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Deliverable 3.1

D3.1 Analysis of the status quo and demands for science communication training

Work package number and title:	WP3 – Train: the status quo and demands for science communication training

Lead-beneficiary: Zeppelin University

Work package Leader: Birte Fähnrich

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Executive Summary

The RETHINK project aims to explore how changing communication practices in the context of digital transformation affect the interactions at the science-society interface.

The rise of the internet and digital media outlets bring opportunities for science communication but are also challenging scientific standards. In a communication environment where anybody can produce communication content referring to science, questions about expertise and legitimacy of information arise. For science communication, societal trends such as individualisation and digitalization change the conditions for communication quality and its assessment tremendously. With regard to developments such as audience fragmentation and rising misinformation, there seems to be a greater demand for a professionalization of science communication than ever before. Against this backdrop, science communication education is an important step for professionalization in the field and and adds further justification to train science communicators for communication activities.

Against this backdrop, WP 3.1. provides an overview of academic science communication programs in four RETHINK partnering countries (the UK, the Netherlands, Portugal, Italy) and Russia to analyze how available programs cope with the challenges of the "new" complex and digitalized communication environments.

Based on a small sample study of 12 programs we show that science communication education is adapting promisingly to the new science communication landscape and related changes and aims at teaching the students a profound understanding of the complexities of the new science communciation dynamics. Programs largely implement content about digitalization and recent developments in their programs, although they rate their importance differently. However, related risks of science communication online are only taught to some extent, by encouraging students´ critical thinking about sources of information and interaction processes between communicators. We identified that most programs assess science communicator roles in line with co-creation and interaction with the public, but some programs also imply more traditional communicator roles of information disseminators. We can conclude that programs, overall, aim at providing their graduates with specific knowledge, competences and attitudes that will help them to serve as professional communicators in an increasingly complex science communication environment. However, further research is needed to assess how programs can ideally implement modules to convey the challenges of digitalization successfully to students.

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1. Introduction- The new science communication landscape

Within the last decade, science communication has witnessed a profound change in the media landscape and a fundamental transformation of societal communication. On the one hand, science communication has increased tremendously in most parts of the world within the last 20 to 30 years (Bauer, 2017). On the other hand, science communication has also been changing fundamentally due to mediatization (Hepp & Hasebrink, 2018), the upcoming of new digital media, the rising hybridity of communication (Chadwick, 2017), the developments of the public sphere into a networked public sphere (Benkler, 2006; Kaiser, 2017) and related changes of private and public communication.

The concept of mediatization is used to describe a societal process that refers to the fundamental "interrelation between changes in media and communications on the one hand, and changes in culture and society on the other" (Couldry & Hepp, 2013, S. 6, cf. (Hepp & Hasebrink, 2018). Accordingly, mediatization has also been affecting science and science communication (Schäfer, Kristiansen, & Bonfadelli, 2015). Whereas in pre-digital times science journalism was the most prevalent form of science communication, media change has fostered the development of a heterogeneous science communication landscape with a great variety of science communicators such as scientists, journalists, spokespersons of universities and science organizations but also other experts, science enthusiasts or even science deniers and propagandists. All these actors communicate online on science related issues for very different objectives. And they all apply a great variety of online channels and formats (e.g. (Brossard & Scheufele, 2013; Bubela et al., 2009) to bring their messages across.

Mediatization thus brings about new opportunities for science communication as it offers new forms of interaction with target publics, enables dialogue and engagement, makes science communication available to a broader audience and thus conveys politically fostered ideas of an open and reflexive science (communication) (Schäfer, 2015)). However, the changes to the science communication landscape also bring about risks and challenges as online and social media offer a stage for strategic and populist interests (e.g. Allgaier, 2019) which could lead to misinformation of the public or even threaten the overall societal perception of science.

"Contemporary scientists, in the West, are communicating in a cultural environment where their expertise is challenged, where their expertise interacts with other forms of knowledge, and where citizens expect to participate democratically in debates over science and technology." (Fahy, 2020, p. 1).

The new ecosystem of digital science communicators is characterized by numerous content producers, a variety of possibilities for interactions between them and fast movement (Trench, 2012). These developments imply that the dissemination of knowledge is not only the domain of scientific institutions or experts anymore (Bubela et al., 2009). Research showed that a recent decline of science coverage in the traditional media goes hand in hand with a major rise in science content in social media from an increasing variety of sources. (Brossard, 2013;

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Bubela et al., 2009; Trench, 2012a). As identified in RETHINK deliverable D1.1 (Scoping report on the science communication ecosystem) science communication actors (like NGOs, foundations, think tanks, scientists, journalists, activists and local or national governments) cope in different ways with scientific topics like climate change, which means that they use different digital media tools to spread information, and make different aspects of one topic salient. For example, NGOs and non-profit organisations focused on news and advocacy campaigns oriented toward taking action against climate change, in contrast activists and non-professional actors spread more diverse kinds of contents on social media, where they share own personal experience or explain scientific facts.

From an audience perspective the diversity of actors and information resources make it more complicated to distinguish between facts and opinions (Brossard, 2013). One develoment in this regard are specific features of digital platforms, e.g. news aggregators or search engines that analyze users' interests and recommend matching news to them (Napoli, 2014; Scheufele & Nisbet, 2012). Also, ordinary citizens taking part in discussions on platforms like news websites and blogs can be seen in light of democratic deliberation (Rowe, 2015; Ruiz et al., 2011), but this development can lead to "counterpublics" (e.g. Toepfl & Piwoni, 2015) that express opinions which are not represented in mainstream media, for example when debating climate change as not caused by human behaviour (Walter, Brüggemann, & Engesser, 2018). Thus, such alternative public spheres on the internet leave room to connect with dis-informational content, where scientific facts are lacking. For example, a study investigated videos on climate change on YouTube and revealed that over 50% of videos in the sample spoke for a position that contradicts scientific mainstream findings (Allgaier, 2019). This seems to lead to a fragmentation of public space where sources with polarized opinions are chosen over traditional information sources because they reflect a person's own opinion (Iyengar & Hahn, 2009; Sunstein, 2018; Yeo, Xenos, Brossard, & Scheufele, 2015). If these opinions support a user´s view, they may even think the position they read reflects general public opinion (Porten-Cheé & Eilders, 2015).

Especially in light of modern science issues such as climate change, nutrition or AI there is a high level of controversy and uncertainty because there are no comparable issues to draw experience from (Trench, 2007). Furthermore, these issues are of high political relevance and associated with possibly high risks which underlines the importance to reflect on new ways as to how such topics could be communicated to audiences (Trench, 2007). Thus, the question in focus is how to ensure reliability and trustworthiness of knowledge and the legitimacy of expertise within this multiperspecitivity (Collins, 2014; Collins & Evans, 2009; McGreavy, Hutchins, Smith, Lindenfeld, & Silka, 2013). Against this backdrop, one could argue that scientists and professional science communicators should be aware of and reflect upon the "new" science communication landscape to cope with related risks and opportunities in their day to day communication. However, research shows that many scientists still hold a rather traditional view of science communication relating to the so called deficit model (Bennett, Dudo, Yuan, & Besley; Besley & Tanner, 2011) and also public engagement activities of science

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organizations often stick to traditional, hierarchical, and unidirectional modes of communication (Irwin & Horst, 2016). In accordance, Fahy (2020) reports with regard to a European communication program for scientists that participants were more interested in practical communication skills but less in course content dedicated to the overall cultural context of science communication. In this perspective, new developments in the media and communication landscape might rather be regarded as "old wine in new bottles" (Peters, Dunwoody, Allgaier, Lo, & Brossard, 2014). Moreover, journalistic science communication is still regarded as the most important bridge to the broader public (Allgaier, Dunwoody, Brossard, Lo, & Peters, 2013). Accordingly, studies on university communication online for instance show that communication hardly uses the potential of digital communication (Metag & Schäfer, 2019; Vogelgesang & Scharkow, 2016). Although there might be several reasons for this, e.g. a lack of resources, a lack of budget or even strategic reasons, one could argue that communicators also lack the competence to cope with the online environment and might not satisfy the needs to meet objectives that become increasingly important in a digital communication environment like building trust. Although these competences have shown to be rated with lower priority by scientists (Besley, Dudo, & Storksdieck, 2015), scholars emphazise the importance to adapt science communication training to these objectives (Bennett et al.; Seethaler, Evans, Gere, & Rajagopalan, 2019; Simis, Madden, Cacciatore, & Yeo, 2016). In this complex communication environment, science communication training should aim at equiping students with the ability to reflect certain circumstances of communication practices, like the topic they communicate and the specific requirements of the platform they use (e.g. interactive features) (Howell & Brossard, 2020). Competence in this regard, however, not only refers to certain skills of media use. Instead, professional competence requires an overall understanding of societal and media changes and the respective consequences for science and science communication as well as an adequate self perception of science communicators and their roles in this context (Baram-Tsabari & Lewenstein, 2017b; Pieczka, 2002; Trench, 2017).

Academic education has been considered to be an important prerequisite or even "the most significant step" (Bennett et al.; Trench, 2017) for the further development and professionalization of science communication (Baram-Tsabari & Lewenstein, 2017a).
Since the 1980s, several science communication programs have been established across the globe (Hong & Wehrmann, 2010; Massarani, Reynoso, Murrielo, & Castillo, 2016). In addition to short training courses for scientists and others, many universities offer science communication education programs on a Bachelors or Masters level[1]. This education should aim "to develop in science communicators a critical understanding of scientific and social institutions" (Trench, 2017). However, to date it is not clear if this is really the case. Although there is some research on science communication education, the main focus of previous

[1] We focus in our study on academic science communication programs which have academic content and are longer whereas training courses for scientists and practitioners focus around practical skills with no formal assessment.

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research has been on practical content and skills that the programs teach. In contrast, few studies have taken a closer look at the extent science communication programs are designed to give a "broader picture" of science communication (Trench, 2017) and thus provide participants with the "meta-expertise" (Collins & Evans, 2009; Fahy, 2020) in the context of the profound and fast changes that have been occurring due to mediatization in the last years (Dudo & Besley, 2016; Fahy, 2020).

Against this backdrop, task 3.1 examined science communication education. We have analyzed how science communication programs cope with the mediatization and related changes in the science communication landscape. More specifically task 3.1 asked:

How do science communication programs adapt to changing environments and equip their students with the required competences to do and deal with science communication in a mediatized, diversified and increasingly complex science communication environment?

The report starts with a brief overview on the mediatization of science communication in chapter 2. In chapter 3, a model to analyze science communication programs is introduced which builds upon two approaches to learning outcomes (Baram-Tsabari & Lewenstein, 2017b) and competences of professional communicators (Pieczka, 2002). The following section explains the conduction of a program survey across Europe. Survey results are presented in chapter 5. The conclusion summarizes and discusses the results of the study and works as a starting point to conduct tasks T3.3 and T3.4.

2. State of the art science communication education

Lately, science communication education has been seen as an important step for the further professional development of the field (Baram-Tsabari & Lewenstein, 2017a; Trench, 2012b). Different scholars have commented on the need for scientists training (Leshner, 2007; Warren, Weiss, Wolfe, Friedlander, & Lewenstein, 2007). Also, a demand for career specific science communication training for the youngest generation of scientists has been expressed (Bankston & McDowell, 2018; Neeley, Goldman, Smith, Baron, & Sunu, 2014).

In recent years, several science communication programs have been established internationally. Many universities and science conferences offer short workshops that target scientists, journalists, policymakers and a general audience (Neeley et al., 2014). A diversity of such programs exist in Europe, mostly one day training courses or few day workshops, for example the Royal Society offers courses for writing skills or presenting research for scientists (Royal Society, 2020). UWE Bristol offers short courses for professionals to train them in science communication skills, for example through its "science communication building blocks" short courses (University of the West of England, 2020). A survey conducted at the British Science Communication Conference 2007 shows differences between different science communicators regarding access to training opportunities, from 17% who have completed courses of science communicators working in PR and 19 % of respondents working in academic

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contexts. Whereas 33% of PR personnel and 85% of academics received postgraduate and postdoctoral science training. Of all respondents, only 30% have been trained at university in science communication (Miller, 2008). Empirical evidence shows that these short courses emphasize either general communication skills or direct communication with the media or public audiences (e.g. Miller & Fahy, 2009; Silva & Bultitude, 2009). Often, studies focus on the evaluation of courses by attendees (e.g. Rodgers et al., 2018) or on implications for learning goals by scholars (e.g. Besley & Tanner, 2011).

In addition to short training courses for scientists in public engagement, several degree programs at a Bachelor and Master level have been set up across the globe. Existing studies on science communication education (e.g. Baram-Tsabari & Lewenstein, 2012; Besley & Tanner, 2011; Hong & Wehrmann, 2010; Massarani et al., 2016) demonstrate that there are a great variety of programs which differ in terms of target groups, objectives, and content. Imperial College London was the first Institution in the UK to offer a graduate program in science communication ("MSc Science Communication") (Turney, 1994). Previously, a map of science communication programs in Europe showed 78 science communication degree programs at universities (Rhein-Waal University, 2020)[2], although this information hasnot been updated for the last few years. In our recent research we found 43 courses in six countries which were sampled[3] (see section 4). In contrast to short term training possibilities mentioned above academic degree programs provide a "bigger picture" of science communication which means that theory in communication studies is combined with practical skills (Turney, 1994). For our mapping study, we drew from Turney´s (1994) perspective and concentrated on academic science communication degree programs.

Whereas short courses are offered as a supplement to students, experienced scientists or practitioners which are rather skill oriented, degree programs in science communication emphasize communication theory and skills in a broader way (Mulder, Longnecker, & Davis, 2008). Degree programs run over a longer time period than training courses (usually 1 or 2 years at postgraduate level) and are organised in programmodules. The contents of these programs are – as science communication as a field - mostly multidisciplinary (Davies & Horst, 2016). Previous research on course content shows that they incorporate different areas of study including science, social studies of science, communication studies and educational studies (Mulder et al., 2008). The programs aim to educate students to enable them to take up positions in different fields like science journalism, science policy or strategic science communication, as well as working at science centres (Hong & Wehrmann, 2010).

Research on science communication programs is very heterogenous. Programs are often analyzed as single case studies with a best practice approach (e.g. Clarkson, Rohde, Houghton, & Chen, 2018; Heath et al., 2014; Mellor, 2013; Silva & Bultitude, 2009). More systematic

[2] http://www.scicommfinder.info/DEV/?post_type=gd_course

[3] These results can only serve as a snapshot of programs, due to the limited base of countries in the sample. We exclusively concentrated on programs in RETHINK project partner countries for our research.

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reviews that compare different programs are rarer. Nevertheless, several authors provide an overview of academic science communication courses, but still research scopes arequite different. For example, Baram-Tsabari and Lewenstein (2012) look at academic science communication courses in Europe, Australia and North America by assessing learning outcomes, and specifically writing skills. Another comparative study by Hong and Wehrmann (2010) concentrates on the objective of international programs to educate students as professional communicators. A more general evaluation of Latin American science communication programs is provided by Massarani et al. (2016). Although some of these studies focus on learning outcomes of courses, they do not explicitely address new information environments for science communication and the adaption of curricula to these challenges.

A share of research on science communication education deals with the concept of competence (e.g. Baram-Tsabari & Lewenstein, 2017b; Bankston & McDowell, 2018). A focus of this research is which aspects of competence academic science communication courses are highlighting in their curricula. In a review, Bankston and McDowell (2018) applied the "vowel analogy— AEIOU" to the education of young scientists. The authors highlight communicative aims such as raising public awareness for new aspects of science, understanding of science and its social factors and evoking interest in communicate science issues as goals for effective science communication. Educating general communication skills, for example using an appropriate language for different audiences and use of stylistic elements such as humour, anecdotes, metaphors, imagery had also been mentioned as key aspects for program curricula (Mercer-Mapstone & Kuchel, 2015).

Bray, France, and Gilbert (2012) asked science communication experts for their evaluation on this matter and showed that beyond information transmission, concepts like audience empowerment, participation, responsiveness, trust and honesty are highlighted to be an essential part of science communication courses. In their study, Mercer-Mapstone and Kuchel (2015) find that the ability to identify and understand a target audience are seen as the most essential science communication skills by experts, also considering the social, political and cultural context of communication was rated as highly important. As Trench (2017) points out science communication education should aim at fostering "a critical understanding of scientific and social institutions" (p.1).

Few studies focus on the learning outcomes of programs. One exception is a comparative approach by Hong and Wehrmann (2010) where similarities in content between academic programs were identified. More specifically it was found that programs intend to integrate theory and practice, communication competences and media skills. One study developed guidelines as to how students' writing skills could be assessed (Baram-Tsabari & Lewenstein, 2012). A more general guideline for science communication education could help to adapt programs tonew circumstances for science communication. Also Baram-Tsabari and Lewenstein (2017b) stress the importance of designing broader learning outcomes to adapt to different information environments and communicator roles.

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One first attempt to formulate education guidelines that focus on competences for science communication in *digital* environments has been made by Bankston and McDowell (2018). They identify sharing scientific findings and debunking misinformation as goals for communicatingscience to the public and propose training elements, e.g. writing courses for digital platforms like Twitter. Considering that science communicators use digital platforms to spread research results or engage with audiences it is important for them to evaluate how different modes of communication facilitate or hinder their communication and how to apply features to different topics and audiences (Howell & Brossard, 2020). Moreover, existing research has evaluated how graduates engage in social media activities with the public and that these activities are evaluated positively by graduates (Howell, Nepper, Brossard, Xenos, & Scheufele, 2019). However, there is still no comparative research that focuses on this specific aspect in the development and running of academic science communication programs. Therefore, we examine how science communication programs equip their students with knowledge and skills to cope with digital information environments and modes of societal communication.

3. Competence model for science communication education

Taking this as starting point we asked ourselves how recent questions about digital media and changing information environments could ideally be acknowledged and reflected in science communication courses. In our approach we will develop a category schema that can assess theorientation of programs towards our research interest (see Table 1).

To investigate ways in which education programs can adapt to the challenging conditions of media change, we developed a theoretical model for assessing knowledge and competences as part of the curriculum.

We analysed an approach by Baram-Tsabari and Lewenstein (2017b) on learning outcomes to draw conclusions for own assessment categories. Another view on relevant competences with focus on professional communicators is provided by Pieczka (2002). This concept gave us the overall scope of conditions for science communicators in new information environments that could be included in education programs

Pieczka (2002) describes societal changes due to globalization and digitalization and related demands for professional (science) communicators. Emerging formats are characterized by activity and pace and their ability to allow citizens to take part in an environment with "new orders of knowledge" (Neuberger et al., 2019). Apart from positive effects like new fora for deliberation and more flexible modes of communication these structures provide risks that science communicators should be aware of, for example the misuse of science related information. These societal developmentsbuilt a frame which Pieczka describes as "Picture of the World" and which serves as first main category. Within our analysis this category helps to capture to which extent science communication programs are aware of and adapt to this communication environment. In the context of digitalization, the transformations in the field of

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science communication demand us to rethink role conceptions as professional communicators compete with other actors such as science enthusiasts or quasi-experts for public attention. They have to fill in a boundary role between science, policy and the public sphere. Under these circumstances it is even more important to evaluate how effective science communication can be achieved, which also leads to the demands for quality criteria. Science communicators' work has to be established in this specific „conceptual frame", which is the second main category for analysis. Additionally, science communicators need to be equipped with competences and skills to work in a digitalized world (third main category: professional knowledge). Besides technical knowledge of media and digital tools and practical skills to transfer communication through different channels, science communicators need to be willing to keep up with new developments. This affective dimension of learning science communication is outlined by a statement by Baram-Tsabari and Lewenstein (2017b): "(science communicators) experience excitement, interest, and motivation about science communication and develop attitudes supportive of effective science communication" (p. 291). Another competence requires critical thinking when assessing for example risks and opportunities of digital media.

To sum up science communication training should to provide students with a view of changes taking place in science communication today Students can then learn how to adapt their communication practices to this evolving science communication landscape. Ideally, they are able to do so because they apply required competences. (see Table 1).

Table 1: Overall categories competences digital environment on the basis of Baram-Tsabari and Lewenstein, 2017 and by Pieczka, 2002.

Main Categories	**Explanation**	**Subcategory**	**Explanation**
Picture of the world	refers to the perception of the changing societal framework in which science communication takes place and how it affects the conditions for science communication	overall perception of the science communication landscape	definition of science communication, potential changes of the concept in the context of digitalization
		perception of mediatization	reflection and assessment of changes related to mediatization, e.g. decontextualization of content, hybridity of digital media, interactivity, pace
		perception of the developments of	historical understanding of issues affecting

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	science-society relations	relations between science and society, developments in the context of media change, e.g. open access, open science, citizen science; public expectations and demands, lay communicators, social media
	new orders of knowledge	changing conditions for science, "competition" by new forms of knowledge and knowledge production related to the distrust in academic and traditional experts, the emergence of 'alternative' experts (e.g. influencers)
	perceptions of political demands	assessment of political expectations and obligations of science and science communication to respond to these
	risk perceptions	awareness of risks for science communication in the context of a diversification of communicators and the strategic (mis)use of science related information, assessment of fake news and science denial
	perceptions of	opportunities of digital media such as new

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		opportunities	modes of communication, direct stakeholder interaction, etc.
Conceptual frame	refers to self-perception, professional and normative demands of the profession in the context of digitalization	relevance of digital media for science communication	digital media have changed science communication fundamentally vs. digital media are rather an add on to other traditional forms of science communication
		role concepts of science communicators	self-perception and perceived perception by relevant stakeholders, also interrelation between professional communicators and other publically visible science communicators, e.g. public position in comparison with science enthusiasts, quasi-experts, strategic communicators, science deniers
		assessment of science communication effectiveness	concepts of effectiveness and evaluation, measures and metrics in an online environment
		assessment of quality criteria	assessment of quality, applied criteria
Professional knowledge	refers to perception of required competences and knowledge to be a professional science communicator in a digitalized environment	problem recognition and content knowledge	reflection of objectives of science comm in a digital world, issues management

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	overall assessment of risks and opportunities of digital media for science communication	media effects depend on the specific medium, e.g. open exchange of information on digital platforms
	knowledge and competences to apply digital media to science communication	strategic planning, stakeholder applicability, synergies of media, audience knowledge
	technical knowledge of media and digital tools	knowledge about how digital media function, specific characteristics of different media
	practical knowledge and experience	ability to communicate through different digital media
	openness and motivation/ affection	willingness to keep pace with the developments and to be updated

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4. Methodology of science communication training mapping

To test if and how these competences are considered in curricula of current academic programs we conducted a survey that addressed contact persons (program managers, lecturers) of relevant programs. Survey results are described in this report with regard to the categories outlined above. Eventually, implications for science communication education are discussed in the last section.

Selection of programs

Given the large number of science communication academic programs and trainings (e.g. Rodgers et al., 2018; University of the West of England, 2020) and the background of professionalisation in science communication we decided to focus on science communication degree programs offered by universities (undergraduate and graduate level). These academic programs run over a longer period than training (for instance, usually four semesters at postgraduate level) and are organised in a modular approach.

For the first step, we asked Rethinkerspacehosts in the partnering countries Italy, the Netherlands, the UK, Sweden, Poland, Serbia and Portugal[4] to provide a list of science communication programs in their countries. On this basis, we identified 43 courses in six countries located in Italy (6), the United Kingdom (14), Portugal (3), the Netherlands (11), Germany (5) and Russia[5](4) . Out of these, 39 were graduate courses (Masters) and 4 were undergraduate courses (Bachelors) (see Table 2 and Figure 1). Moreover, we searched online to find further information on these programs . In this way we were able to identify information and curricula documents on university webpages, however, not all pages included English translations.

[4] In Sweden, Poland and Serbia there were no such academic courses, but only short term training programs for scientists and practitioners.
[5]Russia was included to represent academic programs in Eastern European countries in the sample given that to our knowledge, there are no programs in the RETHINK partnering countries Serbia and Poland .

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Table 2: Overview academic science communication programs in European countries

country	Name of program	Institution	degree	Included in study[6]
Italy	Master in Science Communication "Franco Prattico" (MCS)	Scuola Internazionale Superiore di Studi Avanzati (SISSA)	Masters	yes
	Master in Giornalismo e comunicazione istituzionale della scienza	University of Ferrara	Masters	no
	Master in Comunicazione delle Scienze	University of Padua	Masters	no
	Master La Scienza nella Pratica Giornalistica	University of Roma	Masters	no
	Master in Communication of Science and Innovation (Scicomm)	University of Trento	Masters	yes
	Master in Comunicazione della Scienza e dell'Innovazione Sostenibile	University of Milano	Masters	no
United Kingdom	MSc in Science Communication[7]	UWE Bristol	Masters	yes
	MSc in Science Communication	Imperial College London	Masters	no
	MSc in Science Media Production	Imperial College London	Masters	yes
	MSc in Science Communication	University of Manchester	Masters	no
	MSc in Science Communication and Future Media	University of Salford	Masters	no
	MSc in Science Communication	University of Sheffield	Masters	yes
	MSc in Science Communication and Public Engagement	University of Edinburgh	Masters	no
	MSc in Science Communication	Cardiff University	Masters	no

[6] We invited all the 43 identified programs to our survey, this category displays responses to the questionnaire.
[7] For this program are interviews by two separate responsible persons in the sample.

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	MA in Science Communication	University of Kent	Masters	no
	MSc in Scientific Research and Communication	University of Warwick	Masters	no
	MA Journalism (Science and Environment)	University of Lincoln	Masters	no
	Postgraduate Diploma in Applied Science Comminication,	University of the West of England	Masters	no
	Postgraduate Diploma/Certificate in Science Communication and Public Engagement	University of Edinburgh	Masters	no
	Postgraduate Certificate in Practical Science Communication	University of Cambridge	Masters	no
Portugal	Master in Science Communication	University nova Lisboa	Masters	yes
	Master in Scientific Culture and Science Dissemination/Mestrado em Cultura Científica e Divulgação das Ciências	University of Lisboa	Masters	yes
	Master in Science Communication/Mestrado em Comunicação de ciência	University of Minho	Masters	yes
Nether-lands	Educatie en Communicatie in de Bètawetenschappen	Rijksuniversiteit Groningen (RUG)	Masters	no
	Science Education and Communication	Universiteit van Utrecht (UU)	Masters	no
	Wetenschapscommunicatie voor Betaonderzoekers	Vrije Universiteit Amsterdam (VU)	Bachelors	no
	Science Communication	Vrije Universiteit Amsterdam (VU)	Masters	yes
	Science Communication & Society	Universiteit van Leiden (UL)	Masters	yes
	Wetenschapseducatie en communicatie	Technische Universiteit Delft (TUD)	Masters	no
	Major Wetenschapscommunicatie	Universiteit van Amsterdam (UvA)	Masters	no

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	Communication and Digital Sciences/ Communication and Information Sciences	Universiteit van Tilburg (TU)	Masters	no
	Wetenschapseducatie en communicatie	Universiteit Twente	Masters	no
	Wetenschapseducatie en communicatie	Technische Universiteit Eindhoven (TUE)	Masters	no
	Educatie en Communicatie in de Bètawetenschappen	Rijksuniversiteit Groningen (RUG)	Masters	no
	Science Education and Communication	Universiteit van Utrecht (UU)	Masters	no
Germany	Wissenschaft – Medien – Kommunikation	Karlsruher Institut für Technologie (KIT)	Masters	no
	Wissenschaft - Medien - Kommunikation	Karlsruher Institut für Technologie (KIT)	Bachelors	no
	Science Communication & Bionics	Hochschule Rhein-Waal	Bachelors	no
	Wissenschaftsjournalismus	TU Dortmund	Masters	no
	Wissenschaftsjournalismus	TU Dortmund	Bachelors	no
Russia	Science Journalism and Communication	Moscow State University	Masters	no
	Science Journalism	Saint Petersburg State University	Masters	yes
	Public Relations in Science and Emerging Technologies	Peter the Great St. Petersburg Polytechnic University	Masters	no
	Science Communication	ITMO University St. Petersburg	Masters	yes

Survey Sample

We contacted program managers from all 43 academic programs mentioned above by e-mail and invited them to complete the survey. Data collection took place from 09.10.-29.10.2019. We conducted the online survey with the platform "Soscisurvey".

Overall, we received 13 complete questionnaires out of the 43 contacted programs that are examined in this report, which provides a response rate of 30,23%. Included in analysis are 12 different programs: UK (3), the Netherlands (2), Italy (2), Russia (2) and Portugal (3) (see Figure 1). All of these are graduate programs at masters level which require students to already have an academic degree (M.A., N=3; M.Sc., N=7; other graduate degrees, N=3).

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Most of programs are taught in English (8), some of them in Dutch (2), German (1), Italian (1), Portuguese (3) or Russian (2).

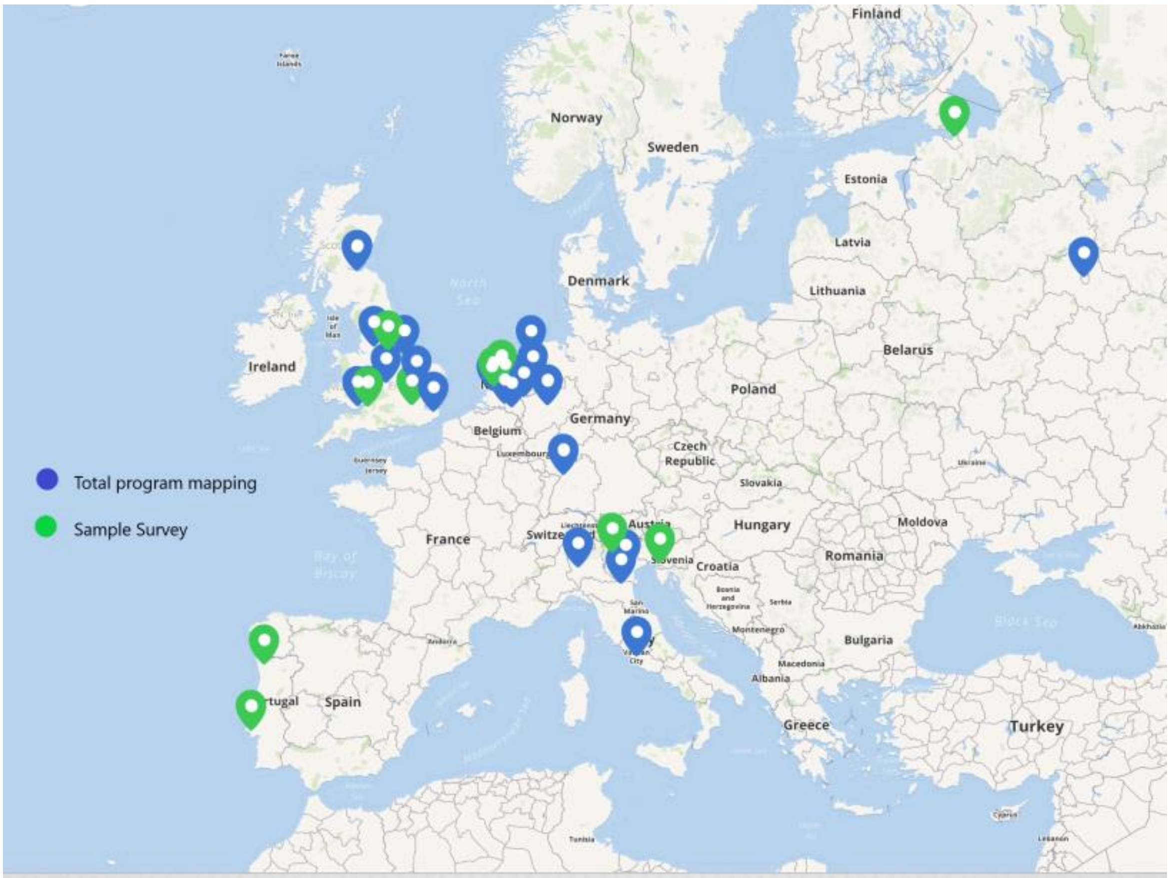

Figure 1: Map of science communication programs in Europe (source:own)

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Development of the questionnaire

To get an overview of the academic science communication landscape, the survey contained questions about general course contentsand personal information about program managers and lecturers. However, the focus was on specific questions about the role of digital media and its evaluation in the program. We openly asked for a program specific definition of science communication. Also, we wanted to enquire how courses prepare students to adapt their communication style to new information environments (for the questionnaire see Appendix 1). The questionnaire was developed on the basis of the theoretical categories of learning outcome and competence by Baram-Tsabari and Lewenstein (2017b) and Pieczka (2002) (described in "Competence model for science communication education") (see Figure 2).

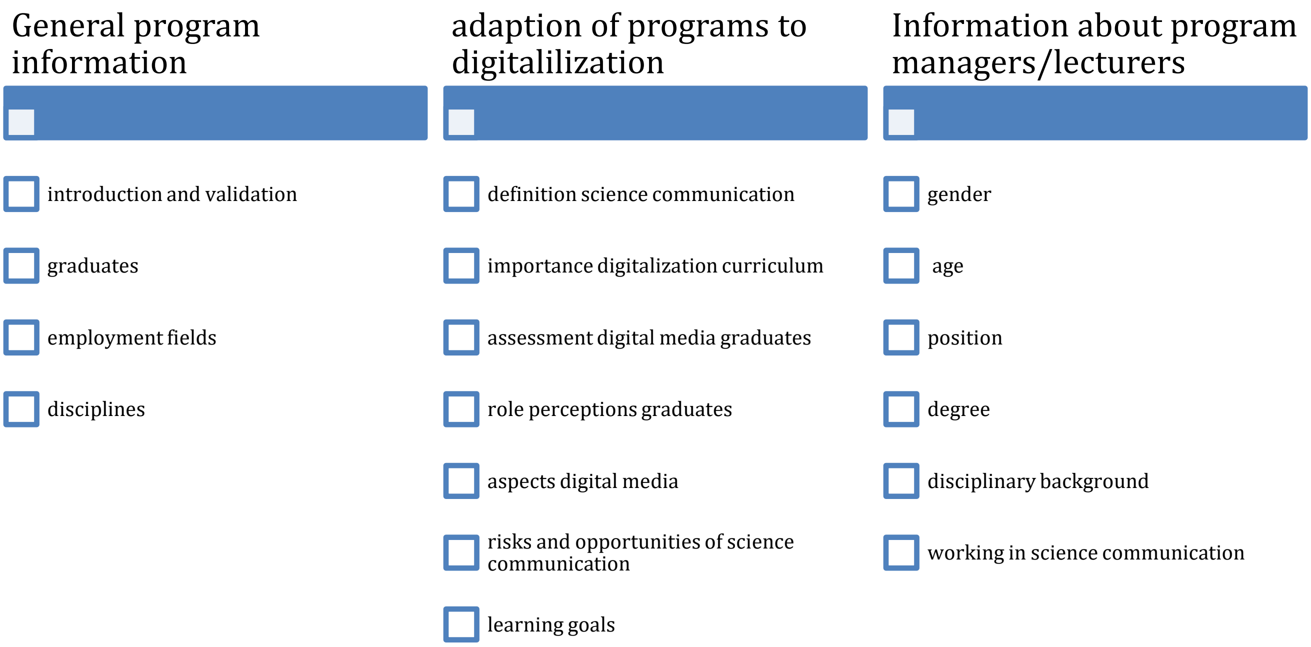

Figure 2: Survey questionnaire

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5. Mapping study results

In this section we first report general information about the sample of participants and of academic programs. After that specific results concerning the research question of how academic science communication programs adapt to challenges in the context of the digital transformation are presented.

Sample of Respondents

The sample for further analysis consists of 13 participants, their position in the organization can either be described as program managers (N=11) or lecturers (N=7) or as a combination of these occupations. Men and women were roughly equally represented (46% and 54%). Concerning different age groups, there were mostly individuals between the age of 40 to 59 (N=9) and also some younger participants at the age of 20-39 (N=3). One participant was between 60 and 69 years old. Their highest academic degrees were Master (N=2), Doctorate (N=10) or other postgraduate degrees (N=1). For experience in science communication they stated work experience of 5-10 years (N=4), 11-15 years (N=2), 16-20 years (N=2) or over 20 years (N=4) in the field. For teaching science communication, there were slight differences, 5-10 years was stated by 5 individuals, 11-15 years by 2 individuals, 16-20 years by 2 individuals and over 21 by one respondent. Furthermore, the respondents showed a diversity of disciplinary backgrounds from which they draw their experience from, for example sociology or Science and Technology Studies (N=4), communication science and media studies (N=7) or physical and life sciences (N=7) (see Table 3).

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Table 3: Information about respondents (N=13)

Category	Parameters	Frequency		Cumulative Percent	
Gender	Male	6		46	
	Female	7		54	
Age	20-29	1		8	
	30-39	2		15	
	40-49	5		38	
	50-59	4		31	
	60-69	1		8	
Position	Program management	11		64	
	lecturer	7		36	
Degree (highest)	Master	2		15	
	Doctorate	10		77	
	Other postgraduate	1		8	
	Sociology/STS	4		18	
	Communication	3		14	
	science	4		18	
	Media studies	3		14	
	Physical sciences	4		18	
	Life sciences	1		4,5	
	Education	1		4,5	
	Journalism	1		4,5	
	Economics	1		4,5	
Disciplinary background	Philosophy of sciences				
Working in science communication (in years)		In any role	role teaching science comm	In any role	role teaching science comm
	5-10	4	5	33	50
	11-15	2	2	17	20
	16-20	2	2	17	20
	over 21	4	1	33	10

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General program Information

Looking closer at the programs which responded, they were mostly introduced between 2000 and 2010 (N=4) or 2011 to 2019 (N=7), with one exception – one course has been running since 1993. Overall most of the programs are validated on a regular basis, eleven respondents indicated that their program was validated between 2011 and 2019, six programs got validated in 2019 (see Figure 3).

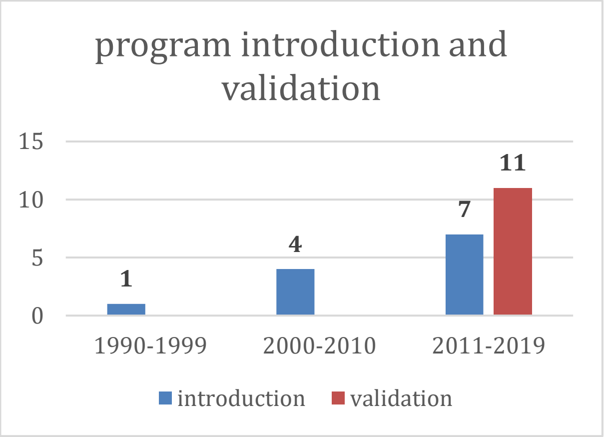

Figure 3: introduction and validation of science communication programs in years (source: own).

We also asked for the number of graduates of these science communication programs, these ranged from 10 to 25 students per year. Most frequently mentioned were 10-15 graduates (17%) annually, behind that 16-20 (25%) or 21-25 (17%) (see Figure 4).

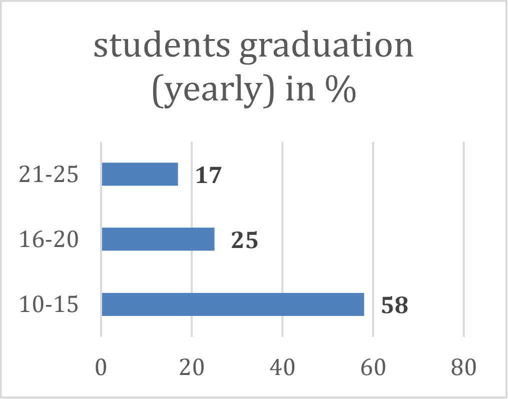

Figure 4: Number of students graduating per year (source: own)

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For working opportunities it was shown that most graduates are working in communication related fields, more specifically in strategic communication (N=11), journalism (N=9) and media production and presenting (N=8). Other common employment sectors are teaching/tutoring (N=3), administration (N=3), management (N=3), research (N=2). Other mentioned options are working in museums and science centres (N=1) or scientific publishing (N=1) (see Figure 5).

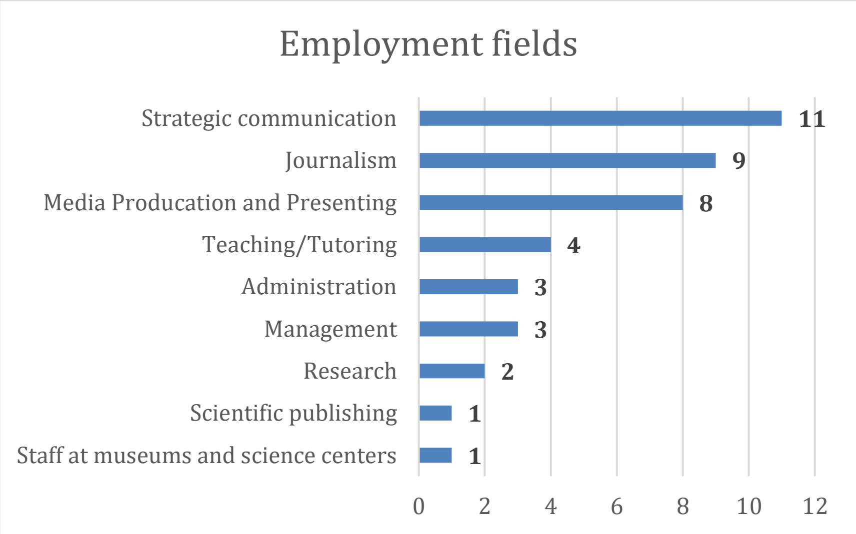

Figure 5: Most mentioned employment fields for graduates (up to three mentions) (source: own)

The overall orientation of programs can be described as either practical skills oriented (6 mentions) or equally theoretical and skills oriented (7 mentions). Interestingly, no respondent indicated that his or her program has an exclusive theoretical focus. Content wise, most programs refer to science communication and public engagement perspectives (N=10), followed by media studies/journalism (N=9) and Science and Technology Studies (STS)/sociology (N=7). Infrequently reported were disciplines like strategic communication (N=3), communication theory, museum studies and natural science (each mentioned once) (see Figure 6).

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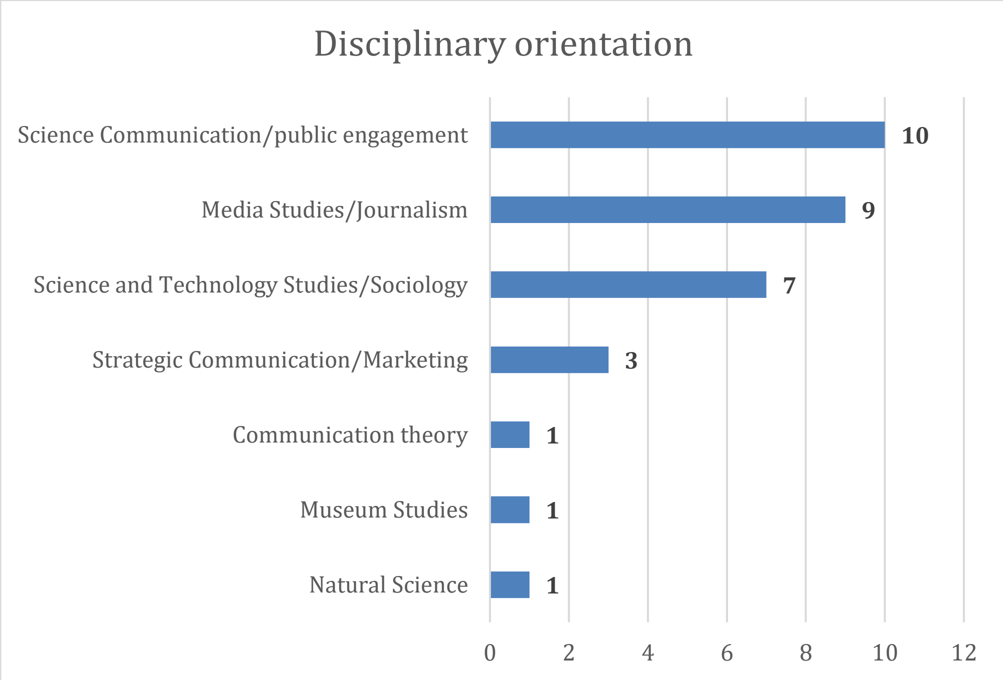

Figure 6: Disciplines of science communication programs (source: own)

Competences related to digitalization

To turn to more competence oriented questions we asked for a definition of science communication that is taught in the programs. Not surprisingly, most of the definitions emphasized practical considerations when communicating science (see Figure 7). Science society relations have been identified as starting point for interactions between a variety of actors (mentioned 6 times, see Appendix 2), either defined as any interaction between science and society (science comm definitions Appendix 3, Pos. 7 and 8) or more complex as a process of co-production:

"From an STS perspective, we take the complexities of science-society interactions as a starting point. Science Communication we see as the interaction and communication processes that take shape across diverse science-society interfaces. Taking a coproductionist perspective means we see science-society interfaces as sites of co-production, where the relationship of science and society is shaped. We emphasize the variety of actors and their relationships, their different backgrounds and perspectives. That is probably why we don't use one definition of science communication, other than this broad view on interaction and communication processes" (pos. 13).

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The role of the public is evaluated differently by individual program respondents. It becomes clear that the deficit model is still present in some cases, seen as a one-way process where science informs and educates the public.

"Science communication is the practice of informing, educating and raising awareness of the general public on science-related issues" (pos 1).

"We teach scientists how to effectively communicate scientific concepts to a variety of audiences, and the reasons for doing so." (pos. 3)

One definition refers to one way and two-way thinking of knowledge dissemination (pos6).

"I suppose we use roughly the definition that science communication is about engaging the public with science and technology, including a variety of one-way and two-way mechanisms and addressing societal concerns and issues through approaches such as responsible research and innovation" (pos 6).

The definitions also take the variety of actors in the communication landscape into account, e.g., the government, scientists, schools, science museums, media and the industry. One statement makes clear that these different communicator roles imply discourses with different functioning:

"For the purpose of our masters, we consider science communication to be a social practice with multiple meanings. Science communication is much more than the public dissemination of scientific knowledge, and includes communication between scientists, between scientific organizations and schools, between scientists and their organization and the general public. We understand that science communication is a social pratice that involves the government and state bodies, the scientific community, schools and the whole system science museums, media and industry. This also involves variety of social roles, logics and modes of functioning, discourses and communication technologies " (pos 10).

One statement concludes that in this line their program does not employ a specific understanding of science communication, because the program´s goal is to convey different meanings of science communication and effects on society (pos 14).

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Figure 7: Programs science communication definition
base: most frequent words mentioned in definitions (N=100) (source: own)

Next, we asked how important digitalization and related changes are content wise for the curriculum. All respondents indicated that digitalization is in some way included in lectures, 31% said that this perspective is part of the program, though these contents are not included in seperate modules . Overall these changes are considered to be important for program content 38 % indicated a high importance for several modules and 31% a major importance for the whole program. To sum up, these results demonstrate the importance of digitalization in the respective science communication programs but also show different ways of integration into the curricula (see Figure 8).

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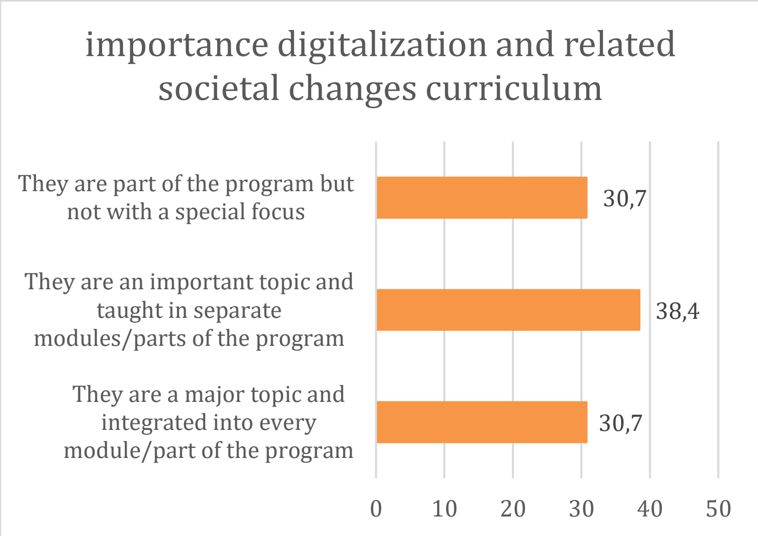

Figure 8: Relevance of digitalization and related changes in the surveyed programs, in %; N=13 (source: own)

For the next question, we evaluated more specifically how science communication program managers or lecturers would like their graduates to assess new developments of digital media. Due to the small sample size, the following results show only tendencies of how programs deal with these developments of the digital science communication environment and how students are enabled to become science communicators.

We presented several statements (with positive and negative valence) about risks and opportunities of digital media to capture possible preferable attitudes that are generated by participation in related science communication courses. Overall, being aware of new communicative opportunities online was rated positively (see Figure 9), for example the diversity of content online rated as having had a positive impact on science communication (*M*=3,77, *SD*=0,83) and digital media in general were said to have improved science communication (*M*=3,62, *SD*=0,96). Concerning different modes of communication, participants indicated that digital media foster public engagement with science (*M*=3,69; *SD*=0,75). Also, critical aspects of digital media like the misuse of science communication for strategic interests of different actors like activist groups are rated as important for graduates to be aware of (cf. the arithmetic mean which shows a tendency in this direction) (*M*=3,69, *SD*=1,11). There were less agreement about whether lay communicators had a negative effect on science communication or society (*M*=2,62; *SD*=0,87; *M*=2,62; *SD*=0,77).

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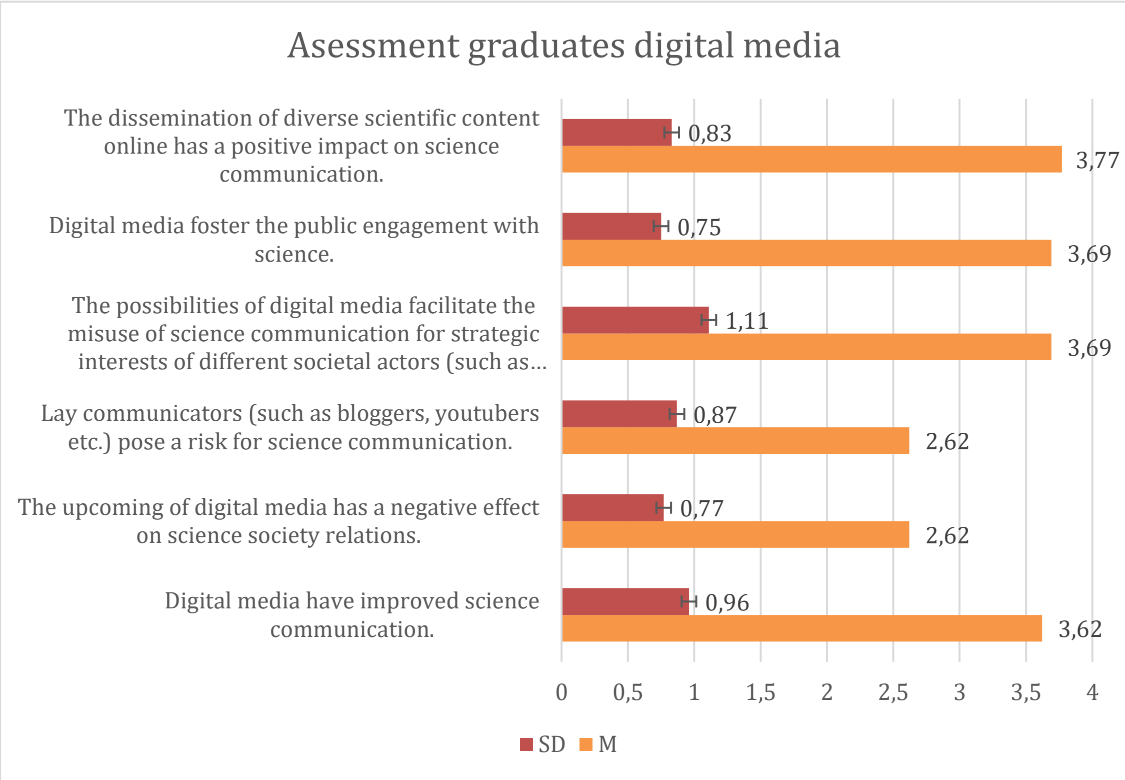

Figure 9: Assessment of risks and opportunities of digital media
(by asking how program managers or lecturers would like their graduates to assess the statements)
1=fully disagree; 5=fully agree, N=13 (source: own)

The next question covered keywords for describing the roles that science communication graduates were perceived to be relevant for (see Figure 10). Respondents were able to make up to five choices. Overall, those science communication roles that refer to interaction modes between science and the public (mediator and bridge builder) received most mentions in the sample (9 mentions each). The role conception of a "civic educator" is also seen as important for science communication (7 mentions). Journalistic role perceptions, e.g., agenda setter, reporter or gatewatcher, received moderate support (3 or 4 mentions). Traditional roles like serving as a "public intellectual" or as a "service provider" for the public were mentioned fewer times (1-2 times).

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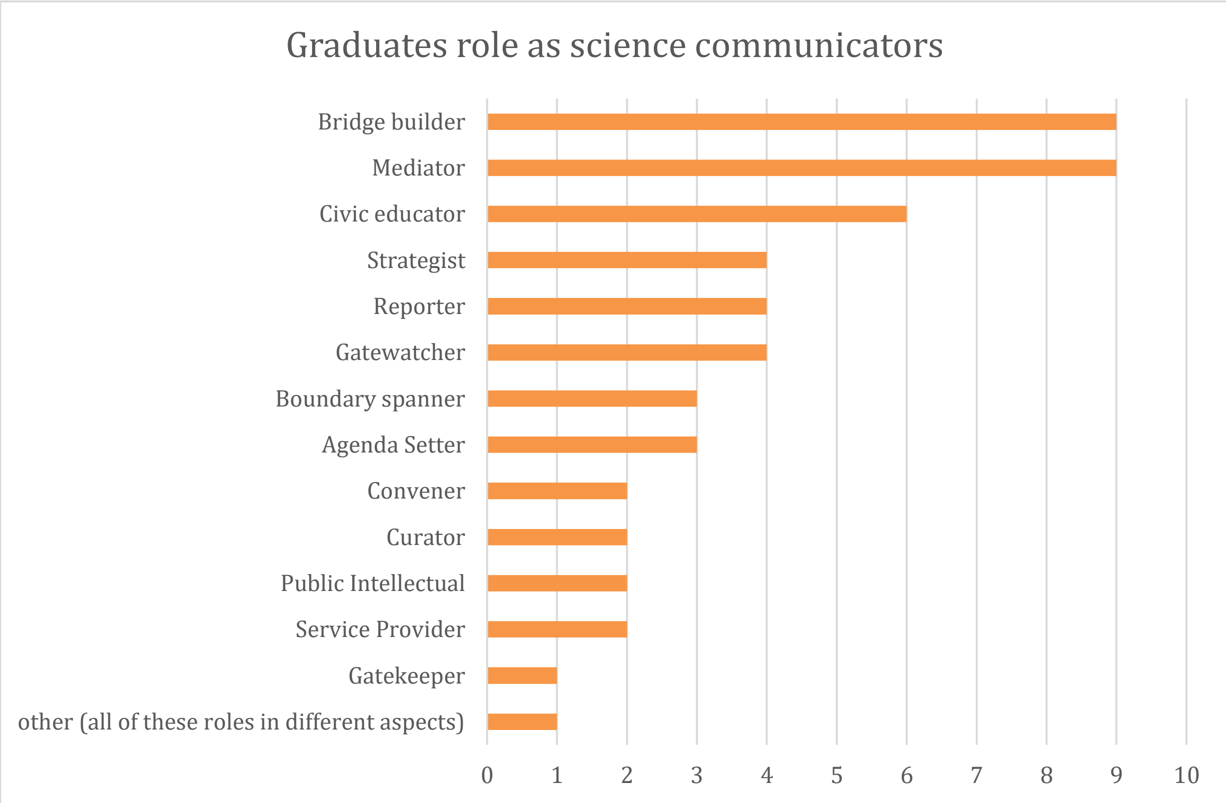

Figure 10: Graduate roles as science communicators up to five mentions (source: own)

Furthermore, we were interested in capturing to what extent specific elements of digital media such as diverse audiences and interactivity were captured by programs. Therefore, we presented a list of aspects describing digital media and asked participants for their agreement about the inclusion of these in programs on a scale from 1=not at all to 5=strongly (see figure 11). Data showed high agreement on teaching the availability of different multimedia content (M=4,23, SD=0,60) and diversity of communicators and perspectives (M=4,23, SD=0,60) as well as diversity of audiences (M=4,08, SD=0,86). Other dimensions of the internet environment for example currency of information (M=3,23, SD=1,36) and interaction possibilities (M=3,38, SD=1,26) received moderately support which means that these issues are included to a lesser extent in programs.

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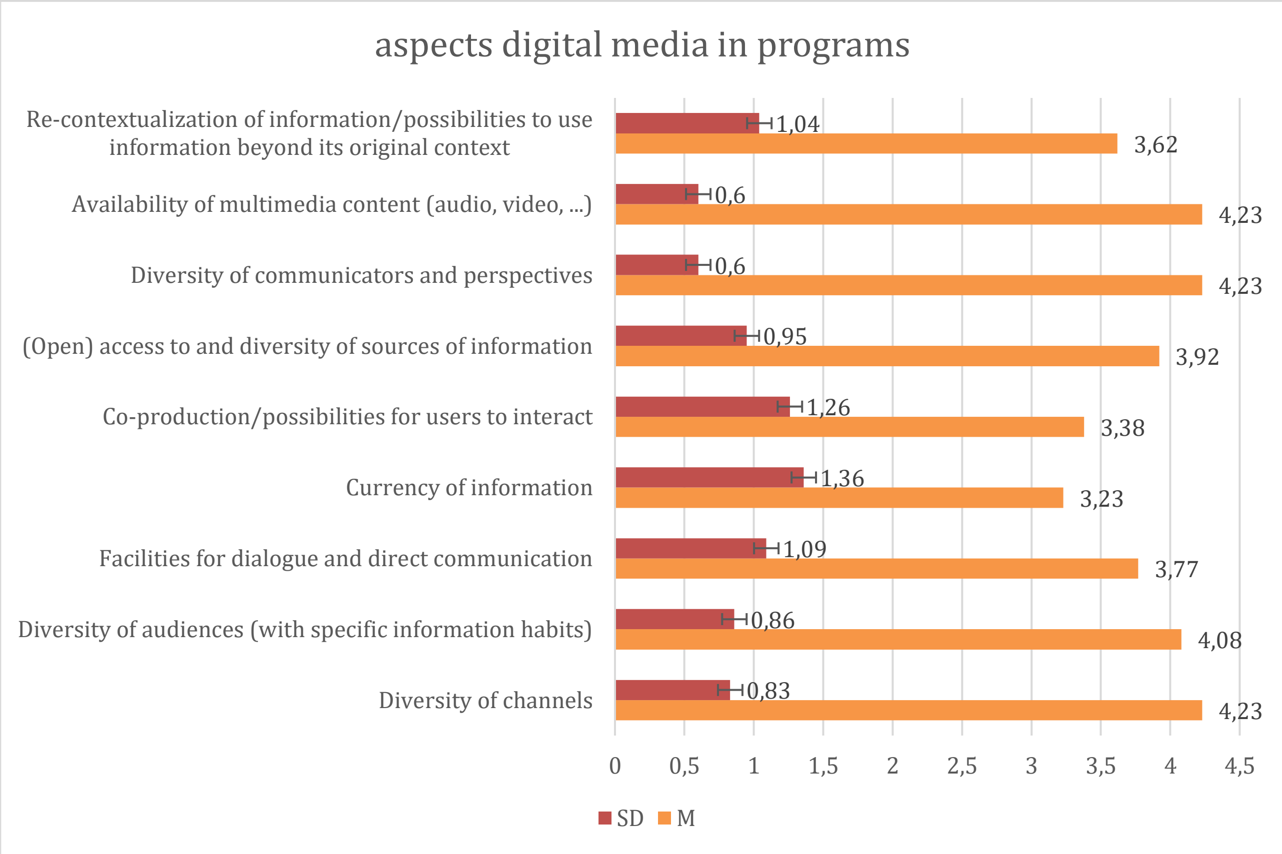

Figure 11: Aspects of digital media included in the content of programs
(by asking to which extent specific characteristics of digital media are included in programs)
1= not at all 5=strongly N=13 (source: own)

Additionally, we asked what the risks and opportunities of digitalization are to science communication today and how these issues should be considered by students (open question).

Figure 12 shows tendencies why science communicators should reflect the context the communication takes place. This means for example to consider different sources and channels of communication. It was also mentioned that programs aim at encouraging critical thinking of students. One statement highlights this as an important component of effective science communication courses:

"If the course is well constructed the students will be capable of analysing information and assessing risks and opportunities of science communication, critically, independently,

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collaboratively. The programme is oriented to critical thinking, source analysis and discussion of actual themes" (pos. 10).

Critical thinking by students was mentioned in several statements, as well (pos 10; pos 12). More specifically two statements revealed how the exposure to risks of science communication like handling misinformation is addressedin courses. One course implements a stand-alone module of critical issues in science communication (pos 9). Another course offers writing workshops with case studies to controversial topics with the goal to make students clear which intervening factors influence the effect of a scientific message (pos 8).

Figure 12: Program manager and lecturers perspectives on risks and opportunities of science communication
base: most frequent words mentioned in definitions (N=100) (source: own)

By asking for the learning goals of the courses we differentiated between knowledge, competences and attitudes (see Figure 13). For the knowledge dimension of educating students respondents indicated the highest merit for knowing the public sphere and science communication audiences (M=4,54, SD=0,52), almost equally important was knowledge of the media system (M=4,23, SD=0,73). Relevant competences such as developing a professional identity in science communication (M=4,46, SD=0,66) or being aware of the importance of

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building a trustful relationship relationship with audiences (M=4,54, SD=0,78) were also rated highly. Other qualities that science communicators could need and which are addressed in programs are openness for different contexts of science communication (M=4,23, SD=1,09). and to experience excitement for the profession as science communicator(M=4,15, SD=1,21). These aspects refer to the affective dimension of science communication learning by Baram-Tsabari and Lewenstein (2017b). Overall, the results show tendencies that not only knowledge and competences matter in terms of required science communication skills for graduates but also individual aspects like experiencing excitement, interest, and motivation about science communication are relevant

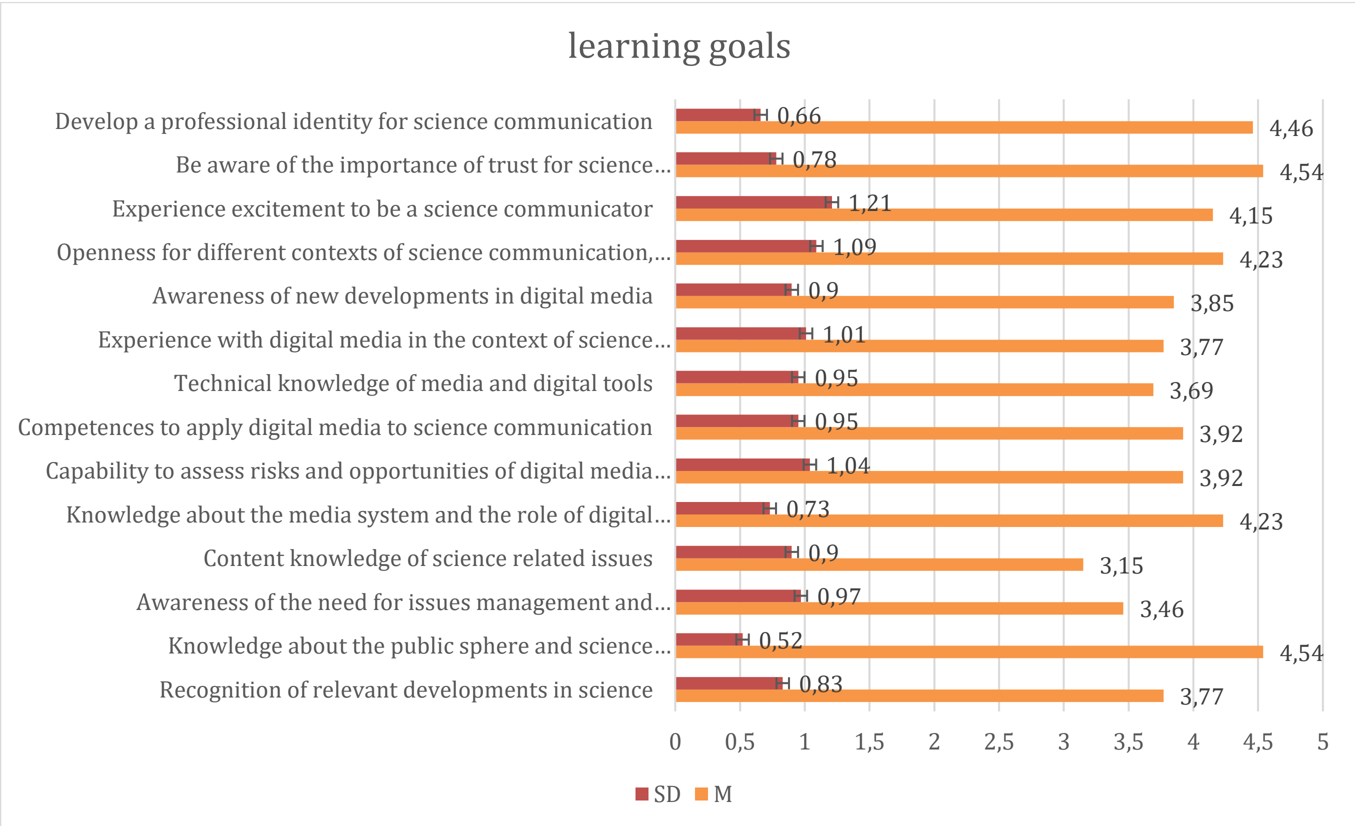

Figure 13: Learning goals, knowledge, attitudes and competences (source: own)

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6. Conclusion

Unsurprisingly, all of the surveyed science communication programs deal at least to some extent with digitalization and related perspectives in their curricula. The competence model for science communication education presented in chapter 3 describes the overall perception of the science communication landscape as “picture of the world”. Our results show that some programs convey a view of these new conditions for science communication in a mediatizised landscape. These programs convey a perception of science communication as interaction and co-production and thus emphazise that different actors, like scientists, institutions, the media, or the lay public interact in science-society interfaces. In contrast, some programs in the sample rather show a more traditional thinking of science-society relations where the communication of scientific findings to audiences is in the core.[8] However, the understanding of science communication in programs indicates that different perspectives of communication modes are assumed. This is an important finding, because depending on how the role of science communicators and audiences is defined – as one-way interaction (Besley, 2013; Besley & Nisbet, 2013; Besley & Tanner, 2011) or dialogue (Einsiedel, 2014) – one can think of different attitudes and competences that are taught in courses.

Moreover, the results indicate that teaching the profession of science communication in a mediatized landscape (see “conceptual frame” in chapter 3) requires to consider its features in programs, like interactivity, diversity of communicators and audiences. Also, program managers and lectures overall evaluate different opportunities of digital media like diversity of content or positive impacts on public engagement as important. In addition, opportunities of digital media are seen as improvement for science communication, although the need to be aware of critical aspects like the strategic misuse of communication is stresssed by the respondents, too. Moreover, most of the answers show that programs are developed to educate their students for communicator roles that foster interaction between science communicators and the public, rather than serving as a traditional gatekeeper. Especially, taking a “mediator role”[9] could serve the interaction needs in digital contexts. Beside these results towards new role perceptions and competence approaches, we also find that traditional journalistic role perceptions like agenda setting or gatekeeping/-watching still remain important for some settings. These roles of science communicators also mirror the view of one-way-dissemination processes from science to the public which some respondents indicated. Nevertheless, these answers refer to a role concept (“or conceptual frame”) that is open to different science communication contexts. Today, science communication requires being prepaired for one way information needs, for example to spread scientific content through (digital) media, but also to interact with audiences, for example on science events or digital platforms. Therefore, academic programs should consider that “specific communication practices (such as dialogue or message

[8] Although the open question for definition only provides insights in this direction and some respondents stated that they don´t use a specific definition.
[9] See graduates science communicator roles (Figure 10)

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delivery) will be appropriate in different contexts depending on audience needs and communicators' objectives" (Baram-Tsabari & Lewenstein, 2017b, p. 300).

Our competence model indicates that specific knowledge and competences are required to fill in a professional communicator role in the complex and digitalized science communication landscape (Baram-Tsabari & Lewenstein, 2017a, 2017b; Pieczka, 2002). Therefore, we evaluated how programs adress risks and opportunities of science communication. According to surveyed program managers and lecturers, possible ways to do so are by engaging students in critical thinking, evaluation of scientific information and its reliability and to rank different sources for this matter. Participants suggested some approaches as to how these could be practically implemented . These examples could provide the basis for further evaluation of the assessment of quality criteria in science communication education. Furthermore, we investigated to which extent different kinds of knowledge are taught in programs by asking about learning goals. Our results show that both science communication knowledge such as knowing the public sphere and of the media system and competences to build a trustful relationship with audiences are seen as highly relevant for graduates in the field. Affective goals, for example to experience excitement, are desirable outcomes of science communication programs. These findings can be seen as empirical validation for theoretical learning goal dimensions. As Bennett et al. 2019 suggest, this broader view on dimensions of learning objectives could help to evaluate academic courses more systematically which can be useful for further developments of science communication programs and can serve as a baseline for RETHINK´s next step at developing training resources (D3.4). Some researchers claim that there is no formal guideline for science communication programs (e.g. Bankston & McDowell, 2018; Davies & Horst, 2016). However, with our approach we offer first findings on how science communication programs could adapt their curricula and learning competences to the current complex world of communication. Our results are limited due to the small number of surveyed programs and the low response rate, therefore future studies are in demand to evaluate this research interest in a broader way, for instance, on a more representative European sample or for different cultural settings. For implementing further evaluation one centralized online resource with course information could be a useful starting point (Bankston & McDowell, 2018).

Finally, it would be interesting to focus on the students' perspective, too. One study by Crone et al. (2011) manipulated different elements in a givn course structure which could be tested in regard to learning outcomes to evaluate whether these would improve. In context of RETHINK WP3 we will therefore refine and test training resources that can be used in academic education contexts to adapt communication of scientific issues to new modes and settings of science communication.

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References

Allgaier, J. (2019). Science and Environmental Communication on YouTube: Strategically Distorted Communications in Online Videos on Climate Change and Climate Engineering. *Frontiers in Communication*, *4*, 36. https://doi.org/10.3389/fcomm.2019.00036

Allgaier, J., Dunwoody, S., Brossard, D., Lo, Y.-Y., & Peters, H. P. (2013). Journalism and Social Media as Means of Observing the Contexts of Science. *BioScience*, *63*(4), 284–287. https://doi.org/10.1525/bio.2013.63.4.8

Bankston, A., & McDowell, G. S. (2018). Changing the Culture of Science Communication Training for Junior Scientists. *Journal of Microbiology & Biology Education*, *19*(1). https://doi.org/10.1128/jmbe.v19i1.1413

Baram-Tsabari, A., & Lewenstein, B. [B.] (2012). An Instrument for Assessing Scientists' Written Skills in Public Communication of Science. *Science Communication*, *35*(1), 56–85. https://doi.org/10.1177/1075547012440634

Baram-Tsabari, A., & Lewenstein, B. [B.] (2017a). Preparing Scientists to Be Science Communicators. In *Preparing Informal Science Educators: Perspectives from Science Communication and Education* (pp. 437–471). https://doi.org/10.1007/978-3-319-50398-1_22

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

Bauer, M. W. (2017). Kritische Beobachtungen zur Geschichte der Wissenschaftskommunikation. In H. Bonfadelli, B. Fähnrich, C. Lüthje, J. Milde, M. Rhomberg, & M. S. Schäfer (Eds.), *Forschungsfeld Wissenschaftskommunikation* (pp. 17–40). Wiesbaden: Springer Fachmedien Wiesbaden. https://doi.org/10.1007/978-3-658-12898-2_2

Benkler, Y. (2006). *The wealth of networks: How social production transforms markets and freedom*. New Haven Conn.: Yale University Press. Retrieved from http://www.jstor.org/stable/10.2307/j.ctt1njknw https://doi.org/10.2307/j.ctt1njknw

Bennett, N., Dudo, A., Yuan, S., & Besley, J. C.(2019). Scientists, trainers, and the strategic communication of science. In *edited by Todd P. Newman (Hg.) – Theory and best practices*.

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

Besley, J. C. (2013). The State of Public Opinion Research on Attitudes and Understanding of Science and Technology. *Bulletin of Science, Technology & Society*, *33*(1-2), 12–20. https://doi.org/10.1177/0270467613496723

Besley, J. C., Dudo, A., & Storksdieck, M. (2015). Scientists' views about communication training. *Journal of Research in Science Teaching*, *52*(2), 199–220. https://doi.org/10.1002/tea.21186

Besley, J. C., & Nisbet, M. (2013). How scientists view the public, the media and the political process. *Public Understanding of Science*, *22*(6), 644–659. https://doi.org/10.1177/0963662511418743

Besley, J. C., & Tanner, A. H. (2011). What Science Communication Scholars Think About Training Scientists to Communicate. *Science Communication*, *33*(2), 239–263. https://doi.org/10.1177/1075547010386972

Bray, B., France, B., & Gilbert, J. K. (2012). Identifying the Essential Elements of Effective Science Communication: What do the experts say? *International Journal of Science Education, Part B*, *2*(1), 23–41. https://doi.org/10.1080/21548455.2011.611627

Brossard, D. (2013). New media landscapes and the science information consumer. *Proc Natl Acad Sci U S A.*, 14096. https://doi.org/10.1073/pnas.1212744110

Brossard, D., & Scheufele, D. A. (2013). Science, New Media, and the Public. *Science (New York, N.Y.)*, *339.* https://doi.org/10.1126/science.1232329

Bubela, T., Nisbet, M. C., Borchelt, R., Brunger, F., Critchley, C., Einsiedel, E. [Edna], . . . Caulfield, T. (2009). Science communication reconsidered. *Nature Biotechnology*, *27*(6), 514–518. https://doi.org/10.1038/nbt0609-514

Chadwick, A. (2017). *The hybrid media system: Politics and power* (Second edition). *Oxford studies in digital politics*. New York, NY: Oxford University Press.

Clarkson, M. D., Rohde, J., Houghton, J., & Chen, W. (2018). Speaking about science: a student-led training program improves graduate students' skills in public communication. *Journal of Science Communication*, *17*(02). https://doi.org/10.22323/2.17020205

Collins, H. (2014). *Are We All Scientific Experts Now?* Cambridge: Polity Press.

Collins, H., & Evans, R. (2009). *Rethinking Expertise*. Chicago: University of Chicago Press.

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

Crone, W. C., Dunwoody, S., Rediske, K. R., Ackerman, S., Zenner-Peterson, F., & Yaros, R. (2011). Informal Science Education: A Practicum for Graduate Students. *Innovative Higher Education*, *5.* https://doi.org/10.1007/s10755-011-9176-x

Davies, S. R., & Horst, M. (2016). The Changing Nature of Science Communication: Diversification, Education and Professionalisation. In S. R. Davies (Ed.), *Science communication 2016* (pp. 79–101). [Place of publication not identified]: Palgrave Macmillan. https://doi.org/10.1057/978-1-137-50366-4_4

Dudo, A., & Besley, J. C. (2016). Scientists' Prioritization of Communication Objectives for Public Engagement. *PloS One*, *11*(2), e0148867. https://doi.org/10.1371/journal.pone.0148867

Einsiedel, E. F. (2014). Publics and their participation in science and technology. Changing roles and blurring boundaries. In M. Bucchi & B. Trench (Eds.), *Routledge handbook of public communication of science and technology* (2nd ed., pp. 125–139). New York: Routledge.

Fahy, D. (2020). What studies of expertise and experience offer science communication training. In edited by Todd P. Newman (Ed.), *Routledge studies in environmental communication and media. Theory and best practices in science communication training*. London and New York: Routledge [2020].

Heath, K., Bagley, E., J. M. Berkey, A., M. Birlenbach, D., K. Carr-Markell, M., W. Crawford, J., . . . J Wesseln, C. (2014). Amplify the Signal: Graduate Training in Broader Impacts of Scientific Research. *BioScience*, *64.* https://doi.org/10.1093/biosci/biu051

Hepp, A., & Hasebrink, U. (2018). Researching transforming communications in times of deep mediatization: A figurational approach. *Communicative Figurations*, 15–48.

Hong, C.-P., & Wehrmann, C. (2010). *Do Science Communication University Programs Equip Students to Become Professionals? A Comparison of 20 University Programs Worldwide*. 11th International Conference on Public Communication of Science and Technology (PCST), New Delhi, India.

Howell, E. L., & Brossard, D. (2020). Science engagement and social media Communicating across interests, goals, and platforms. In edited by Todd P. Newman (Ed.), *Routledge studies in environmental communication and media. Theory and best practices in science communication training*. London and New York: Routledge [2020].

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

Howell, E. L., Nepper, J., Brossard, D., Xenos, M. A., & Scheufele, D. A. (2019). Engagement present and future: Graduate student and faculty perceptions of social media and the role of the public in science engagement. *PloS One*, *14*(5), e0216274. https://doi.org/10.1371/journal.pone.0216274

Irwin, A., & Horst, M. (2016). Communicating trust and trusting science communication — some critical remarks. *Journal of Science Communication*, *15*(06). https://doi.org/10.22323/2.15060101

Iyengar, S., & Hahn, K. S. (2009). Red Media, Blue Media: Evidence of Ideological Selectivity in Media Use. *Journal of Communication*, *59*(1), 19–39. https://doi.org/10.1111/j.1460-2466.2008.01402.x

Kaiser, J. (2017). Public Spheres of Skepticism: Climate Skeptics ' Online Comments in the German Networked Public Sphere. *Internatnational Journal of Communication*, *11*, 1661–1682.

Leshner, A. I. (2007). Outreach Training Needed. *Science*, *315*(5809), 161. https://doi.org/10.1126/science.1138712

Massarani, L., Reynoso, E., Murrielo, S., & Castillo, A. (2016). Science Communication Postgraduate Studies in Latin America: a map and some food for thought. *Journal of Science Communication*. (15), 1–19. https://doi.org/10.22323/2.15050203

McGreavy, B., Hutchins, K., Smith, H., Lindenfeld, L., & Silka, L. (2013). Addressing the Complexities of Boundary Work in Sustainability Science through Communication. *Sustainability*, *5*(10), 4195–4221. https://doi.org/10.3390/su5104195

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

Mercer-Mapstone, L., & Kuchel, L. (2015). Core Skills for Effective Science Communication: A Teaching Resource for Undergraduate Science Education. *International Journal of Science Education, Part B*, *7*(2), 181–201. https://doi.org/10.1080/21548455.2015.1113573

Metag, J., & Schäfer, M. S. (2019). Hochschulkommunikation in Online-Medien und Social Media. In B. Fähnrich, J. Metag, S. Post, & M. S. Schäfer (Eds.), *Forschungsfeld Hochschulkommunikation* (pp. 363–391). Wiesbaden: Springer Fachmedien Wiesbaden. https://doi.org/10.1007/978-3-658-22409-7_17

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

Miller, S. (2008). So Where's the Theory? on the Relationship between Science Communication Practice and Research. In D. Cheng, M. Claessens, T. Gascoigne, J. Metcalfe, B. Schiele, & S. Shi (Eds.), *Communicating Science in Social Contexts: New models, new practices* (pp. 275–287). Dordrecht: Springer Netherlands. https://doi.org/10.1007/978-1-4020-8598-7_16

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

Mulder, H. A. J., Longnecker, N., & Davis, L. S. (2008). The State of Science Communication Programs at Universities Around the World. *Science Communication*, *30*(2), 277–287. https://doi.org/10.1177/1075547008324878

Napoli, P. M. (2014). Automated Media: An Institutional Theory Perspective on Algorithmic Media Production and Consumption. *Communication Theory*, *24*(3), 340–360. https://doi.org/10.1111/comt.12039

Neeley, L., Goldman, E., Smith, B., Baron, N., & Sunu, S. (2014). *GRADSCICOMM: Report and recommendations.* Retrieved from http://www.informalscience.org/sites/default/files/GradSciComm_Roadmap_Final.compressed.pdf

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

Peters, H. P., Dunwoody, S., Allgaier, J., Lo, Y.-Y., & Brossard, D. (2014). Public communication of science 2.0: Is the communication of science via the "new media" online a genuine transformation or old wine in new bottles? *EMBO Reports*, *15*(7), 749–753. https://doi.org/10.15252/embr.201438979

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

Porten-Cheé, P., & Eilders, C. (2015). Spiral of silence online: How online communication affects opinion climate perception and opinion expression regarding the climate change debate. *Studies in Communication Sciences*, *15*(1), 143–150. https://doi.org/10.1016/j.scoms.2015.03.002

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

Rhein-Waal University (2020). Science Communication Finder. Retrieved from http://www.scicommfinder.info/DEV/?post_type=gd_course

Rodgers, S., Wang, Z., Maras, M. A., Burgoyne, S., Balakrishnan, B., Stemmle, J., & Schultz, J. C. (2018). Decoding Science: Development and Evaluation of a Science Communication Training Program Using a Triangulated Framework. *Science Communication*, *40*(1), 3–32. https://doi.org/10.1177/1075547017747285

Rowe, I. (2015). Deliberation 2.0: Comparing the Deliberative Quality of Online News User Comments Across Platforms. *Journal of Broadcasting & Electronic Media*, *59*, 539–555. https://doi.org/10.1080/08838151.2015.1093482

Royal Society (2020). https://royalsociety.org/grants-schemes-awards/writing-media/.

Ruiz, C., Domingo, D., Micó, J. L., Díaz-Noci, J., Meso, K., & Masip, P. (2011). Public Sphere 2.0? The Democratic Qualities of Citizen Debates in Online Newspapers. *The International Journal of Press/Politics*, *16*(4), 463–487. https://doi.org/10.1177/1940161211415849

Schäfer, M. S. (2015). Digital Public Sphere. In *Mazzoleni (Hg.) – <The> international encyclopedia of political* (Vol. 15, pp. 1–7). https://doi.org/10.1002/9781118541555.wbiepc087

Schäfer, M. S., Kristiansen, S., & Bonfadelli, H. (Eds.) (2015). *Wissenschaftskommunikation im Wandel*. Köln: von Halem.

Scheufele, D., & Nisbet, M. (2012). Online news and the demise of political debate. In *Communication yearbook* (Vol. 36, pp. 45–53).

Seethaler, S., Evans, J. H., Gere, C., & Rajagopalan, R. M. (2019). Science, Values, and Science Communication: Competencies for Pushing Beyond the Deficit Model. *Science Communication*, *41*(3), 378–388. https://doi.org/10.1177/1075547019847484

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

Simis, M. J., Madden, H., Cacciatore, M. A., & Yeo, S. K. (2016). The lure of rationality: Why does the deficit model persist in science communication? *Public Understanding of Science (Bristol, England)*, *25*(4), 400–414. https://doi.org/10.1177/0963662516629749

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

Sunstein, C. R. (2018). *#Republic: Divided Democracy in the Age of Social Media.* Oxford: Princeton Univ. Press.

Toepfl, F., & Piwoni, E. (2015). Public Spheres in Interaction: Comment Sections of News Websites as Counterpublic Spaces. In: Journal of Communication. *Journal of Communication*, *65*, 465–488. https://doi.org/10.1111/jcom.12156

Trench, B. (2007). How the Internet changed science journalism. In M. Bauer & M. Bucchi (Eds.), *Routledge studies in science, technology and society: Vol. 7. Journalism, science and society: Science communication between news and public relations* (pp. 133–142). New York, NY: Routledge.

Trench, B. (2012a). Scientists' Blogs: Glimpses Behind the Scenes. In S. Rödder, M. Franzen, & P. Weingart (Eds.), *Sociology of the Sciences Yearbook: Vol. 28. The Sciences{u2019} Media Connection {u2013}Public Communication and its Repercussions* (Vol. 28, pp. 273–289). Dordrecht: Springer Science+Business Media B.V. https://doi.org/10.1007/978-94-007-2085-5_14

Trench, B. (2012b). *Vital and Vulnerable: Science Communication as a University Subject.* https://doi.org/10.1007/978-94-007-4279-6_16

Trench, B. (2017). Universities, science communication and professionalism. *Journal of Science Communication*, *16.* https://doi.org/10.22323/2.16050302

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

University of the West of England (2020). https://courses.uwe.ac.uk/Z51000113/science-communication-building-blocks.

Vogelgesang, J., & Scharkow, M. (2016). *Evaluating the Facebook message effectiveness of Top 50 Evaluating the Facebook message effectiveness of Top 50 Shanghai Ranking Universities.* Paper prepared for the 2016 ICA conference, Fukuoka, Japan.

Walter, S., Brüggemann, M., & Engesser, S. (2018). Echo Chambers of Denial: Explaining User Comments on Climate Change. *Environmental Communication*, *12*(2), 204–217. https://doi.org/10.1080/17524032.2017.1394893

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

Warren, D. R., Weiss, M. S., Wolfe, D. W., Friedlander, B., & Lewenstein, B. [Bruce] (2007). Lessons from Science Communication Training. *Science*, *316*(5828), 1122. https://doi.org/10.1126/science.316.5828.1122b

Yeo, S. K., Xenos, M. A., Brossard, D., & Scheufele, D. A. (2015). Selecting Our Own Science: How Communication Contexts and Individual Traits Shape Information Seeking. *The ANNALS of the American Academy of Political and Social Science*, *658*(1), 172–191. https://doi.org/10.1177/0002716214557782

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Appendix

1) Survey questionnaire

Page 1

Thanks for your participation!
We are conducting a short survey on academic science communication education. Our research is dedicated to the question how academic science communication programs adapt to digitalization and media change.

We would like to cover as many science communication programs across Europe as possible and thus would like to ask you to support us with this endeavor and fill in the questionnaire with regard to the program you are involved in. If your organization offers more than one science communication program we would kindly ask you to fill in one questionnaire for each program.

We estimate that it takes 10-15 minutes to complete the survey. If you are currently unavailable we would be grateful for the recommendation of a colleague with good knowledge of the program.

Please do not hesitate to contact us with any question on behalf of the survey or the project.
Thanks a lot for your support,
best regards,

Birte Fähnrich & Laura Heintz (for the RETHINK team)

This research is part of RETHINK, a Horizon 2020 project funded by the European Commission.

https://cordis.europa.eu/project/rcn/219057/factsheet/en

The objective of RETHINK is to understand existing activities and challenges in science communication, develop strategies to deal with these challenges and barriers, experiment with new strategies to then allow the synthesis of findings into new approaches to science communication.

The data we collect are processed, stored and shared in accordance with the European Data Protection Regulation. This means that your data will not be identified in any reports or publications and any data extracts will be carefully reviewed to ensure you are not identifiable. Any sensitive or identifiable data will be kept confidential, whereas aggregated and pseudonymised data will be shared with our project partners and third parties. The information gathered will be used for the purposes of the study report, academic dissemination, and potentially as a basis for future guidelines on best practices in science communication. There will also be a presenatation of results at the PCST Conference 2020. The final report will be published online and will be publicly available. This questionnaire is authorized by the ethics commission of the Zeppelin University. In case you want your contribution withdrawn from the study or have questions about your participation please use the comment box at the end of the questionnaire or contact us via e-mail.

☐ I read the information above and hereby confirm my participation in this study.

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Page 2

1. Please indicate the name of your science communication program.

[ ]

2. Please indicate the university and organizational unit (e.g. faculty, department) that offers the program.

[ ]

3. In which language is the program taught?

- ☐ English
- ☐ Dutch
- ☐ German
- ☐ Italian
- ☐ Portugese
- ☐ Russian
- ☐ Swedish
- ☐ Other (please indicate)

4. Which degree do the students taking your program gain?

- ☐ B.A.
- ☐ B.Sc.
- ☐ M.A.
- ☐ M.Sc.
- ☐ Other undergraduate degree
- ☐ Other graduate degree

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Page 3

5. When was the program introduced? Please indicate the year?

☐ I don´t know

6. When was the last time the program/curriculum was validated? Please indicate the year?

☐ I don´t know

7. How many students graduate in the program each year (on average)?

☐ I don´t know

8. What are the most common occupations/positions that graduates take? Please indicate the up to five most common fields.

- ☐ Journalism
- ☐ Strategic communication and public engagement at universities, research centers, museums, science centers etc.
- ☐ Research
- ☐ Teaching/Tutoring
- ☐ Media Production and Presenting
- ☐ Administration (in policy, research councils and founders)
- ☐ Management (e.g. in science and health organizations)
- ☐ Evaluation
- ☐ (Political) Consulting
- ☐ Freelance
- ☐ Others, please indicate
- ☐ I don't know

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Page 4

9. How would you assess the overall orientation of the program?

- ◯ Theoretical orientation
- ◯ Practical skills orientation
- ◯ Equally theory and practice oriented
- ◯ Other, please indicate

10. Does the program have a certain disciplinary orientation? If so, please indicate how you would classify the program? (you can make up to three choices that apply to the program)

- ☐ Science and Technology Studies/Sociology
- ☐ Communication theory
- ☐ Science Communication/public engagement
- ☐ Strategic Communication/Marketing
- ☐ (Social) Psychology
- ☐ Museum Studies
- ☐ Media Studies/Journalism
- ☐ Education
- ☐ Natural Science
- ☐ Other, please specify

11. There is a large variety of definitions of science communication. Please define the concept as taught in the program. You can also give more than one definition.

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Page 5

12. How would you describe the overall importance that digital media and related societal changes play throughout the curriculum?

- ◯ They are a major topic and integrated into every module/part of the program
- ◯ They are an important topic and taught in separate modules/parts of the program
- ◯ They are part of the program but not with a special focus
- ◯ There is no special content referring to digital media
- ◯ I don't know

13. How would you like your graduates to assess the following statements?

	fully agree				fully disagree
Digital media have improved science communication.	◯	◯	◯	◯	◯
The upcoming of digital media has a negative effect on science society relations.	◯	◯	◯	◯	◯
Lay communicators (such as bloggers, youtubers etc.) pose a risk for science communication.	◯	◯	◯	◯	◯
The possibilities of digital media facilitate the misuse of science communication for strategic interests of different societal actors (such as activist groups, political actors, corporations).	◯	◯	◯	◯	◯
Digital media foster the public engagement with science.	◯	◯	◯	◯	◯
The dissemination of diverse scientific content online has a positive impact on science communication.	◯	◯	◯	◯	◯

14. How would you like your graduates to perceive their roles as science communicators? (please choose up to five options)

- ☐ Civic educator
- ☐ Curator
- ☐ Convener
- ☐ Mediator
- ☐ Gatekeeper
- ☐ Gatewatcher
- ☐ Reporter
- ☐ Agenda Setter
- ☐ Bridge builder
- ☐ Boundary spanner
- ☐ Strategist
- ☐ Service Provider
- ☐ Public Intellectual
- ☐ Activist/Advocate
- ☐ Other, please indicate ________

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Page 6

15. Within your program to what extent do you convey the following aspects of digital communication to your students?

	strongly				not at all
Diversity of channels	○	○	○	○	○
Diversity of audiences (with specific information habits)	○	○	○	○	○
Facilities for dialogue and direct communication	○	○	○	○	○
Currency of information	○	○	○	○	○
Co-production/possibilities for users to interact	○	○	○	○	○
(Open) access to and diversity of sources of information	○	○	○	○	○
Diversity of communicators and perspectives	○	○	○	○	○
Availability of multimedia content (audio, video, ...)	○	○	○	○	○
Re-contextualization of information/possibilities to use information beyond its original context	○	○	○	○	○

How would you like your students to assess risks and opportunities of science communication?

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Page 7

16. To what extent do students acquire the following knowledge, competences and attitudes throughout the program?

	strongly				not at all
Recognition of relevant developments in science	○	○	○	○	○
Knowledge about the public sphere and science communication audiences	○	○	○	○	○
Awareness of the need for issues management and knowledge of related approaches	○	○	○	○	○
Content knowledge of science related issues	○	○	○	○	○
Knowledge about the media system and the role of digital media for society	○	○	○	○	○
Capability to assess risks and opportunities of digital media for science communication	○	○	○	○	○
Competences to apply digital media to science communication	○	○	○	○	○
Technical knowledge of media and digital tools	○	○	○	○	○
Experience with digital media in the context of science communication	○	○	○	○	○
Awareness of new developments in digital media	○	○	○	○	○
Openness for different contexts of science communication, like different sources or actors	○	○	○	○	○
Experience excitement to be a science communicator	○	○	○	○	○
Be aware of the importance of trust for science communication	○	○	○	○	○
Develop a professional identity for science communication	○	○	○	○	○

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17. Please indicate your position (in relation to the science communication program, e.g. program manager, lecturer)

18. Please indicate your personal background. What is your highest degree?

- ◯ Bachelor
- ◯ Master
- ◯ Doctorate
- ◯ Other

19. Please indicate your disciplinary background.

- ☐ Sociology/STS
- ☐ Communication science
- ☐ Media studies
- ☐ Psychology
- ☐ Museology
- ☐ Physical sciences
- ☐ Life sciences
- ☐ Arts and humanities
- ☐ Education
- ☐ Other, please indicate

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How long have you been working in science communication? (please indicate the duration in years)

In any role	
In a role specifically related to teaching science communication	

20. Please indicate your gender.

◯ Male
◯ Female
◯ Non-Binary

21. Please indicate your year of birth.

22. Do you have any other comments based on the points the questionnaire has raised?

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Page 8

Thanks for your contribution!

If you have any questions on the questionnaire or would like more information on the study, please contact Dr. Birte Fähnrich (birte.faehnrich@zu.de) or Laura Heintz (laura.heintz@zu.de) from the Zeppelin University Friedrichshafen Germany via email.

This research is part of RETHINK, a Horizon 2020 project funded by the European Commission.

https://cordis.europa.eu/project/rcn/219057/factsheet/en

The objective of RETHINK is to understand existing activities and challenges in science communication, develop strategies to deal with these challenges and barriers, experiment with new strategies to then allow the synthesis of findings into new approaches to science communication.

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2) Wordcloud mentions (N=100)

science communication program definition

Word	Frequency
science	28
communication	19
public	6
society	6
scientific	5
variety	5
approaches	4
between	4
definition	4
research	4
social	4
their	4
different	3
including	3
interaction	3
involves	3
media	3
perspective	3
practice	3
processes	3
schools	3
scientists	3
students	3
technology	3
use	3
about	2
audiences	2
broad	2
category	2
discourses	2
engaging	2
general	2
information	2
interactions	2

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interfaces	2
issues	2
knowledge	2
more	2
museums	2
non	2
organization	2
participatory	2
understand	2
way	2
academic	1
across	1
actors	1
addressing	1
align	1
awareness	1
backgrounds	1
based	1
begins	1
behind	1
beyond	1
bodies	1
capacity	1
centre	1
centres	1
citizen	1
co	1
communicate	1
community	1
complexities	1
complicated	1
concepts	1
concerns	1
consider	1
continues	1
coproductionist	1
covered	1
covers	1
definitions	1

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develop	1
discourse	1
disseminated	1
dissemination	1
dissertation	1
diverse	1
doing	1
down	1
educating	1
effectively	1
effects	1
emphasize	1
employ	1
enable	1
encompass	1
essentially	1
established	1
exchange	1
expert	1
facts	1
field	1
functioning	1
goes	1
government	1
growing	1
idea	1
importance	1

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Wordcloud mentions (N=100)

risks and opportunities science communication

Word	Frequency
science	20
communication	13
risks	8
opportunities	7
students	6
different	5
critical	4
make	4
making	4
may	4
scientific	4
them	4
attitude	3
knowledge	3
programme	3
public	3
what	3
able	2
about	2
analysis	2
approaches	2
assess	2
assessment	2
assessments	2
been	2
can	2
case	2
clearly	2
communicators	2
course	2
critically	2
example	2
factors	2
if	2
itself	2

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more	2
new	2
presented	2
sources	2
their	2
through	2
uncertainty	2
understand	2
want	2
well	2
where	2
would	2
ability	1
activity	1
actual	1
affords	1
aim	1
all	1
allows	1
already	1
ameliorating	1
analysing	1
application	1
assumptions	1
at	1
awareness	1
because	1
become	1
behind	1
between	1
capable	1
challenge	1
channels	1
climate	1
closure	1
collaboratively	1
communicated	1
community	1
compare	1

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complete	1
completely	1
consider	1
constructed	1
contaminated	1
context	1
contexts	1
controversial	1
convey	1
countries	1
covered	1
crucial	1
decision	1
decisions	1
democracy	1
develop	1
developers	1
differentiate	1
dimension	1
discourse	1
discussion	1
disseminate	1
doing	1
during	1
earth	1
effectively	1

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3) definitions of science communication taught in programs

1. Science communication is the practice of informing, educating and raising awareness of the general public on science-related issues.

2. Science communication is a growing and broad field research that involves several players, and that begins from listening to the public and continues with interactions and exchange of information about the important and complicated role that science plays in our lives.

3. We teach scientists how to effectively communicate scientific concepts to a variety of audiences, and the reasons for doing so.

4. To us, science communication goes beyond the communication of scientific theories or established facts to encompass the processes - political, social - by which scientific knowledge is made and disseminated.

5. Science communication is a space that use to align information on science and technology with their own values and visions of the world

6. I suppose we use roughly the definition that science communication is about engaging the public with science and technology, including a variety of one-way and two-way mechanisms and addressing societal concerns and issues through approaches such as responsible research and innovation.

7. Any interaction between science and society, including top-down approaches such as mass media as well as more interactive approaches such as citizen science.

8. Science to society

9. We don't employ one specific definition. The different definitions are something that is covered in the programme to enable students to understand it's scope, its effects and the motivations behind it.

10. For the purpose of our master, we consider science communication to be a social practice with multiple meanins. Science communication is much more than the public dissemination of scientific knowledge, and includes communication between scientists, between scientific organizations and schools, between scientists and their organization and the general public. We understand that science communication is a social pratice that involves the government and state bodies, the scientific community, schools and the whole system science museums, media and industry. This also involves variety of social roles, logics and modes of functioning, discourses and communication technologies.

11. Science communication in the program has a large perspective, but essentially of science organization for public understanding in schools or museums or science centres. We intend to

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give students the idea of the importance of different types of discourses, from scientific till media discourse. This is based on research so there is also a research methodology unit in order to give students the capacity to develop a dissertation or a project or a practicum in a communication centre.

12. We think of science communication as a wide umbrella term which covers both the academic study and professional practice of engaging non-expert audiences with science and technology in a variety of ways, including participatory and non-participatory approaches.

13. From an STS perspective, we take the complexities of science-society interactions as a starting point. Science Communication we see as the interaction and communication processes that take shape across diverse science-society interfaces. Taking a coproductionist perspective means we see science-society interfaces as sites of co-production, where the relationship of science and society is shaped. We emphasize the variety of actors and their relationships, their different backgrounds and perspectives. That is probably why we don't use one definition of science communication, other than this broad view on interaction and communication processes.

4) statements of risks and opportunities of science communication

1. Science communication is a completely open field where you can experiment multiple approaches to science communication, making use of a miriad of new tools and new media. At the same time, it is crucial that you can develop a critical perspective that allows you to clearly separate what is science from what is pseudoscience and disseminate that attitude to your publics, some of which may be already contaminated by all the garbage they receive from mutiple sources, mainly online.
Through identification, analysis, evaluation, treatment, monitoring and review of both risks and opportunities.

2. It really is up to them to make their own decisions.

3. Science communication affords opportunities to make knowledge-making more transparent and is thereby a public good, an important element of public discourse in a modern democracy. The risks are that in revealing or emphasizing the social dimension of scientific knowledge-making, science communicators may undermine trust in the institution of science (because science has for so long presented itself as essentially infallible) and so make it harder for scientists to make a persuasive case for the application of scientific knowledge in the public sphere, for example in vaccination programs or in ameliorating the effects of human activity on the Earth's climate.

4. Through the ability to differentiate between different contexts

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5. not entirely sure what you mean here. I would hope that my students are thoughtful communicators that respect (but may also challenge) a range of opinions about science and who are able to present risks and uncertainty clearly in their work.

6. We would like them to become critical developers of science communication products where they understand the strengths and weaknesses of different sources/channels and implement them thoughtfully.

7.the problem of the scientific community closure

8. During the teaching on the programme, students are provided with case studies that illustrate risks behind science communication, such as misinformation leading to poor decision making (for example in relation to vaccines) as well as the opportunities presented. This is also reflected in the assessments. In one of the first assessments students complete on the programme, they are invited to write about a controversial topic from science and compare how it has been handled in different settings eg countries, or how different topics have been covered or received. By doing these things, the aim if for students to consider the factors which influence how effectively science is communicated, such as the medium (or platform) employed and factors intrinsic to science itself, such as the role of scientific uncertainty.

9. We strongly invest in the assessment of risk in science communication. We even have a course that intends to raise awareness in that matter: Critical Issues in Science and Communication.

10. If the course is well constructed the students will be capable of analysing information and assess risks and opportunities of science communication, critically, independently, collaboratively. The programme is oriented to critical thinking, source analysis and discussion of actual themes.

11. We don't usually teach any specific approaches to the assessment of risks and opportunities in science communication, but we try to convey a more reflexive attitude to communication and the idea of precaution. We have a module on general statistics, which may help to foster this attitude.

12. We want our students to be able to reflect critically on the underlaying values and assumptions embedded in different practices of science communication. I find the question hard to understand, but I guess we want them to assess risks and opportunities openly, with eye for the context, and the relational and emergent properties of any given science communication process.

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