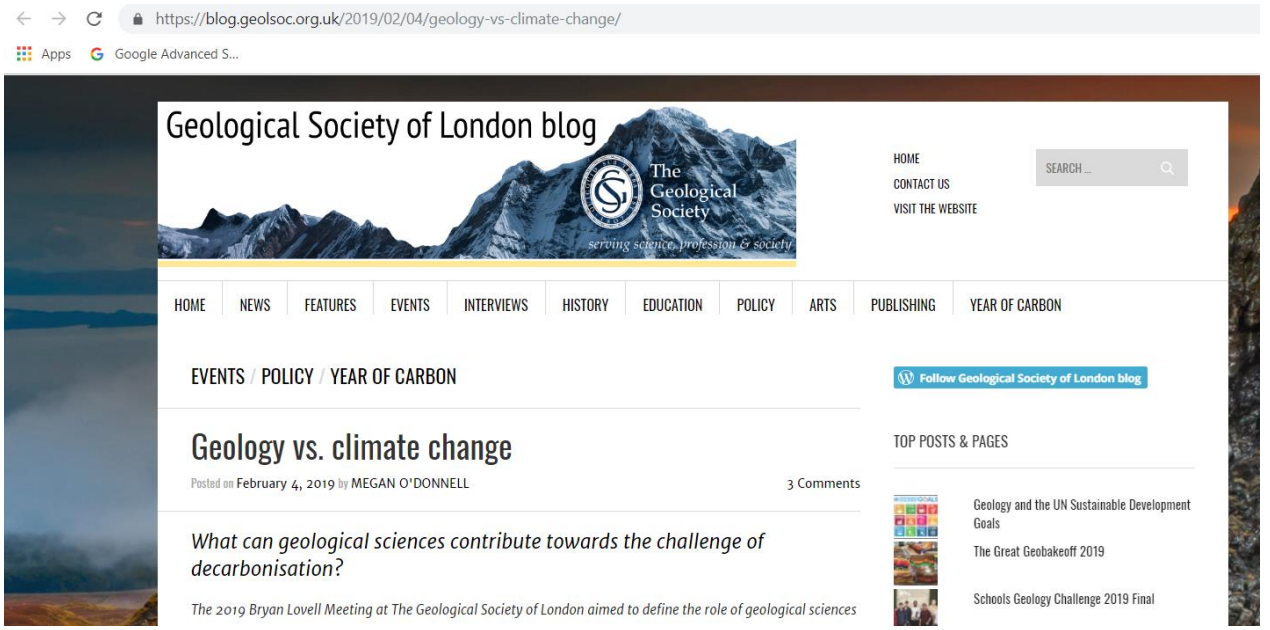
From the search mentioned above, Google returned several results - some of those are shown in the following screenshot.

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



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

The first link shown in the results brought me to the blog of a Geological Society.

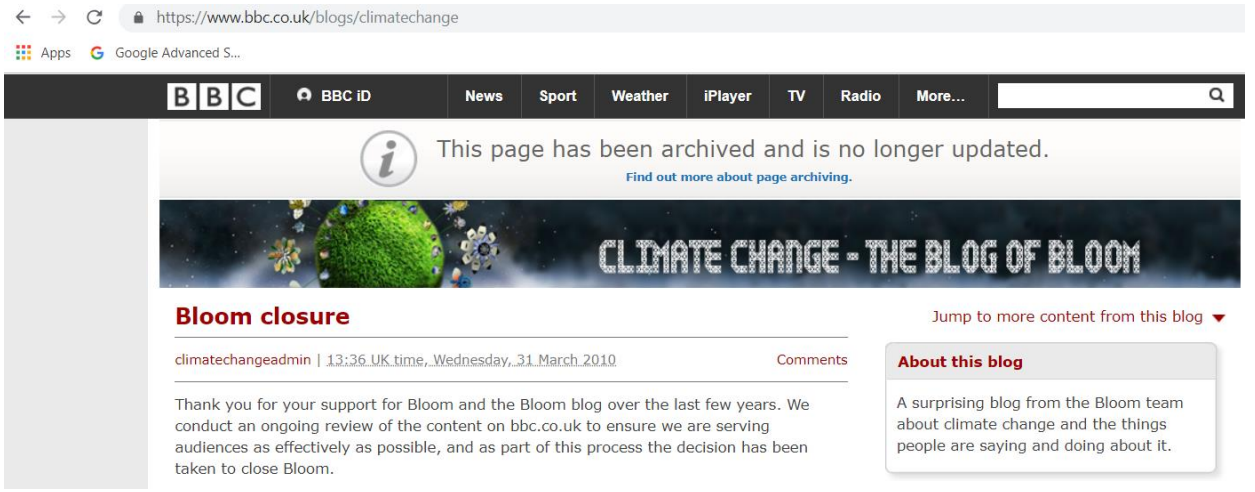


My first question was: Is this institution British? Because of the advanced search I did and the name of the society, I could assume so.

My next question was: Does this institution publish content that follows the inclusion criteria? E.g. Is the content written in English? Does it communicate climate change? Is it not educational? To answer this, I read a few of the posts published in the Home page and in the other sections. Most of the articles and features were not about climate change, and those that did mention climate change did so incidentally,focusingon geology instead. The inclusion criteria state that the content should focus on the topic; therefore, I excluded this institution and I moved to another one.

The next blog is hosted by the BBC, but there is a notice saying that is not active anymore. Hence, I excluded it from the data collection.

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



The next blog I analysed, was run by the Campaign against Climate Change. The last post was published this month; hence, the blog is still active.

In the "About us" page, I found out that they are an activist group. Since they are a formal organisation with a steering committee, I could include them in the category *NGOs, CSOs, Think Tanks and Foundations* (see Glossary). Most of the members of the committee say they are

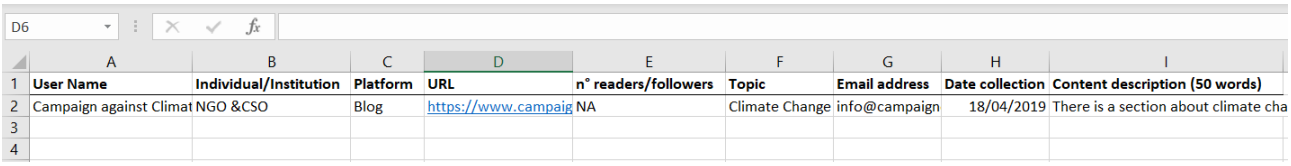
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824573

based in the UK, and in the Contact section they provided an address in London. Therefore, I could say this organisation is based in the UK.

The blog has a section "Climate Change", so I read some of the posts they published there. They offer a few explanatory articles on climate change and climate change misinformation, as well as further linked resources to visit. The "News" section provides news articles on their protests, but also on how specific events (e.g. Bristol Airport expansion) can increase the pollution and affect the climate. Therefore, the content published in this blog follow the content characteristics criteria mentioned in Section 5.

The blog does not have plugins showing the number of visualisations or shares of each post, so I could not access that information. However, the blog of the Campaign against Climate Change (and the institution as well) matches the inclusion criteria and I could include it in my mapping file.

I filled the boxes in the *Mapping template* document as shown below.



	A	B	C	D	E	F	G	H	I
1	**User Name**	**Individual/Institution**	**Platform**	**URL**	**n° readers/followers**	**Topic**	**Email address**	**Date collection**	**Content description (50 words)**
2	Campaign against Climat	NGO &CSO	Blog	https://www.campaig	NA	Climate Change	info@campaign	18/04/2019	There is a section about climate cha
3									
4									

In the box "n° readers/followers" I wrote NA (Not Applicable) because I could not find this information. In the "Date collection" I wrote the date when I collected these pieces of information. Please you the same format: dd/mm/yyyy.

In the "Content description" box I simply wrote: "There is a section about climate change with explainer and debunking articles that include pictures and graphs. The News section has news articles with images".

You do not need to write a long description. Mention what nature of content you found (i.e. News, Comments/Opinions, Feature/Long-form writing, Storytelling, Debunking, SciArt, Humour, Explainer – see Glossary) and recurrent formats of content (i.e. Text, Videos, Still images, Audio, Digital collections, Comics, Infographics – see Glossary).

After this, I checked if the Campaign against Climate Change uses other platforms. On the top left of the page, there are a Facebook and a Twitter icon. I clicked on each and evaluate if the content published in both sites matches the inclusions criteria.

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

In the Facebook page, the organisation mainly posts about the campaigns, but they also share articles from the blog and articles from other CSOs or NGOs and media organisations. Some of the articles are about climate change, so I decided to include this Facebook page in the mapping. I checked the links *Posts*, *Photos* and *Videos* to see the format and nature of content that the institution shares on their Facebook page.

The institution shares even more news on climate change on the Twitter account, though written by media organisations. Therefore, I included it in the mapping.

Then, I checked the tab *Media* to see the format of content that the institution shares on Twitter.

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

I filled the Excel file with the new data I found, as shown below.

User Name	Individual/Institution	Platform	URL	n° readers/followers	Topic	Email address	Date collection	Content description (50 words)
Campaign against Climat	NGO &CSO	Blog	https://www.campaig	NA	Climate Change	info@campaign	18/04/2019	There is a section about climate cha
Campaign against Climat	NGO &CSO	Twitter	https://twitter.com/c	8652	Climate Change	info@campaign	18/04/2019	They share still text, images and vide
Campaign against Climat	NGO &CSO	Facebook	https://www.faceboo	8531	Climate Change	info@campaign	18/04/2019	They share still text, images and vide

In the cell "n° readers/followers", I wrote the number of followers the institution has on Twitter and on Facebook. I did not consider the number of likes on Facebook.

In the content description, I wrote the type and nature of the original content shared by these two accounts. I also added a note on the type of shared content, i.e. content that was not created by the institution, but retweeted or posted by them on their accounts.

For Twitter, I wrote "They share still text, images and videos, but also comics and graphs (though not infographics). Most of their original content is call to actions and news about the protest they organised. Their shared content includes news articles".

For Facebook, I wrote "They share still text, images and videos, and graphs (though not infographics). Most of their original content is news about the protest they organised or calls to participate. Their shared content includes news articles".

Then, I moved to the next blog.

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

Appendix 3

Glossary

Institutions

Universities | Higher education institutions that offer Science, Technology Engineering, Mathematics and Medicine (STEMM) programs of studies, such as Bachelor's Degrees, Master's Degrees, and Research Degrees (e.g. PhD). Some of these institutions may also conduct STEMM research.

Research Centres | Institutions that conduct STEMM research. They may or may not be related to universities.

Research Funding Bodies | Governmental institutions or charities that provide funding for national or regional research projects on STEMM. For example, the *Research Councils* in the UK.

Scientific Societies | Academic societies or associations of scientists that provide fellowships, grants, and/or other forms of support relevant for a science career (e.g. formative courses, networking opportunities, bureaucratic advice) to their fellow members. Some of these associations can be formal institutions. For example, the Koninklijke Nederlandse Akademie van Wetenschappen (KNAW) in the Netherlands, the Royal Society in the UK, and the Ordine dei Biologi in Italy.

Science Museums & Science Centres | A science museum is an informal education institution "open to the public, which acquires, conserves, researches, communicates and exhibits the tangible and intangible heritage of humanity and its environment for the purposes of education, study and enjoyment" (ICOM Statutes, 2007). Included institutions must focus on STEMM rather than broader cultural heritage or arts. A science centre is an informal education institution open to the public, which communicate STEMM through interactive exhibits and hands-on activities and may not have its own research collection.

Industries/Companies | Businesses that produce and sell products related to the topic – either serving a relevant industry or in some way producing a product or service that has a baring on that topic (e.g. petrochemical companies and climate change). They may communicate science to engage with their consumers and/or the wider public to improve their reputation or more broadly to influence discussions/debates relevant to their industry. For example, they may talk about the potential causes of the climate change and show how they are tackling them to become more environmentally sustainable.

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

NGOs, CSOs, Think Tanks and Foundations | Non-governmental organisations (NGOs), non-profit organisations, charities, foundations, and Civil Society Organisations (CSOs). They are advocacy groups and voluntary societies that aim to address a social or political issues and/or represent the needs of a local community. These groups are formal organisations that work independently of governments, for example, Greenpeace. These groups can also be organisations with a political/ideological background that conduct their own science research or fund research.

Media organisations | Organisations involved in the dissemination of information and news to the general public through mass media (e.g. newspapers, magazines, radios, television, online material).

Local/National Governments | Authorities that govern a country, a region or a province. This might include, for example, departments within an administration such as ministries of health and ministries of agriculture and at local level it could be city councils, regional councils and local councils.

Individuals (Science Communicators)

Scientists | Senior researchers, Early Career researchers, PhD students, associate and full professors, engineers, and university lecturers in STEMM that use digital media to communicate science and research. Researchers can be employed in universities, research centres, or in businesses.

Health practitioners | Physicians, nurses, General Practitioners, surgeons, allied health professionals, midwives, and pharmacists that use digital media to communicate medicine and health.

Curators | Curators of science exhibitions, centres and museums, who use digital media for the purpose of science communication.

Activists/Pressure group staff | Individuals or groups of individuals that aim to address a social or political issues and/or represent the needs of a local community. They may be part of formal organisations (such as NGOs) or not belong to formal organisations, but form spontaneously around a common cause and lack a defined hierarchical structure.

Journalists | Individuals who write articles, investigative reports, opinions for newspapers, news websites, magazines or other mass media. They are employees in media organisations and are paid by the organisation to produce media content.

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

Press officers/Communication officers (also public engagement officers) | Staff working on behalf of an organisation to communicate the organisation's research or activities. These staff are likely to be found in universities, research institutes, funding bodies, scientific societies and industry. They may also be found in NGOs and CSOs.

Non-professional communicators – Individuals using digital media for science communication who are not employed as scientists, engineers, curators, activists, journalists, or policy makers. They may have a STEMM background, they may be Bachelor's or Master's students, and they do science communication for personal/professional interest (e.g. as a hobby, or as an effort to make a career in science communication). These individuals can include bloggers, vloggers, social media influencers, Facebook/Reddit group moderators.

Online video makers | Individuals who produce STEMM-related videos and upload them online. These videos can be news, tutorial, and explanatory videos.

Policy makers | Individuals involved in making policies in local, regional and national governments. They have the power to make decisions on how a law is implemented, how a legislation is applied and converted to practice. They can also affect the strategy to make a legislation. Policy makers can also be involved in corporate policy and Non-Governmental Organisations policy.

Support community | Individuals with similar interests that form an online community, where they exchange information, news, and emotional support. The community is regulated by moderators or administrators (e.g. of a Facebook Page), who curate the posts shared by the community and share content as well.

Nature of science communication

Informative | One-way communication intended to inform the public. The institution/science communicator conveys information to the public, but does not seek feedback/comments from them. For example, science dissemination through news, blogs articles, and press release.

Consultation | The institution/science communicator may ask the public for their opinion on a specific topic or issues, but there is not dialogue between the two parties. The institution/science communicator only initiates the process, and the public convey their opinions or feedback to him/her. For example, a local council might create a blog post or an online poll inviting feedback on their plans for climate change mitigation.

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

Participation | Two-way communication, dialogue, between the institution/science communicator and the public, which involves a process of negotiation that can change both parties' opinions. For example, an open discussion on Facebook, Twitter, or Reddit, where the institution/science communicator replies to the public comments and both parties seeks to reach a common agreement.

Live events coverage | Institutions (e.g. science museums) can use digital platforms to cover an exhibition or other event; but instead of using the coverage as an advertisement, they use it to do science communication. For example, they may communicate the scientific concepts illustrated by the exhibit.

Entertainment | Some content may aim to entertain the public rather than to engage or inform them. For example, some Internet memes, videos, or comics may attract the public's attention with the intention of being entertaining. The science might be delivered explicitly or 'by stealth' through these mechanisms or incidentally (i.e. information is not the main point).

Formats

Text | Text of news articles, blog articles, social media posts, etc.

Videos | News, science demonstration and explanatory videos. Videos of science events aimed at the public, such as science festival talks and demonstrations and TED/TEDx talks. Expressly EXCLUDED are videos of lectures and conferences aimed at either other academics or students as well as webinars, documentaries and movies.

Still images | Photos, cartoons, digital images (i.e. made or modified with graphic software packages), artistic images (either digital or analogical), Internet memes (photos with an ironic/humorous text overlaid).

Audio | For example, podcasts. But not radio.

Digital collections | Online archive or collection of digital objects, which can include text, still images, audio, video.

Comics | To be classed as a comic (rather than a cartoon which is a still image), it must have more than one panel..

Infographics | Combine visuals elements (icons, graphs, images) and text to convey information to non-expert audiences.

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

Platforms

Websites | Set of related web pages located under a single domain and about a particular subject. Websites are often published by institutions, such as universities, science museums, companies. Pages that communicate science will be included but not those related to the organisation/administration of the organisation, details of staff (staff directories) or undergraduate/postgraduate programmes/training offered by the institution.

Blogs | Blogs are similar to websites but they can host several posts on the home page, which are ordered chronologically from the newest to the oldest. Blogs are often informal, and they can be hosted by platforms such as WordPress, Blogger, Tumblr.

Online video platforms | Platforms based on video uploading and sharing, for example YouTube and Vimeo.

Social Media | Sites where multimedia content can be created, uploaded, downloaded, and shared selectively (private accounts) or publicly (public accounts). Social media users form reciprocal and non-reciprocal relationships with other users that know already (offline) or not. Users often follow others based on shared interests. On social media, the content is often shared from one to many (all site's users or followers). An example of social media is Instagram.

Social Networks| Sites were multimedia content can be created, uploaded, downloaded, and shared selectively (private accounts, private groups) or publicly (public accounts, public pages, public groups). Social networks' users form only reciprocal relationships with other users that know already (offline) or not. An example of social network is Facebook.

Social News aggregation sites | Sites where users share news and information on various topics. Users can become members of more than one topical group inside the site and interact with the other participants. There may be some mechanism to rate posts. An example of Social news aggregation site is Reddit.

Microblogs | Sites where users post short blog messages, updates. These messages can include multimedia content and web links, and can be liked, re-shared, quoted and forwarded from the users' followers to other audiences. An example of microblogging site is Twitter.

Online forums | Online discussion site where users can hold conversations in the form of posted messages. These messages can be either short or long, and they stored for long time (years). An example of online forum is Quora.

Podcast platforms | Platforms that host podcasts.

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

Nature of content

News | Time-sensitive and factually based posts. Shorter in length than features.

Comments/Opinions | Opinion-lead, may or may not be time-sensitive.

Feature/Long-form writing | Similar to news, but longer in length**.**

Storytelling | Involves some narrative components.

Debunking | Set the record straight on a myth or misconception in STEMM.

SciArt | Artistic representation of STEMM.

Humour | Conveys science in an amusing way.

Explaination | Makes STEMM clear by describing STEMM in more details or revealing relevant facts. It is not related to teaching.

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