

# Science Communication of the Faculty of Science & Engineering of the University of Groningen: Staff and key actors' views and practices

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## Abstract

The creation of social impact is one of the core tasks of a university. Science communication is an important tool for linking science and society and making research socially relevant. Over the years there has been an increasing emphasis on the scientist as a public communicator, especially now that creating social impact has become a mandatory part of fund applications. Hence, it is anticipated that universities in general design and implement plans of actions related to science communication and public engagement. In this research I examined how public outreach and science communication is managed within the Faculty of Science & Engineering (FSE) at the University of Groningen, and how scientists (junior and senior) experience science communication. Data were collected via a mixed methods approach: a survey among the research institutes of the FSE (n=5), a survey among PhD students (n=28), interviews with senior scientists (n=7) and interviews with experts in the field (n=2). The analysis of the data illustrate that there is a lack of a shared vision on science communication throughout the university, that a culture of science communication is lacking, and that scientists and institutes would benefit from more support in the following forms: organizational support as well as support from science communication experts.

## Introduction

A review of the international literature points to the importance of science communication because it can positively influence the attitudes of people towards science, it can empower individuals to make decisions about science as for example citizens and policymakers, and it can also increase the amount of trust placed in scientists by the general public (Jucan & Jucan, 2014). Science communication is often described as activities of professional communicators, such as journalists or the scientists themselves, which aim to promote the public understanding of science. But that does not capture all the aspects of science communication. Burns, O'Connor, and Stocklmayer (2003) defined science communication through the vowel analogy: AEIOU. This means that science communication can be defined as the use of appropriate skills, media, activities, and dialogue to produce one or more of the following personal responses to science:

**A**wareness, including familiarity with new aspects of science

Enjoyment or other affective responses, e.g. appreciating science as entertainment or art

Interest, as evidenced by voluntary involvement with science or its communication

Opinions, the forming, reforming, or confirming of science-related attitudes

Understanding of science, its content, processes, and social factors

The Dutch Government also recognizes the importance of science communication and public outreach as it launched '*Wetenschapsvisie 2025: keuzes voor de toekomst*', a document presenting, inter-alia, the ambitions of the government to enhance the connection between science and society (Ministerie van Onderwijs Cultuur en Wetenschap, 2014). Therefore, scientists are encouraged or often even obliged to spend part of their research budget on creating social impact or science communication.

Universities play an important role in enhancing the connections between science and society: creating social impact is, in addition to education and research, one of the core tasks of a university. Science communication is an important tool to give social relevance to research. Given that creating social impact is one of the core tasks of a university, one would expect that universities, including the University of Groningen, have formulated a clear vision of science communication. Strikingly, a search through the website of the University of Groningen does not provide a clear vision on science communication.

When I asked prof. dr. Jouke de Vries, the President of the university of Groningen for the vision of the university on science communication, he referred to the following quote on the website:

"We want our students to become active, independent, and responsible citizens who can think critically and help solve the scientific and societal challenges of today and the entrepreneurs of tomorrow" (President of the University, email communication).

This refers to the education of students and not to science communication, indicating a false understanding of what science communication is. He added:

"Science communication is essential and indispensable for the dissemination of knowledge and the conversion of knowledge."

While this statement reveals an understanding for the need of science communication, at the same time, it illustrates that a clear vision of science communication is lacking. This raises the following question: *how is science communication and public outreach arranged within the university, and the Faculty of Science & Engineering (FSE) in particular?* Recently, the FSE has updated their Career Paths in Science tenure track policy, stating that staff members must develop a strategy to highlight the societal relevance of his or her research in a structural way.

"The staff member must promote the societal relevance of his or her own research by, for example, lecturing or publishing about the research to a broad audience, or by collaborating with companies, governments or NGOs to make the insights gained applicable in those organizations or by registering patents" (*Career Paths in Science, edition 4, 2018*).

This indicates that on a faculty level creating social impact and science communication is being encouraged. But is this indeed the case? Are staff members actually involved in science communication activities or highlighting the social relevance of their research in a structural way?

A review of related literature indicates that only a few studies have investigated if and how much scientists participate in public outreach (Andrews, Weaver, Hanley, Shamatha, & Melton, 2005; Dudo & Besley, 2016). However, the findings of those studies are consistent and show the scientists' decision to either contribute to or to refrain from public engagement (Andrews et al., 2005; Dudo & Besley, 2016; Jacobson, Butterill, & Goering, 2004; Poliakoff & Webb, 2007). The findings of these studies show that, even though scientists seem to be motivated to participate in outreach activities,

they feel limited to actually be able to do so. Scientists mention environmental constraints, such as a lack of time or money, to be the greatest limiting factor (Abes, Jackson, & Jones, 2002; Andrews et al., 2005; Poliakoff & Webb, 2007).

Strikingly, the study of Poliakoff and Webb's study (2007) shows that although scientists do mention a lack of time as limiting factor, time constraints do not emerge as a negative predictor for participation intentions. This suggests that these constraints might be used as an excuse to mask other concerns about participating in public engagement activities. These results are important because they can be used as input for the design of interventions that aim to motivate scientists to engage in public outreach.

In my research I would like to examine how public outreach, as part of science communication, is managed within the FSE, in which ways FSE scientists are involved in public outreach activities, what motivates them to engage with the general public and their possible reasons to refrain from engagement.

## Methods

For this research a mixed method approach was used, combining both quantitative and qualitative methods for data collection and analysis. I collected quantitative data from the different institutes and PhD students of the Faculty of Science & Engineering (FSE) through an online survey. The survey was conducted in English. Qualitative data was collected through interviews with several senior scientists from this faculty. Depending on whether the scientists spoke Dutch fluently, the interviews were conducted in Dutch or English. All participants are fluent in English. Hence, I did not come across any instances where the meaning was unclear. Additionally, I interviewed two key actors, working in important outreach units of our university: a program maker of Studium Generale and the project manager of Science LinX. The interviews were conducted in Dutch, and were then translated in English for the purpose of this report. This could potentially serve as a limitation as the meaning might not be totally accurate in certain instances. To address this limitation, when I translated the interviews and analyzed the data I shared those with both of them to check the meaning. This was also done for issues related to researcher-participant trust as I had indicated to both of them prior to the interviews that they could read my interpretations to make sure that those were accurate for the purpose of trustworthiness, but that they also felt comfortable with these being public. It is also important to notice that they both approved mentioning their positions within their organization in this report, hence, there are no confidentiality issues. More details on each of the methods used are discussed in the sections below.

## Survey institutes

To gain more insight in how science communication is structured within the different research institutes of the Faculty of Science & Engineering, I distributed an online survey, using Qualtrics, among the 11 research institutes of the faculty: Bernoulli Institute for Mathematics, Computer Science and Artificial Intelligence, ENTEG - Engineering and Technology institute Groningen, ESRIG - Energy and Sustainability Research Institute Groningen, GBB - Groningen Biomolecular Sciences and Biotechnology Institute, GELIFES - Groningen Institute for Evolutionary Life Sciences, GRIP -

Groningen Research Institute of Pharmacy, ISEC - Institute for Science Education and Communication, Kapteyn Institute, Stratingh Institute for Chemistry, Van Swinderen Institute for Particle Physics and Gravity and Zernike Institute for Advanced Materials. The survey was aimed at either the director or the scientific coordinator of the institute: a person with insight into the (outreach) activities of the institute.

The purpose of the survey was to collect information on public outreach within the institutes. The survey therefore included questions like: *Are you or researchers from your research institute involved in science outreach activities? What training, if any, do researchers get in communicating science to the non-specialist public? Is there someone in service at the institute responsible for managing science communication and outreach activities?*

The survey was conducted using questions from a validated survey (Rees, 2006) and input from Studium Generale and Science LinX in order to add questions that are directly related to the context of the study. The survey was validated by having it assessed by two fellow students and a professor in science communication. The survey consisted of 20 questions, and completion took about five minutes. The institutes received the survey through an email, and were given six weeks to fill it in. The data were analyzed using Qualtrics, graphs and tables were made in Microsoft Excel.

## Data collection: Interviews with scientists

To gain more insight in the experience of science communication of senior scientists, seven scientists (either tenure trackers or professors) were interviewed. With the help of Science LinX, I selected scientists who were already actively involved in outreach activities and also scientists who were less active in science communication, in order to get different views on science communication. Scientists were distributed among the several institutes and research fields as follows:

Bernouilli Institute – Dynamical systems, Geometry & Mathematical systems

Bernouilli Institute – Fundamental Informatics

Bernouilli Institute – Information Systems

Bernouilli Institute – Software Engineering

Zernike Institute for Advanced Materials – Surfaces and Thin Layers

Van Swinderen Institute – High energy physics

Van Swinderen Institute – Fundamental Interactions and Symmetries

The aim of these interviews was to gain insights into how scientists experience science communication: why do they (not) do it? What difficulties do they face when they engage in science communication activities? And what would encourage them to do more science communication? Some examples of the interview questions are as follows: *What is the main reason for you to engage with the non-specialist public? What is stopping you from getting (more) involved in activities that engage the non-specialist public in science? What would encourage you personally to get involved in activities that engage the non-specialist public in science?*

The interview questions were conducted using questions from an existing and validated survey (Rees, 2006) and input from Studium Generale and Science LinX. The questions have been validated by

having them assessed by two fellow students and a professor in science communication. The interviews lasted between 40 and 60 minutes. All the interviews were transcribed. Then, the interviews with the Dutch researchers were translated from Dutch to English. Following on that, the interviews were analyzed through an en vivo coding system, with codes being developed through a combination of existing research findings and as they emerged in the data. Examples of the codes are as follows: *“Reasons to participate in outreach activities – obligation towards society”*, *“Issues and barriers – Lack of time”* and *“Issues and barriers – Lack of skills”*. A second assessor (my supervisor) went over the analysis and we discussed any disagreements until we reached a consensus in our interpretations of the data for the purpose of establishing trustworthiness in the analysis.

### **Data collection: Survey administered to PhD students**

In order to gain more insight in how PhD students experience science communication, an online Qualtrics survey was distributed via a newsletter among the approximately 800 PhD students from the Faculty of Science & Engineering. With this survey, I wanted to collect information on, among other things, the ways in which PhD students are involved in outreach activities, whether they receive training in science communication and whether they know who to turn to if they need support in science communication. The survey therefore included questions like: *Thinking about public engagement with, and communication about, science, roughly how many times in the past 12 months have you done each of the following outreach activities? What training, if any, have you had in communicating science to the non-specialist public? If you require support when it comes to science communication, whom do you contact?*

The survey was conducted using questions from an existing survey (Rees, 2006) and input from Studium Generale and Science LinX. It consisted of 28 questions, and completion took about five minutes. The survey has been validated by having it assessed by two fellow students and a professor in science communication. The PhDs had three weeks to fill in the survey. Data was analyzed using Qualtrics, graphs and tables were made in Microsoft Excel.

### **Data collection: Interviews with key actors**

In order to collect information about the outreach policy of the university I interviewed experts working at important outreach organs of the university: a program maker of Studium Generale and the project manager of Science LinX.

Studium Generale is a collaboration between the University of Groningen and the Hanze University. They organize all kinds of activities in the domain of science, culture and society like lectures and debates. The interviewee is a program maker from Studium Generale. She is responsible for a part of their programming. To recruit scientists or other experts for their program, she has intensive contact with researchers and research institutes of the University of Groningen. To be able to set up a good program, she is kept up to date on all scientific and social developments.

Science LinX is the faculty's center of expertise in outreach and engagement. Science LinX coordinates programs to inform and involve pupils, lecturers, non-profit organizations and the general public in research conducted by the faculty. The interviewee is the project manager of

Science LinX, which means she is the leader of this department. Right now she is implementing a multi-year plan on how to set up the faculty mission in the field of outreach and engagement.

The questions for these interviews were validated by having them assessed by two fellow students and a professor in science communication who responded to the questions first and then discussed them with me. The interviews included questions like: *what is the vision of the university about science communication? Are issues of internationalization, diversity, and inclusion taken in consideration when planning? What difficulties do you face when trying to involve scientists in your activities?*

Both interviews took an hour. The interviews were transcribed, translated from Dutch to English, and analyzed through an open-coding system. A second assessor (my supervisor) went over the analysis and we discussed any disagreements until we reached a consensus in our interpretations of the data, for the purpose of establishing trustworthiness.

## Results

### Scientists' views and practices: survey results

To gain more insight in how science communication is structured within the different research institutes of the Faculty of Science & Engineering, I distributed a survey among the 11 research institutes of the faculty. The survey was aimed at either the director or the scientific coordinator of the institute: someone with insight into the (outreach) activities of the institute. Of these 11 institutes, either the director or the scientific coordinator of five institutes filled in the survey, resulting in a response rate of approximately 45%.

#### View on science communication

I asked the representative of the institutes to give their opinion about science communication and engaging in public outreach activities. They offered the following answers:

*"At GRIP we believe that it is very important to communicate what we do to society. Pharmaceutical science intrinsically has a strong societal focus, as it deals with human beings in health and disease. We encourage our researchers to do public outreach activities and to communicate their work to society, which they do in a variety of ways - including teaching programs at high schools and contributions to national press/media."*

*"Increasingly important (rightfully), but not always easy."*

*"Unfortunately, capacity is lacking to fully pursue a very active outreach. However, via Science LinX (and accompanying releases via EurekAlert) the research at GBB acquires public attention. Also high-level journal use Altmetrics for tracking impact of their publications."*

*“Our institute is engaged in research in education and communication. This research can only be done with professionals from these fields’ like teachers, school principals, science centers. Further, the nature of our research makes that we are frequently asked for advice on educational policy (professional development of teachers, curriculum development etc.). So, collaboration with stakeholders is very obvious in our work.”*

*“Important, because of the fact that external (often public) money is used and it is therefore good to explain to society what happens within science and what the importance of this is.”*

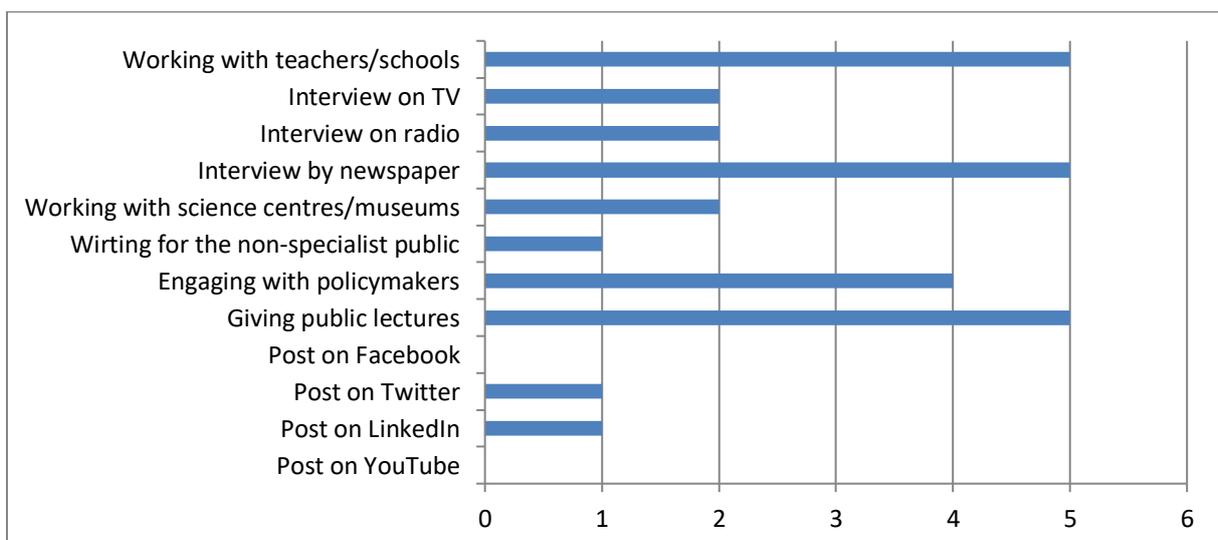
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The first respondent highlights the importance of science communication and offers some examples of how their institute is involved in outreach activities. The following respondents indicate that science communication is not always easy and that the capacity is lacking to fully pursue a very active outreach program. Communication with stakeholders is mentioned by one of the respondents, which does not count as public outreach. As becomes obvious, the majority of the responders did not respond directly to the question. Which might mean they are not doing public outreach, or they do not really understand what public outreach is.

### **Outreach activities**

When asked directly, all of the responders feel that researchers from their institute are involved in outreach activities and that their institute’s research has societal implications. The types of science outreach activities in which they are involved are displayed in Graph 1. Strikingly, there are no responses regarding the use Facebook and YouTube, and only one response for Twitter as well as LinkedIn, while these are used widely for science communication purposes. When asked directly how social media are used, the participants responded that social media are not often used by senior staff, only sometimes by younger staff. They post about their research in general, but how these social media are used exactly remains unclear.

***Outreach activities of research institutes***



*Graph 1. This graph shows the different kind of outreach activities researchers of the institutes are involved in. The blue bars indicate the absolute amount of times each activity is mentioned by the institutes.*

The respondents indicated that researchers from their institute are generally supportive towards those who take part in science communication activities. Three responded that researchers are very supportive, one responder describes the researchers as fairly supportive, and one responder describes the researchers as not particularly supportive. This indicates that the atmosphere within the institutes around science communication is generally positive, so this is probably not an obstacle for those who would like to do science communication.

### **Established structures**

Two of the five institutes indicated that someone is in service at their institute who is responsible for managing science communication and outreach activities. When being asked what kind of activities this person is involved in, they offered the following answers:

*“At the institute level we try to have all activities and attention of others on our work added in the PURE system, whenever possible linked to the respective publication. This data is accessible (green open access) via the research database page of every staff member.”*

*“I do parts of this (mainly providing news and link to press) as part of my work as a scientific coordinator. Researchers also do a lot themselves.”*

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From the first answer it does not become clear what kind of activities the person, who is responsible for managing science communication, is involved in. This person refers to a system, which suggests that there is no one in service to manage outreach activities. This also goes for the second answer: the scientific coordinator only functions as a link to the press, but scientists manage their outreach activities themselves. The other three institutes, who indicated that there is no one in service to manage science communication, also mention that there is no strong policy on how these activities are managed: scientists take care of this themselves. They provided the following answers:

*“Researchers do this themselves. They are aware that societal relevance is becoming an increasingly important parameter in the evaluation of their performance. Any particularly interesting activities are published on our institution's website.”*

*“Individually for the moment (at the researcher or research group level). Future development possibly more at the institute level.”*

*“We do not have a strong management or policy on this. We are a very small institute. This means that we talk about this informally, so that every researcher is aware of most things colleagues are doing.”*

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What is striking is that none of these answers describe public outreach activities. This may mean that the respondents have a false understanding of what public outreach is.

All the respondents noted that their institute would benefit from more support in science communication. They mentioned training in general, support in writing for a broad audience, support in the form of journalists, support in developing outreach strategies and more manpower for professional outreach in general.

When asked who they contact when they require support in science communication, a variety of answers were provided. However, within none of those responses there was a concrete or specific reference to an organized unit of the university. Ideally, all responders would have provided a similar answer, containing one of the organized units of the university aimed at (supporting in) science communication, as for example, Studium Generale.

When institutes responded to whether the office of the University supports or stimulates the outreach activities of the institute, all responded negatively. Even though researchers are asked more and more to communicate with the general audience, no support is provided from higher up to do that.

## Senior scientists' views and practices: interview data

In order to gain more insight in how senior scientists experience science communication, seven senior scientists (either tenure trackers or professors) were interviewed. The findings of these interviews are discussed below.

### Reasons to participate in outreach activities

Four scientists stated that creating social impact has become a mandatory part of their appointment as researchers, which provides an important reason for doing more about science communication. This shows that making social impact, or science communication in particular, a prerequisite is indeed a way to motivate researchers to do more science communication.

*"It has recently been required that if you submit a research proposal, you dedicate a paragraph to social relevance. So science communication is expected from scientists. Especially younger colleagues in the current tenure track system need to do science communication, because it is necessary to do so if you want to survive in the academic world." (interview 4)*

*"In order to go to the next level in your career you have to fulfill certain criteria: only with the recent career paths document this public outreach has been introduced." (interview 5)*

*"One of the new criteria, for getting tenure in a faculty is societal relevance. So from my point of view communicating with the general public becomes necessary." (interview 3)*

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Two things become obvious from these three quotes. One is the importance of science communication skills when writing a proposal, which is now a requirement. The second is the importance of developing these skills for career and promotion purposes.

Six of the interviewees mention that they experience science communication as an obligation towards society. Either because they feel that it is important that society is informed about the research in general, or because they feel an obligation towards the tax-payers to show what is being done with their money.

*"I think you should always communicate about your research, because our work is paid by the taxpayer, so you have a duty: explain what you do, and why that is important. A responsibility towards society." (interview 2)*

*"It is important, for the general public to know what we are doing here, because first of all we are getting paid by the government, by the general public. But people won't know what we are doing unless we go out and explain it to them. So from this point of view it is extremely important to communicate the value of our work here." (interview 3)*

*"Science communication is an attempt to let others experience what you do here with community money." (interview 4)*

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Besides it being mandatory, and the obligation towards society, scientists have several personal reasons to engage in science outreach activities. They experience science communication to be fun, or an enrichment of their career, while others see it as a networking opportunity or an opportunity to make their field more attractive for the general public.

*"Science communication is truly an enrichment of your work as a researcher! You really learn things: how do you present things? Your scientific presentations will also benefit from it." (interview 1)*

*"The fact that it has a potential for further collaborations for example. So you communicate to the general public and it turns out a part of this audience are actually practitioners. So it becomes a networking experience." (interview 7)*

*"I communicate about my field to make the whole field more attractive and more interesting for people from outside." (interview 3)*

*"I just really like doing science communication!" (interview 6)*

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Other reasons for engaging in science communication, as mentioned by the scientists in the interviews are to entertain the public and to advertise the university. Responding to these personal reasons could therefore be a way to motivate them to actually participate in science outreach activities.

### **Issues and barriers**

Scientists encounter all kinds of obstacles when they want to do science communication. Having too little time is one of them. All scientists mention a lack of time as a huge limiting factor when it comes to science communication. In the big pile of things they have to do, science communication is not at the top of their list of priorities. This shows that communicating about your research is not yet seen as part of their job, as there is little to no allocated time for this.

*"There is simply no time to do science communication during working hours: we already work much more than the 40 hours we get paid for!" (interview 2)*

*"One problem is: people are overloaded. There is not enough time for science communication." (interview 5)*

*“Making material for a public lecture is a huge time investment. That will be less at a given moment. To give a public lecture takes an hour, but it takes a week to prepare for that: what is the right picture, the right tone, what can you say and what not. Lack of time to me is the only reason to really say no to giving a public talk.” (interview 6)*

*“Time management is a big issue for tenure trackers (...) We are fighting for survival!” (interview 7)*

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Another reason scientists are sometimes hesitant to participate in outreach activities is that they do not feel well equipped enough to engage with the general public. Five participants indicated that they indeed doubt their skills when it comes to science communication. This is not surprising, as all the interviewees had little or no training at all in communicating with the general public: five out of seven have not no training at all, and two have only had media training.

*“I indeed have difficulties understanding or I am not educated in this: how can I convey to people from the broader public what I am doing in terms of research and what the results are. How do I find the right language to communicate about my research to the public?” (interview 5)*

*“I wouldn't know how to interact with the general public. I don't know what would be a venue where I could talk to people.” (interview 4)*

*“Many researchers want to communicate, but not everyone has the tools to translate that, or the coaching for it.” (interview 1)*

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Two out of three of the non-Dutch speaking interviewed scientists mentioned their Dutch language skills as a barrier. This suggests that there either are not enough venues where they could go and communicate about their research in English, or that they are not aware of them.

*“Another issue is language. I would not feel confident enough to talk to a general audience in my broken Dutch about anything basically.” (interview 2)*

*“I don't speak Dutch. So if a public event is in Dutch I will not be able to participate.” (interview 5)*

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Five out of seven scientists mention that their field of expertise is too difficult or too specific to communicate to the public. This indicates that these scientists would benefit a lot from support in translating their research to a broad audience, so that they can find ways to simplify it, without losing its scientific value.

*“Often it needs a lot of vocabulary to be able to talk about my research. So you need to build up terminology to be able to explain what all these things appearing really are. Some basic understanding.” (interview 3)*

*“Well I think that I can explain what I am doing in a very simple manner, but I don't think that everyone who doesn't know how computer systems work on a very simple will understand this. In order to understand my research you need to have a basic understanding on how software is built. This is one of the things that is making our communication with the public more difficult.” (interview 5)*

*“Communicating about this field is not easy, especially because it is so theoretical.” (interview 1)*

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The scientists mentioned that they would need a lot of vocabulary to be able to talk about their discipline, or that the audience will need some basic understanding of the topic, before it can understand what the research is about. From this, it becomes clear that the scientists do not have a clear understanding of what science communication can do, and how empowering it can be. Because a skilled science communicator can explain the research through analogies, without using a lot of terminology or can help people build a basic understanding.

A lack of opportunities was also mentioned as a barrier to do science communication by the scientists. Three of them indicated that having contacts is very important for organizing outreach activities, or for being asked to participate in science communication activities. This emphasizes the importance of having someone in service who is responsible for maintaining these contacts and organize these outreach activities.

*“I am very willing to communicate more and to do more science communication, but if I am not asked, then I also do not know what I can do except to help write press releases.” (interview 2)*

*“I am always happy if people invite me to give a presentation, which doesn't happen very often because we don't have a track record of having spoken to the broader public” (interview 5)*

*“Contacts are important: how do you organize public outreach? Not everybody has those contacts.” (interview 1)*

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Some other issues and barriers that the scientists mentioned were the lack of human resources and the fact that they feel like their research is not interesting for the broad audience. Again, scientists might underestimate the value of science communication, as it could make the research interesting for the public.

### **Positive impact on science communication**

The interviewed scientists proposed several actions that would have a positive influence on their science communication practices. Three out of seven scientists mentioned that science communication should be recognized more from higher-up, either by expressing the appreciation or by treating it as part of their jobs. Right now scientists feel that they have to do science communication in their own time, there is no allocated time for this, as mentioned before.

*“It would be motivating if it would be more appreciated as part of your career path. (...) Like using going to public venues to count towards service time.” (interview 7)*

*“There should be more appreciation about science communication from above. (...) We should appreciate science communication from the organization more actively, both in personal conversations and in the system. (...) You just have to pay more attention to science communication, appreciate it and create exemplary functions.” (interview 4)*

*“The fact that people do not spend their time on science communication has more to do with remuneration: it's nice that you do it, but it's really a bonus. And you should not spend an afternoon of your working time on science communication. That is a bit weird, because we all*

*find it important that it happens. Then you just have to make time for it! I also try that, but that does not always work.” (interview 1)*

*“I would suggest the following policy: researchers can drop a course if they spend this time on science communication.” (interview 1)*

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As more than half of the scientists indicated that they do not feel equipped enough to engage with the general public and that they did not have any training in doing so, it would seem logical that they would benefit from some kind of training. Indeed, four scientists mentioned training as a way to improve their science communication skills:

*“You could offer science communication training to the people you see potential. (...) If you offer it and make it fun, there are always people who will do that. And if people have learned something from it, they will definitely do something with it.” (interview 2)*

*“I would benefit from training like: Storytelling, public speaking. How to stand in front of an audience and give a presentation.” (interview 3)*

*“It would be nice to have a workshop where you can see someone communicating your research to the general public without your research losing its value.” (interview 5)*

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The third quote expresses the fear of the research losing its value, when communicated to a lay audience. This is something that good science communication can achieve: communicating the research in a simple, but not a simplified manner.

In addition to this, some scientists feel like this training should not be too general, but more of a personalized training. As mentioned before, scientists experience a lot of time pressure, so attending a general training would take up too much of their time, with perhaps too little result.

*“I think researchers benefit from specific support to improve science communication. We are all busy, so a general training takes too much time. But for example Science LinX and Scholierenacademie can support you, for example, in a vidi project. That makes the training more specific. This way the researcher benefits more.” (interview 1)*

*“ (...) One size fits one! There are no one size fits all solutions. You need to figure out what works best for each person, based on their social skills and on the work they are doing.” (interview 7)*

*“Not every kind of science requires the same kind of support.” (interview 5)*

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One way to lower the barrier to do science communication is to make it less time-consuming. Having someone to take care of the organizational part of organizing outreach activities might be a way to make it less time-consuming for the scientists.

*“For me the missing link is lowering the barriers, to have the opportunities to engage the public: selecting venues with an international audience, organizational support.” (interview 3)*

*“It would help to have someone who can handle the administrative aspect of outreach activities.” (interview 7)*

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Three out of seven scientists indeed indicated that they would like to receive support for the organizational part of outreach activities, such as selecting venues and taking care of administrative things.

### **Fear of making science communication a prerequisite**

Five of the interviewed scientists think it is a bad idea to make science communication a prerequisite.

*“Not everybody should be forced to do science communication. There are different sorts of scientists, the ones who are good at communicating about their job, and the ones that should not be allowed around people. You don't want them to talk to the public.” (interview 7)*

*“I am totally opposed to obligating science communication. The public's suspicion is already there, so you really have to come up with a very positive story. So please leave it to the people who can do that.” (interview 6)*

*“Somehow making people aware that science communication will help them in their scientific career is great, but making them forced to do so I not a good idea because there are people that are not interested or not excited or cannot do public outreach. But they can be really good researchers and good teachers. This criteria should not somehow sabotage their career. They are not hired as PR people, but as researchers.” (interview 5)*

*I do not think it's a good development if we ALL have to do just as much science communication: some people are just less suitable for it. (...) You should not force all scientists into science communication, nor do you want all scientists to communicate.” (interview 1)*

The scientists mentioned that not all researchers are suitable for communicating about their research, and that you should leave it up to the people who are good at this. They fear it would sabotage the career of people who are great scientists, but not great science communicators. This could point to the need of an in-house expert on science communication, supporting researchers to communicate about their research. These quotes also give the impression that scientists have the idea that science communication equals speaking for a large audience. There are several ways of communicating your research that do not include standing in the spotlight, like for example science writing, or being interviewed by a newspaper journalist.

### **Survey PhD students**

In order to gain insights into how PhD students experience science communication, a survey was distributed via a newsletter among the approximately 800 PhD students from the Faculty of Science & Engineering. From these 800 PhD students 28 responded, resulting in a response rate of 3,5%. Out of these 28 respondents, 71% was male and 29% was female and they varied from first years PhDs to fourth year PhDs and everything in between. Table 1 describes how the PhD students were distributed among the

#### ***Distribution of respondents***

Medicine	2
Engineering/engineering sciences	1
Life Sciences	9
Artificial Intelligence	4
Chemical/chemical engineering	1
Physics and astronomy	2
Science education	3
Pharmaceutical sciences	1
Mathematics	2
Environmental sciences	1
Data Science	1
Other	1
	28

*Table 1. Distribution of respondents among research areas of the Faculty of Science & Engineering. Numbers represent the amount of participating PhD students working in the mentioned research field.*

different research areas of the Faculty of Science & Engineering. 54% of the participants are Dutch native speakers and 46% are non-native speakers.

When asked how many times in the past 12 months they participated in different public outreach activities, they offered the responses as described in table 2. This Table shows that for the each of the outreach activities described, the vast majority answered that they did not participate in that kind activity for the past 12 months. Almost no participants indicate that they engage with each of these activities for more than four times a year. These data suggest that in general PhD students do not often engage in any outreach activities.

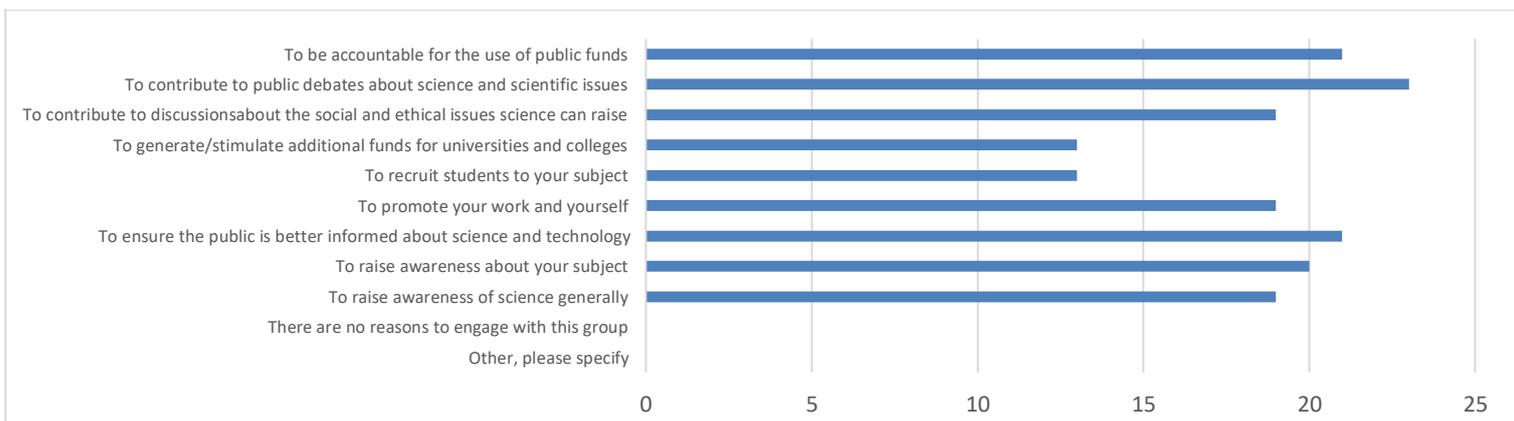
### **Engagement in outreach activities**

	None	Once	2-3 times	4-5 times	>5 times
Worked with teachers / schools (including writing educational materials)	56%	26%	0%	7%	11%
Participated in an institutional open day	78%	11%	11%	0%	0%
Given a public lecture, including being part of a panel	68%	18%	14%	0%	0%
Taken part in a public dialogue event / debate	85%	4%	7%	4%	0%
Been interviewed on radio	96%	0%	4%	0%	0%
Been interviewed by a newspaper journalist	85%	7%	7%	0%	0%
Written for the non-specialist public (including for the media, articles and books)	85%	15%	0%	0%	0%
Engaged with policy-makers	82%	18%	0%	0%	0%
Engaged with non-Governmental organizations (NGOs)	93%	4%	4%	0%	0%
Worked with science centres / museums	93%	7%	0%	0%	0%
Judged competitions	96%	4%	0%	0%	0%
Posted on social media about your work	70%	15%	7%	4%	4%

Table 2. This table shows how many times the PhD engage in several outreach activities in the past 12 months. The percentages indicate how often each answer is given in relative terms.

The PhD students were asked to indicate the main reasons for scientists to engage with the non-specialist public. They were given the choice of the reasons shown in Graph 2. According to the PhD students the main reason for communicating about science to the general public seems to contribute to public debates about science and scientific issues. All the other reasons also appear to be relevant to the PhD students, as all reasons were chosen at least 13 times. This indicates that according to PhD students scientists have several different reasons for doing science communication.

### **Main reasons to communicate with the non-specialist public**



Graph 2. This graph shows the main reasons for scientists to communicate with the non-specialist public. The blue bars indicate the absolute amount of times each reason is indicated as important.

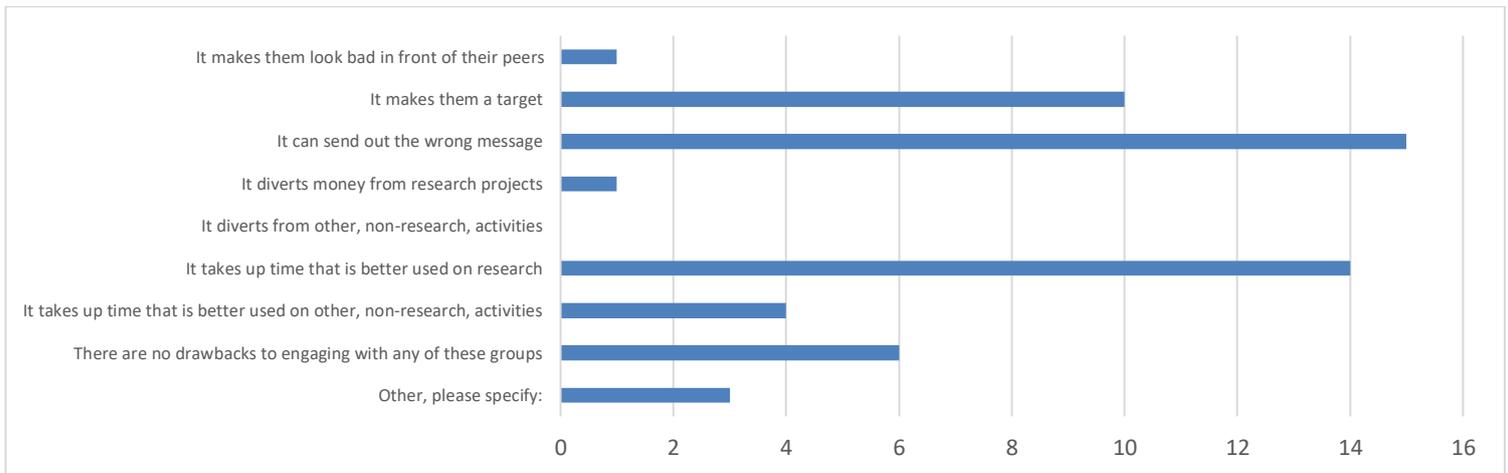
As clearly emerged from the interviews with the senior scientists, scientists also experience a lot of difficulties when trying to engage in public outreach activities. The main drawbacks to engaging with the non-specialist public, according to the PhD students, are displayed in Graph 3. Two participants offered another answer:

*“There is a danger when only one person represents his/her own field: close colleagues of the representative may have completely different opinions, but since they do not get publicity, their opinions are lost to the general public. The general public might then think that the entire scientific field agrees with the opinion of the presenter.”*

*“It’s often so that the uncertainty that comes with science is not always reflected in the interpretation of the media, or welcomed by policymakers. They want an easy truth, not an inconclusive conclusion.”*

More than half of the PhD students worry that communicating about science can send out the wrong message. This fear of sending out the wrong message may result from the fact that scientists do not feel able to communicate their message to the general public in an understandable way. Half of the PhD students mention that science communication takes up time that is better used on research. This finding supports the fact that right now science communication has a very subordinate role in the working life of a scientist.

### **Main drawbacks to engaging with the non-specialist public**

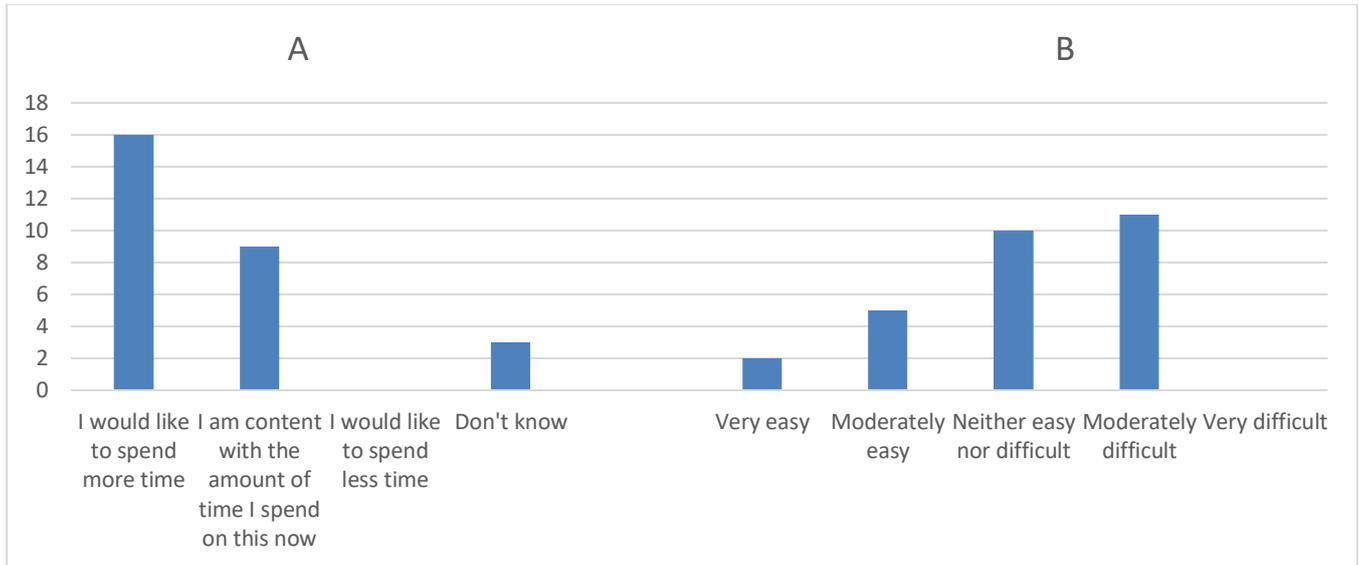


Graph 3. This graph shows the main drawbacks for scientists to communicate with the non-specialist public. The blue bars indicate the absolute amount of times each option is indicated as a drawback.

The PhD students were asked whether they would like to spend more time, less time or about the same amount of time as they do now engaging with the non-specialist public, and how easy or difficult they thought it is to get involved in science engagement activities for those who want to do so. The results of these questions are shown in Graph 4. These data show that the majority of the PhD students would like to spend more time engaging with the non-specialist public (4A), but that a large part of the participant find it quite difficult to get involved in outreach activities (4B).

### Time spend on science communication

### Difficulty of engaging in science communication

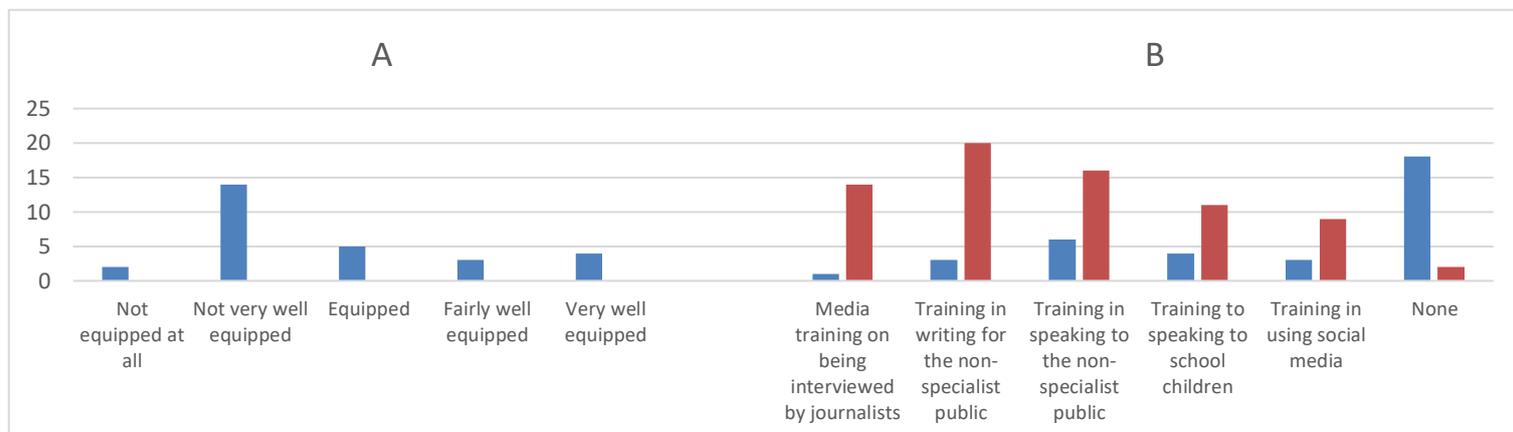


Graph 4. A) This graph shows whether the participants would like to spend more, less or the same amount of time in public outreach. The blue bars indicate the absolute amount of time each answer is given. B) This graph shows how easy or difficult PhD students think it is to get involved in outreach activities for those who want to do so. The blue bars indicate the absolute amount of time each answer is given.

Besides the fact that PhD students find it difficult to get involved in outreach activities, they experience other barrier when wanting to do science communication. When asked what is stopping them to do more science communication, the participants indicate several reasons, from which I will discuss the most frequently given answers: 19 out of 28 participants point to the aforementioned lack of time in general, whereas 12 mention that they should spend more time on their research, leaving no time for science communication. Not having the contacts stops 14 PhD students from doing more science communication. This suggests that these PhD students are not aware of the existence of the science communication units from our university, such as Science LinX or Studium Generale. 10 participants indicate the fact that Dutch is not their first language are a barrier. This suggests that there either are not enough venues where they could go and communicate about their research in English, or that they are not aware of them.

Another possible drawback for communicating with the general public is whether someone feels equipped enough to do so. The majority of the participants indicated that they do not feel sufficiently equipped, or even not equipped at all to engage with the non-specialist public as shown in Graph 5A. This seems logical as only a few PhD mention that they have had training in communicating science to the non-specialist public. The vast majority answers they have not had any training at all (Graph 5B). Almost all participants feel that they would benefit from several kinds of (extra) training in communicating with the non-specialist public as shown in Graph 5B.

### Science communication skills and training



Graph 5. A) This graph shows how well equipped the participants feel to engage with the non-specialist public. The blue bars indicate the absolute amount of times each answer is given. B) This graph shows in blue how many participants have had different sorts of training in communicating science, and in red what kind of training the participants think they would benefit from. The bars indicate the absolute amount of times each answer is given.

Besides additional training, the participants also mentioned other forms of support that they would benefit from, such as more opportunities or allocated time for doing so. Two PhDs mentioned that they feel like right now science communication is not so much a PhD thing as it is a PI thing.

*“Right now, science communication to the general public is more a PI thing, rather than for PhD students. I think my boss would consider it waste of time if I would do it during working hours. If it would be normal/required that PhD students share their work with the public, that would be helpful.”*

*“I think in general, as a PhD, the time is too precious to spend on this. Might be something for senior members.”*

These answers provide evidence that the culture of the faculty is organized in such a way that it is not common for young researchers, such as PhDs, to engage in science communication. This is supported by the results shown in Table 1, where it becomes clear that PhDs do not participate in outreach activities on a regular basis.

When being asked “To what extent would you personally be encouraged to get more involved in activities to engage the non-specialist public in science by each of the following?”, all given options scored above average, meaning all options were somewhat relevant to the participants. Options were as follows:

- If the Director of my institute were to give me more support and encouragement
- If there were awards and prizes for me as an individual
- If it helped with my own career
- If I was relieved of other work
- If it brought money into my institute
- If it was easier for me to get funds for engagement activities

- If it was easier to organize such activities
- If I had some (more) training
- If it was taken seriously in my evaluation/promotion

What becomes evident in this is the importance of getting support from the director, of recognition of science communication, of relieving PhDs of other work when putting time in science communication, of getting more support in organizing outreach activities, of organizing training and of taking science communication seriously in evaluations.

I asked the PhD students who do they contact when they require support when it comes to science communication. Their answers vary from “my father” to “my supervisor” and from “the government” to “colleagues”. What is striking is that they all give different answers, and that nobody mentions the (science) communication units of our university. Ideally they all give a similar answer in which they mention the following: Science LinX, Studium Generale, de Scholierenacademie or the scientific coordinator. The fact that they all gave these different answers provide evidence that they do not know who can help them organizing outreach activities. This finding is emphasized by the fact that only five of the participants state that they have cooperated with any of the (science) communication units of the university. This is supported by the fact that indeed a large number of participants mentioned that they do not have the contacts to help them engage in science communication activities.

**The main finding of this survey is that the PhD students acknowledge the importance of science communication, and that they would like to invest more time in this. However, at the moment science communication is not yet embedded in the culture of the faculty and they do not actually reserve time for this and their PhD trajectories do not include science communication training or activities.** As a result, students do not know how they can get involved in outreach activities and who they can approach when they need support in science communication.

## Interviews with experts in the field of science communication

In order to gain more insights into key actors’ views on science communication, I interviewed two experts: a program maker from Studium Generale, and the project manager of Science LinX. Highlights from both interviews are discussed below.

### Interview program maker Studium Generale

When being asked on her opinion on the fact that scientists are being asked more and more to communicate their research, she indicates that it is good that there is more attention for the scientist as a public communicator. According to her, this demand for science communication bears the risk of over-popularizing and simplifying science.

*“I think it is good that there is more attention for the scientist as a public communicator. I also think that scientists can communicate more about their work. There is also a field of tension here: on the one hand, I think that researchers can devote more attention to science*

*communication. At the same time, I do not think that over-popularizing and thus simplifying science are a good trend. And unfortunately you see that often as a result of that demand for more communication about science: that it is simplified."*

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This quote stresses the importance of the support of science communicators for scientists, to help them communicate their research, without the research losing its value.

The program maker works from the vision of Studium Generale. She has no information on the UG vision on science communication, nor of the vision for the new center of public engagement, as becomes clear from the following quote. This would indicate that either the university does not have clear a vision on both, or that this vision is not shared actively with Studium Generale. This is quite striking as Studium Generale functions as an important science communication unit of our university, and will be part of this center for public engagement in the near future.

*"I do not know whether the university has a certain vision on science communication. I do know that they are setting up a public engagement center. The vision behind it is still unclear to me. They want to bring SG, de Scholierenacademie, the University Museum and the USVA together under that new department. They also want these organizations to cooperate more. A nice idea, but it is rather contradictory, because we have very different target groups."*

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As emerged from the interviews and the surveys, our university does not have a culture where science communication is seen as a part of your job as a scientist. The program maker from Studium Generale confirms this.

*"The science communication system is much better developed in England. There is much more focus on science communication, it is intertwined in the culture of the universities there. That culture of science propagation is less embedded in the Netherlands."*

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She states that this culture of science propagation is much more developed in England, and that this culture is less developed and less stimulated in the Netherlands.

Junior scientists in the survey, and senior scientists in the interviews mentioned a lack of time to be a huge constraint for those who would like to get involved in science communication. This is supported by this interview with Studium Generale, where the program maker states that she notices that researchers are getting busier and busier. Making public outreach activities less time-consuming, by for example hiring an expert to help them prepare outreach material or offering organizational support, might positively influence the willingness of scientists to participate in these activities.

*"I almost never have people say: no, I do not want to do a lecture. When they say no it is often because they are just very busy, or that it is not possible logistically. I also notice that they are getting busier and busier."*

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In the following quote she stresses the importance of the university to take action in order to get the center for public engagement off the ground.

*"The University of Groningen is now talking about Public Engagement: but do not forget to do it! And do not just create a center that people can go to. Public Engagement is an action. This action is still missing: it is too much of a waiting game. Action is necessary to get things off the*

*ground. You need an organization that is a kind of match maker, who has a large network and can bring people together."*

---

As before mentioned, it seems like the university is lacking in vision when it comes to science communication and setting up this center for public engagement. According to the programmer, the university cannot afford a wait-and-see role if it wants to make this center a success: an organization with a large network that can bring people together.

### **Interview project manager of Science LinX**

In the quote below, the project manager of Science LinX is emphasizing the interaction with the public. This is interesting, because it indicates a two way relationship between the researchers and the public.

*"Inspiring and learning together is central here. It is not our goal to teach an ignorant audience what science entails. We are really looking for that interaction with the public."*

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From the previous data, the interviews and the surveys, science communication sounded like one way communication from the scientists to the public, without considering what scientists could learn from the public.

Even though a university broad vision on science communication seems to be lacking, Science LinX did formulate a clear vision on their role within the Faculty of Science and Engineering.

*"In the vision of Science LinX I have formulated a faculty mission that is being carried out by Science LinX. This vision is supported by the Faculty Board. But how it will be implemented is still to be thought out. This mission sounds as follows: "Science LinX is FSE's center of expertise in outreach and engagement of pupils, teachers, civil society and the general public, to spark interest in science and engineering at the University of Groningen, and show the Faculty's value; to the City, the Region, and beyond. With a fresh and tailor-made approach, Science LinX facilitates continuous mutual learning and collaboration in a regional learning ecosystem." This mission has been discussed in the faculty board and they support this part, but the broader communication strategy of which this is part of still needs to be elaborated."*

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The mission of Science LinX again emphasizes this two way street, by focusing on mutual learning. Mission and vision have only been drawn up recently. As the project manager mentioned, this vision is supported by the faculty, but how this vision will be implemented is, because of its recentness, still to be determined.

As became clear from the surveys and the interviews, right now science communication is not yet seen as a legitimate part of your work as a scientist, and there is no time allocated for this. This is confirmed by the project manager in the quote below. She proposes that time should be reserved for this at the expense of other tasks.

*"It would be great if science communication is seen as part of your job responsibilities. And that space is therefore reserved for this at the expense of other tasks like teaching. This would solve a number of problems that we now face at once."*

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It became clear from the surveys that more recognition for science communication would encourage them to spend more time engaging with the general public. It also emerged as an important

motivator in the interviews with the scientists. In the following quote the project manager of Science LinX also mentions the lack of recognition for science outreach activities. She also points to the fact that science communication is not imbedded in the culture of our university, as also mentioned in the interview with Studium Generale, and for this to happen it should be propagated at board level.

*“But it would be of great help if there were more appreciation among colleagues about science communication, that it would be seen more as normal, as part of the culture of the university. For this to happen, science communication has to be propagated at board level.”*

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Lastly, she proposes that each institute should have someone who is responsible for outreach and engagement.

*“In addition, each institute should have someone who is responsible for outreach and engagement, with whom we can maintain contact and with whom we can develop outreach activities.”*

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When each institute has someone responsible for the institutes’ outreach and engagement portfolio, Science LinX can maintain contact with that person to develop programs and to incorporate these in the Faculties’ outreach and engagement calendar. In order to be able to follow up on ideas and activities of all institutes, ideally, an employee should be hired by Science LinX for continuation and effective exchange of good practices.

## Conclusion & Discussion

### **Lack of a shared vision across the university**

As becomes clear from the email communication with the president of the board of the University of Groningen, and the interview with Studium Generale, a shared vision on science communication across the university seems to be lacking. This is in contradiction with the fact that the university has the third core task of valorizing knowledge. At the same time, the university seems to attach value to public engagement, given the introduction of the Center for Public Engagement. Although this center shows a great potential of joining forces, in order to make this center a success, a clear vision of science communication must be formulated, which is shared by all key actors.

This clear vision on science communication should lead to a clear policy within the various organizations of the university. As becomes evident in the analysis of the data there is no clear policy within the FSE-institutes regarding science communication. There is no division of roles regarding science communication: there is not someone in service who is responsible for public outreach and at the same time scientists do not know who to contact if they want to get involved in science communication activities.

### **Initiating a cultural shift**

As becomes evident from the interviews with Science Linx and Studium Generale, the interviews with the senior scientists and the surveys: a culture of science communication is lacking within our faculty. Especially for young researchers it is not obvious to communicate about their research. PhD students indicate that science communication is more a PI thing, and not something that PhD students should spend their precious time on. Their professors find that a waste of their time.

In order to initiate a cultural shift towards more science communication, one could start by encouraging young researchers, PhDs or even graduate students, to start engaging in outreach activities: by giving them science communication training and imparting the value of science communication at an early stage (Hundey et al., 2016; Kuehne et al., 2014). PhD students from our faculty mention to not have had any science communication training, but that they would indeed benefit from it. One of the main reasons for them not to participate in outreach activities is because they do not feel well equipped enough to engage with the general public. Science communication training could remedy this.

As becomes obvious from the analysis of the data, PhD students do not often engage in outreach activities, but they indicate that they would like to spend more time on science communication. One of the main reasons is that they find it difficult to get involved in outreach activities as do not know how to contact when they want to get involved. Again, this points to the need of having someone in service who is responsible for the coordination of outreach activities.

Another way of initiating this cultural shift is by recognizing science communication as an important part of the scientists' jobs. Senior scientists mentioned in the interviews that science communication is seen as an extra, not as something that you should spend a couple of hours of your workday on. Therefore there is no allocated time for this. As the project manager of Science LinX also mentioned: "It would be great if science communication is seen as part of your job responsibilities. And that space is therefore reserved for this at the expense of other tasks like teaching. This would solve a number of problems that we now face at once." In order to initiate this cultural shift, science communication will have to be treated as part of your job responsibilities as a researcher.

### **Organizational support**

All institutes mentioned that they would benefit from more support, and scientists expressed the need for more organizational support in public outreach. All this together points to the need having someone in service responsible for outreach activities: someone who coordinates these activities, offers organizational support to scientists and can maintain contact with for example Science LinX. This need for an outreach coordinator is supported by the literature: many more scientists are willing to participate in outreach programs once their outreach efforts are focused on science and others are responsible for the organizational and administrative part of these activities (Andrews et al., 2005; O'Neill, Wagner, & Gomez, 1996; Waldman, Schechinger, & Nowick, 1996).

Employing someone who coordinates the outreach activities could also reduce one of the main problems faced by scientists who want to engage in science communication: a lack of time. In line with the current literature (Andrews et al., 2005; Rees, 2006), the majority of the PhD students and the senior scientists mention a lack of time as a huge constraint. An outreach coordinator could make public outreach less time consuming of the scientists, which is one of the indicated barriers for them in engaging with such activities.

### **Training in science communication**

In the interviews, scientists offered several reasons to participate in outreach activities. One of these reasons is that science communication has become a mandatory component for tenure trackers, since they must add a social impact section in fund applications. For pursuing a career in science, it is therefore necessary to have a basic skillset in science communication. At the same time scientists, senior researchers as well as PhD's, often not feel equipped enough to engage with the general public. This is not surprising as both groups mention to have had little to no training in science

communication. Offering more training in science communication to researchers can contribute to establishing a foundation in science communication skills, which could encourage them to get involved in science communication. Indeed, as literature suggests, scientists who have received training in science communication, are more likely to participate in outreach activities (Rees, 2006).

### **Support from science communication expert**

Besides getting more training in science communication, scientists could benefit from having support from an expert in science communication to help translate their research. This could be very helpful for scientists who are not (yet) skilled in communicating science, and again it could help make science outreach less time consuming for scientists. The appointment of an expert could also eliminate the fear of making science communication compulsory. The majority of the interviewees mention that they feel that making science communication a prerequisite is a bad idea. This fear might arise from the idea that they will be evaluated on their personal communication skills. Hiring a science communication expert, who will help them communicate their research, might eliminate this fear.

### **False understanding of the power of science communication**

What becomes evident from the interviews is that the researchers do not understand the power or the value of science communication, as they refer to the fact that their research is not interesting for the general public, or having the fear that communicating about their research would result in the research losing its scientific value. Good science communication can make research interesting for the general public, and can communicate research in a simple, but not simplified manner (Jucan & Jucan, 2014). This shows that the researchers would benefit from a basic course in science communication, which supports them in developing an understanding about the value of science communication for bridging science and the society.

### **Social media**

Even though the Internet provides a unique opportunity for scientists to be in direct contact with the public, and communicate about their research, within our faculty social media still has yet to be adopted as a common tool for science communication. As becomes evident from the survey with the research institutes, social media like YouTube, Twitter, Facebook or LinkedIn, are rarely used for science communication purposes. There are only some young researchers who use social media to communicate about their research.

However, according to the literature, social media is the new way to appeal to the general public, and researchers should use these media to engage the public in their research (Darling, Shiffman, Côté, & Drew, 2013; Smith, 2014; Wilcox, 2012). It might be time to modernize and adopt social media as a tool for science communication within our faculty. As the survey shows that only young researchers use social media to communicate about their research, one would expect that encouraging young scientists to engage more in science communication will lead to an increase in the use of social media for science communication purposes.

### **Aim for the future**

The project manager of Science LinX emphasized the two-way relationship between the scientist and the public. She emphasized a very important point here, which had not yet emerged in this study. None of the researchers mentioned this two-way relationship or indicates that they can also learn

from the public. This suggests that science communication is primarily understood by researchers as providing information from the researcher to the public, which is a traditional, elitist and limiting approach to science communication. This dialogue between scientists and the public is very important for various reasons; it reinforces confidence in science (Wilsdon & Willis, 2004; Wynne, 2006), it has a positive effect on the attitude towards science (Wynne, 2006) and it is also educational for the scientists as input from the public can be used for their research (Haywood, 2016). Hence, I would argue that in order to engage the public in the research of our faculty in an effective way, our faculty should focus on encouraging this dialogue between researchers and the public in the future.

### **Limitations**

The senior researchers I interviewed were not evenly distributed among the various institutes. Interviewing both scientists who don't do a lot of science communication and scientists who are active in the field of science communication was my priority. I have not taken the distribution among the institutes into account. It is possible that the interviewees are not a good representation of the researchers from other institutes.

In addition, the response rate of the PhD survey is quite low. Of the approximately 800 PhD students at the Faculty of Science and Engineering, only 28 completed the survey. If this is the result of not reading the newsletter in which the survey is distributed, I expect that it will have little influence on the reliability of the results. If it is the result of a selection of PhD students who think science communication is important and therefore contribute to the research, it may have biased the research results.

## **Summary of practical suggestions and recommendations**

Based on the findings of this study the following suggestions and recommendations are offered which might be used as input for the development of a long-term plan of action by the FSE to promote science communication and public engagement:

- Develop a coherent vision of science communication and public engagement that cuts across all units and offices of the university
- Consider the development of a dialogical relationship between scientists and the public that promotes public engagement (i.e., input from the public) which serves as a more contemporary, democratic, and open approach to science communication)
- Develop a science communication course for scientists and PhD students that supports the development of an understanding of science communication and the development of their science communication skills (i.e., writing for popular science magazines, delivering TED talks)
- Hire science communication officers and assign those to specific institutes
- Appoint a science outreach coordinator for each institute
- Recognize science communication as part of a scientists' job responsibilities by allocating time for this at the expense of other activities
- Explore the potential use of social media and especially twitter, which is largely used by scientists, as a science communication tool

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## Appendix 1: Survey institutes

1. Name or pseudonym (open ended)
2. Research institute
  - a. Bernoulli Institute for Mathematics, Computer Science and Artificial Intelligence
  - b. ENTEG - Engineering and Technology institute Groningen
  - c. ESRIG - Energy and Sustainability Research Institute Groningen
  - d. GBB - Groningen Biomolecular Sciences and Biotechnology Institute
  - e. GELIFES - Groningen Institute for Evolutionary Life Sciences
  - f. GRIP - Groningen Research Institute of Pharmacy
  - g. ISEC - Institute for Science Education and Communication
  - h. Kapteyn Institute
  - i. Stratingh Institute for Chemistry
  - j. Van Swinderen Institute for Particle Physics and Gravity
  - k. Zernike Institute for Advanced Materials
3. Position at the research institute (open ended)
4. What's your opinion about science communication and engaging in public outreach activities? For example, for the purpose of making your institute's research understandable for the public? (open ended)
5. Do you think that there are societal implications for your institute's research?
  - a. Yes
  - b. No
6. Are you or researchers from your research institute involved in science outreach activities?
  - a. Yes
  - b. No
7. If so, in what kind of science outreach activities are the researchers involved? Can you offer some examples?
  - a. Working with teachers/schools
  - b. Interview on TV
  - c. Interview on radio
  - d. Interview by newspaper
  - e. Working with science centres/museums
  - f. Writing for the non-specialist public
  - g. Engaging with policy-makers
  - h. Giving public lectures
  - i. Post on Facebook
  - j. Post on Twitter
  - k. Post on LinkedIn
  - l. Post on YouTube
8. If social media are used, how do you use them? What do you usually post about? (open ended)
9. Are the researchers in your institute generally supportive towards those who take part in activities that engage the non-specialist public in science?
  - a. Yes, very supportive

- b. Yes, fairly supportive
  - c. Not particularly supportive
  - d. Not at all supportive
10. Are researchers of your institute encouraged to engage with the non-specialist public in science?
- a. A lot
  - b. A moderate amount
  - c. A little
  - d. None at all
11. What training, if any, do researchers get in communicating science to the non-specialist public?
- a. Training in writing for the non-specialist public
  - b. Training in speaking for the non-specialist public
  - c. Media training on being interviewed by journalists
  - d. Training in speaking to school children (of any age)
  - e. Other:
  - f. None
12. Is there someone in service at the institute responsible for managing science communication and outreach activities?
- a. Yes
  - b. No
13. If so, what is the official function of this person? What kinds of activities is he/she involved in? Can you offer examples? (open ended)
14. If not, how are science outreach activities managed? (open ended)
15. Would the institute benefit from more support in science communication?
- a. Yes
  - b. No
16. What kind of support does the institute need, when it comes to science communication? (open ended)
17. When researchers require support in science communication, who is contacted to provide this support? (open ended)
18. Does the office of the University support and stimulate the outreach activities of your institute?
- a. Yes
  - b. No
19. Would it be helpful to have a centrally organized department at the UG for public engagement to facilitate outreach activities? `
- a. Yes
  - b. No
20. Has your institute collaborated with:
- a. Studium Generale
  - b. University Museum
  - c. Scholierenacademie
  - d. USVA
  - e. Department of Communication

## Appendix 2: Interview questions senior scientists

1. What is your current position?
2. Which best describes your main role at your institution?
  - Research (including clinical research)
  - Research and teaching
  - Teaching only
  - Clinical work only
  - Management / administration
3. From the list below, which discipline most closely describes your current area of research interest?
  - Clinical medicine (including dentistry)
  - Non-clinical bioscience (including medical, psychology, veterinary, agricultural)
  - Engineering / engineering sciences (including IT)
  - Chemical / chemical engineering
  - Physics (including materials sciences) and astronomy
  - Mathematics
  - Environmental sciences
  - Life sciences
4. Do you think your work has implications for society and/or policy-makers and regulators?
5. To the nearest year, how long have you been working in scientific research, whether in academia or elsewhere?
6. Scientists are being asked to engage more with the non-specialist public. What, if anything, does this mean to you? Why?
7. How important do you think it is that you personally, in your current post, engage directly with the non-specialist adult public? And why?
8. What do you think is the main reason for scientists to engage with the non-specialist public? Why?
9. What do you think is the main drawback to scientists and engineers generally engaging with the non-specialist public? Why?
10. In relation to the other things you have to do in your working life, how important is it to you that you find time to engage with the non-specialist public? Why?
11. Would you like to spend more time, less time or about the same amount of time as you do now engaging with the non-specialist public about science? Why?

12. How easy or difficult do you think it is to get involved in science engagement activities for those who want to do so? What are the barriers or difficulties that you face?
13. How well equipped do you personally feel you are to engage with the non-specialist public about your research?
14. What training, if any, have you had in communicating science to the non-specialist public?
15. Would you like to get (more) training in communicating science to the non-specialist public?
16. What would encourage you personally to get involved in activities that engage the non-specialist public in science? Follow up: to what extent are you encouraged as described?
17. What is stopping you from getting (more) involved in activities that engage the non-specialist public in science? Why?
18. Would you benefit from getting more support from within or from the outside of your institute when it comes to science communication?
19. If you require support when it comes to science communication, do you know who to contact from the University?
20. What kind of support would you benefit from?
21. Do other members of your department take part in activities that engage the non-specialist public in science?
22. Are the researchers in your department generally supportive towards those who take part in activities that engage the non-specialist public in science?
23. Is your institution generally supportive towards researchers who take part in activities to engage the non-specialist public in science? In what form is this support actualized? (time, money, providing student assistants)

## Appendix 3: Survey PhD students

1. From the list below, which discipline most closely describes your current area of research interest?
  - a. Medicine
  - b. Engineering / engineering sciences
  - c. Chemical / chemical engineering
  - d. Physics (including materials sciences) and astronomy
  - e. Mathematics
  - f. Environmental sciences (including earth and marine sciences)
  - g. Life Sciences
  - h. Artificial Intelligence / Computing Science
  - i. Other: ....
2. What is your current position and how many years have you been in this position?
3. Are you
  - a. Male
  - b. Female
  - c. Other
4. Is Dutch your first language?
  - a. Yes
  - b. No
5. Do you think your work has implications for society and/or policy-makers and regulators?
  - a. Yes
  - b. No
  - c. Don't know
6. How important do you feel it is that you personally, in your current post, directly engage with the non-specialist public?  
(5 point scale not important – very important)
7. Which of these groups do you find it easiest to talk with about your research findings? (tick boxes)
  - a. Policy makers
  - b. Young people in schools
  - c. Industry/business community
  - d. Young people outside schools
  - e. Popular science journalists
  - f. The non-specialist public
  - g. General journalists
  - h. NGO's (non-Governmental organizations)
  - i. Others in the media such as documentary and other programme makers
  - j. Patients / Patients groups
  - k. Press officers in your institution
  - l. Schools and school teachers
  - m. Family
  - n. Friends
  - o. None / Don't know
8. Why is this/are these groups the easiest to talk to? Indicate at least 2 reasons

9. Thinking about public engagement with, and communication about, science, roughly how many times in the past 12 months have you done each of the following? (rate on a scale: none – once – 2/3 times – 4/5 times – more than 5 times)
- a. Worked with teachers / schools (including writing educational materials)
  - b. Participated in an institutional open day
  - c. Given a public lecture, including being part of a panel
  - d. Taken part in a public dialogue event / debate
  - e. Been interviewed on radio
  - f. Been interviewed by a newspaper journalist
  - g. Written for the non-specialist public (including for the media, articles and books)
  - h. Engaged with policy-makers
  - i. Engaged with non-Governmental organizations (NGOs)
  - j. Worked with science centres / museums
  - k. Judged competitions
  - l. Posted on social media about your work

The remainder of the questionnaire explores communication and engagement with the non-specialist public only which refers to adults with no specialist knowledge of, or training in, science.

10. How important do you think it is that you personally, in your current post, engage directly with the non-specialist adult public on each of the following? (5 point scale for each answer: not important – very important)
- a. The scientific findings of your research
  - b. Areas for further research
  - c. Policy and regulatory issues
  - d. The wider social and ethical implications of your research findings for society
  - e. The potential benefits of your work to individuals
  - f. The scientific process / the nature of science
  - g. Scientific uncertainty
  - h. The enjoyment and excitement of doing science
  - i. The relevance of science to everyday life
  - j. To raise awareness of career options in science
11. Looking at the list below, what do you think is the main reason for scientists generally to engage with the non-specialist public? Check all that apply.
- a. To be accountable for the use of public funds
  - b. To contribute to public debates about science and scientific issues
  - c. To contribute to discussions about the social and ethical issues science can raise
  - d. To generate / stimulate additional funds for universities and colleges
  - e. To recruit students to your subject
  - f. To promote your work and yourself
  - g. To ensure the public is better informed about science and technology
  - h. To raise awareness about your subject
  - i. To raise awareness of science generally
  - j. There are no reasons to engage with this group
  - k. Other, please specify:
12. Looking at the list below, what do you think is the main drawback to scientists generally engaging with the non-specialist public?

- a. It makes them look bad in front of their peers
  - b. It makes them a target
  - c. It can send out the wrong messages
  - d. It diverts money from research projects
  - e. It diverts money from other, non-research, activities
  - f. It takes up time that is better used on research
  - g. It takes up time that is better used on other, non-research, activities
  - h. There are no drawbacks to engaging with any of these groups
  - i. Other, please specify:
13. In relation to the other things you have to do in your working life, how important is it to you that you find time to engage with the non-specialist public? (5 point scale for each answer: not important – very important)
14. Would you like to spend more time, less time or about the same amount of time as you do now engaging with the non-specialist public about science?
- a. I would like to spend more time
  - b. I am content with the amount of time I spend on this now
  - c. I would like to spend less time
  - d. Don't know
15. How easy or difficult do you think it is to get involved in science engagement activities for those who want to do so? (5 point scale: very easy- very difficult)
16. How well equipped do you personally feel you are to engage with the non-specialist public about your research? (5 point scale: very well equipped – not equipped at all)
17. What training, if any, have you had in communicating science to the non-specialist public? Do not include any teaching training you may have had. (tick boxes)
- a. Media training on being interviewed by journalists
  - b. Training in writing for the non-specialist public
  - c. Training in speaking to the non-specialist public
  - d. Training in speaking to school children (of any age)
  - e. Training in using social media
  - f. None
18. Looking at the list below, what kind of (extra) training would you benefit from? (Tick boxes)
- a. Media training on being interviewed by journalists
  - b. Training in writing for the non-specialist public
  - c. Training in speaking to the non-specialist public
  - d. Training in speaking to school children (of any age)
  - e. Training in using social media
  - f. None
19. To what extent would you personally be encouraged to get more involved in activities to engage the non-specialist public in science and engineering by each of the following? (5 point scale for each answer: a great deal – not at all)
- a. If the Director of my Institute were to give me more support and encouragement
  - b. If there were awards and prizes for me as an individual
  - c. If it helped with my own career
  - d. If I was relieved of other work
  - e. If it brought money into my Institute
  - f. If it was easier for me to get funds for engagement activities
  - g. If it was easier to organize such activities
  - h. If I had some (more) training

- i. If it was taken seriously in my evaluation/promotion
20. What is stopping you from getting (more) involved in activities that engage the non-specialist public in science? Please mark all that apply.
- a. I am already involved enough
  - b. I just don't want to
  - c. I am too junior
  - d. Lack of opportunity
  - e. I don't know how
  - f. I am only in this position for a limited period
  - g. The public don't want to know
  - h. Dutch is not my first language
  - i. The public do not understand
  - j. I feel that I am encroaching on Press Office work
  - k. I do not have the training
  - l. There is no senior level support
  - m. I do not have the contacts
  - n. Peer pressure
  - o. Nature of my research
  - p. There is not enough funding
  - q. Time in general
  - r. I need to spend more time on my research
  - s. Fear of negative reaction
  - t. I need to spend more time teaching
  - u. No benefit / recognition
  - v. I need to spend more time on administration
  - w. I need someone else to organize it
  - x. I need to spend more time getting funding for my research
  - y. I do not have the confidence
  - z. I would have to do it in my own time
21. Would you benefit from getting more support from within our from the outside of your institute when it comes to science communication?
- a. Yes
  - b. No
  - c. Don't know
22. If you require support when it comes to science communication, who do you contact? (open ended)
23. What kind of support would you benefit from? (open ended)
24. Do other members of your department take part in activities that engage the non-specialist public in science?
- a. Yes, most of them
  - b. Yes, some of them
  - c. Yes, one or two of them
  - d. None of them
  - e. Don't know
25. Would it be helpful to have a centrally organized department at the UG for public engagement to facilitate outreach activities?
- a. Yes
  - b. No

c. Don't know

26. Have you collaborated with (mark all that apply)

a. Studium Generale

b. Science Linx

c. University Museum

d. Scholierenacademie

e. USVA (yes/no) use the words instead. I don't know what this refers to 😊

f. Department of Communication

g. Other unit of the University

## Appendix 4: Interview questions Studium Generale

1. What is Studium Generale?
2. What does a program maker do?
3. There is an increasing emphasis on scientists as public communicators. How do you feel about this?
4. What is the vision of the university about science communication
5. Is that vision shared with all key actors?
6. Does the university see a role in bringing about societal change or is the role only for educating students? If indeed the university see a role, is there a clear vision for this role?
7. Do issues of internationalization, diversity, and inclusion taken in consideration when planning?
8. Do scientists communicate enough about their research?
9. What is the role of the scientists in your activities?
10. What criteria are used by Studium Generale for developing a program/inviting speakers?
11. How are scientists being recruited for your activities?
12. What difficulties do you face when recruiting scientists for your activities, or in your communication with scientists?
  - Are scientists enthusiastic to work with you?
  - If they do not want to work with you, why is that?
13. Are you training or supporting scientists in other ways, to help them communicating their research? If so: how?
14. How do you motivate scientists to engage more in science communication activities?
15. Do you work together with other parties inside or outside of the university? Which ones?
16. What does the cooperation with the research institutes of the university look like?

## Appendix 5: Interview questions Science LinX

1. Can you tell me more about Science LinX: what are your projects, your activities, your goals?
2. What is your position within Science LinX?
3. There is an increasing emphasis on scientists as public communicators. How do you feel about this?
4. What is the vision of the university about science communication?
5. Is that vision shared with all key actors?
6. Does the university see a role in bringing about societal change or is the role only for educating students? If indeed the university see a role, is there a clear vision for this role?
7. Do issues of internationalization, diversity, and inclusion taken in consideration when planning?
8. Do scientists communicate enough about their research?
9. What is the role of the scientists in your activities?
10. What criteria are used by Science LinX for developing a program/inviting speakers?
11. How are scientists being recruited for your activities?
12. What difficulties do you face when recruiting scientists for your activities, or in your communication with scientists?
  - Are scientists enthusiastic to work with you?
  - If they do not want to work with you, why is that?
13. Are you training or supporting scientists in other ways, to help them communicating their research? If so: how?
14. How do you motivate scientists to engage more in science communication activities?
15. Do you work together with other parties inside or outside of the university? Which ones?
16. What does the cooperation with the research institutes of the university look like?