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# ALLINTERACT

## **Report 3: Awareness-raising actions which are encouraging an active engagement of societal actors in direct participation in science**

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## Executive Summary

### 1. Introduction

ALLINTERACT, Widening and diversifying citizen engagement in science is a Horizon 2020 project that aims on the one hand, to create new knowledge about how to transform potential citizen participation in science into actual engagement in scientific research with social impact and on the other hand to discover new ways to engage societal actors in research, including young citizens (16-29 years old) and vulnerable groups that have traditionally been marginalized from science (e.g., low socioeconomic background, ethnic and religious minorities, women, LGBTQI). In order to achieve this twofold overall objective, six specific objectives were established. This report aims to respond to objective O3) to identify awareness-raising initiatives succeeding at engaging citizens in scientific participation, including the Open Access movement. This is done in the framework of two Sustainable Development Goals –Quality Education and Gender Equality – and with a mixed method approach.

### 2. Methodology

The methodology followed in this report is grounded on four data collection techniques: a literature review, analytics of social media, communicative focus groups and a survey. Regarding the first technique, the literature review aims to explore how citizens' benefit from scientific research with a focus on gender and education. It has been conducted by retrieving articles published in top-ranked journals indexed in Journal Citation Reports and Scopus and the analysis includes the benefits regarding the social impact, the policy impact and the scientific impact. As for the analysis of social media, it includes the Social Media Analytics (SMA) which aims to collect interactions among users on diverse social networks and analyse this data quantitatively and qualitatively and the Social Media Communicative Observation (SMCO), which aims to explore the impact on citizens' participation and awareness of introducing scientific evidences in social media interactions. Regarding SMA, it has followed a twofold strategy, including bottom-up and top-down approaches. It has been implemented on Twitter Facebook, Reddit and Instagram. The final sample has included a total of 5,647 messages. The SMCO has been conducted on Facebook and Reddit for 6 months and on the evidence-based platforms Sappho and Adhyayana for 15 months, with a total sample of 21,322 members. Third, ALLINTERACT consortium has implemented 12 Focus Groups (6 on gender/6 on education) with women, including youth and vulnerable women, LGBTI+ individuals, students, parents and teachers in Italy, Spain, United Kingdom, Finland, Portugal and the Netherlands. These FG collected the voices of society regarding the benefits of scientific research. Finally, a survey has been conducted with 7507 participants from 13 European countries (with a balanced number of EU members, considering their relative size and geographical area) in order collect quantitative data about how citizens' benefit from scientific research and the impact of interactions with science.

### 3. Results

The main results point to four contributions: 1) Interactions with science and among citizens, 2) Inclusion of all sectors of society, 3) Informal learning spaces promoted by educational settings and 4) Scientific evidence in open access.

Interactions with science and among citizens; two key elements for the participation of citizens in science



The literature review conducted in this report concluded that when citizens share interactions with other citizens and with science, they improve their participation in science. In the analysed cases, interactions were fostered through different strategies, such as games, online tools, peer discussions or mentorships. Qualitative and quantitative data reinforce this conclusion. On the one hand, participants in the FG expressed that innovative and interactive initiatives and projects succeed in getting the public involved in different activities. The SMA identified a great extent of the initiatives aimed at inviting citizens to scientific events, sharing and discussing scientific knowledge on open access or organizing hackathons and other co-creation projects. On the other hand, quantitative data from the survey showed that interactions with science, and especially when citizens follow on social media someone who often publishes about science. In this case, they increase both their knowledge about and their participation in initiatives to foster citizens' engagement in science. Finally, more than one third of the respondents (37.7% in education and 33.4% in gender) expressed sharing conversations about scientific evidence with other people, which reinforce the importance of interactions in the promotion of citizen science.

#### **Inclusion of all sectors of society, including vulnerable groups.**

The SMA enabled the identification of existing initiatives targeting specifically people from vulnerable groups, including people from ethnic minorities, children and youth, women, or people with disabilities, among others. Some of these actions were bottom-up and emerged from individual citizens, citizens' platforms, NGOs and associations, including youth, women and families' associations. The review of existing scientific literature had already demonstrated that the inclusion of the voices of the participants can provide enriching feedback that contributes to the achievement of social impact, as it ensures that the interventions respond to the real needs of the participants. In this line, qualitative evidence gathered in the FG showed that participants perceive the importance of the involvement of diverse people in research and think that the scientific community should implement specific actions to encourage them to do research. In addition, participants perceived the benefits of doing research 'with' rather than doing 'on' communities and remarked the necessity of highlighting this to the general public. The results from the survey are aligned with this finding and demonstrated that in general, respondents from vulnerable groups were more likely to express having participated in actions to discuss scientific evidence in gender and education compared with the total of respondents, ranging from 14.39% to 41.49%.

#### **Informal learning spaces promoted by educational settings foster citizen participation in science**

The analysis of the data collected in this report pointed that educational settings (including schools, universities and museums) have an important role in the promotion of citizens participation in science through the organization of informal learning spaces. Respondents of the international survey expressed that initiatives held in educational centres were the most known initiatives. Based on their personal experience, respondents from FG highlighted the success of university outreach activities, Open Days, Science Festivals, Women in Science Days, Science Museums, popular science shows, Citizen Science websites, online lectures and talks, and projects that sought to involve citizens as public contributors. Therefore, participants think that outreach initiatives can help generate interest in what scientists do and important to take people outside of the classroom. The SMA enabled the identification of numerous initiatives that went in the same line, most of them organized by universities (20.89%-68.18%). This finding is aligned with existing scientific literature that shows that an effective approach to engage citizens in science is through informal learning spaces, including museums and other scientific settings, social media or, in the case of children and students, in activities and programs that extend their learning time beyond the school schedule.



### **Scientific evidence in open access**

According to the survey, almost 3 out of 10 (29.7%) of citizens use information sources to learn about scientific evidence on education and gender and this percentage increases when citizens interact with science. This result demonstrates the importance of sharing scientific evidence in open access, especially on the social media, since the most effective interaction is following someone on social media who often publishes about science. In this vein, although most of the initiatives identified in the SMA did not mention whether participants had access to scientific evidence or not, in most cases scientific evidence was not present on the tweet or message itself, but on the conference, webinar or event that were announcing. Among those that include scientific evidence, open access was common. Qualitative evidence from FG support this finding and most participants believed that Open Access was useful, and they gave examples of accessing Open Access journals and articles. In addition, all the articles of the literature review that reported evidence of social impact, implemented evidence-based interventions, and were based on other interventions that had successfully achieved impact before. This result highlights the importance not only of scientific evidence but also of scientific evidence of social impact.

## **4. Conclusions**

The aim of this report was to identify which elements facilitate (transformative) and hinder (exclusionary) the success of initiatives to encourage citizens' participation in science, including the open access movement. The main conclusions in this regard point that when initiatives incorporate the following four elements, they achieve social impact and foster citizens science: 1) Interactions with science and among citizens, 2) Inclusion of all sectors of society, 3) Informal learning spaces promoted by educational settings and 4) Scientific evidence in open access.



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## 1. INTRODUCTION

As outlined in the description of action (Annex 1, Part A, p.1), the ALLINTERACT project addresses five topics:

- a) How citizens' benefit from scientific research (ISCSP-ULisboa/RUG<sup>1</sup>)
- b) Citizen awareness of the impact of scientific research (ISCSP-ULisboa/RUG)
- c) Awareness-raising initiatives succeeding at engaging citizens in scientific participation, including the Open Access movement (UOXF/UH)
- d) Awareness-raising actions that foster the recruitment of new talent in sciences (UNIMIB/UH)
- e) Policies that promote awareness-raising actions and citizen engagement in science. (UOXF/UB)

This report provides the main output of WP3 covering Objective 3: Awareness-raising actions which are encouraging an active engagement of societal actors in direct participation in science. It is directly related to the SDGs of Quality Education and Gender Equality. In particular it seeks to highlight *which* awareness-raising initiatives that link citizens' benefits from science to the research that led to them are also succeeding in fostering citizen engagement in scientific research with impact.

Accordingly, a number of tasks have been undertaken covering a Literature Review, Social Media Analytics, Focus Groups and a Survey. Different Consortium partners have been involved in these tasks and the results have been integrated by the University of Helsinki. In addition, the report draws on findings from the main report from WP2.

The report is structured as follows:

- Section 2 presents the main findings from the literature review covering education and gender.
- Section 3 explores the social media communicative intervention undertaken by the consortium for gender and education.
- Section 4 changes focus and draws out the main findings from the focus groups covering gender and education.
- Section 5 presents the survey data relevant for Objective 3.

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<sup>1</sup> Abbreviations of organisations responsible for the topics covered in this literature review (ISCSP – University of Lisbon; RUG - University of Groningen; UXOF – Oxford University; UH – University of Helsinki; UNIMB - University Milano-Bicocca). The partnership is led by CREA-Universitat de Barcelona and supported by the European Parents Association (EPA).



## 2. LITERATURE REVIEW

### 2.1 Awareness-raising actions related to gender

A summary of key features of the literature focusing on the top ten themes covering gender and awareness-raising actions which are encouraging an active engagement of societal actors in direct participation in science was undertaken by the University of Oxford. Two broad areas were explored in the research covering 'citizen science' and 'open access'.

#### 2.1.1 Citizen Science

One area of research highlighted in the research focused on the motivation for citizens' involvement in life sciences based on age and gender.<sup>2</sup> The reasons that motivate different segments of the public to participate in research are still understudied. Based on data gathered from a survey conducted in Czechia, Germany, Italy, Spain, Sweden, and the UK (N = 5,870), this study explores five types of incentives that can motivate individuals to become involved in life sciences research. The results demonstrate that men and younger individuals are more persuaded by extrinsic motives (external benefits or rewards), as compared with women and older people, who are driven by intrinsic motives (that originates from within an individual). This paper shows that specific strata of the population are differentially motivated to engage in research, thereby providing relevant knowledge for effectively designing public involvement activities that target various groups of the public in research projects.

A second theme looked at the reasons for (not) participating in citizen science. Based on research in Rwanda this study explores the motivational factors and barriers to participate in a citizen science program for malaria control.<sup>3</sup> Using a qualitative approach, this study involved 44 participants. At the initial stage, people participated in the program because of curiosity, desire to learn new things, helping others, and willingness to contribute to malaria control. As the engagement continued, other factors including ease of use of materials to report observations, the usefulness of the program, and recognition also played a crucial role in the retention of volunteers. Some variations in the motivational factors were observed among age and gender groups. For gender, the usefulness of the project, ease of use of materials, and learning opportunities were important motivational factors among women, while men were more motivated by recognition of their efforts. A framework including motivational factors and barriers at each stage of participation is presented. This framework might help coordinators of citizen science programs to determine whom to target, by which message, and at what stage of participation to retain volunteers in citizen science projects.

Extending this theme was research looking at gendered scientization. Focusing on after the Fukushima nuclear accident, many laywomen established citizen radiation measuring organizations (CRMOS) to measure the concentration of radioactive materials in food to ensure its safety.<sup>4</sup> These women had diverse motivations – for example, as caretakers, many wanted to

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<sup>2</sup> Lakomý M, Hlavová R, Machackova H, Bohlin G, Lindholm M, Bertero MG, et al. (2020) The motivation for citizens' involvement in life sciences research is predicted by age and gender. PLoS ONE 15(8): e0237140. <https://doi.org/10.1371/journal.pone.0237140>

<sup>3</sup> Asingizwe D, Poortvliet PM, Koenraadt CJM, van Vliet AJH, Ingabire CM, Mutesa L, et al. (2020) Why (not) participate in citizen science? Motivational factors and barriers to participate in a citizen science program for malaria control in Rwanda. PLoS ONE 15(8): e0237396. <https://doi.org/10.1371/journal.pone.0237396>

<sup>4</sup> Aya H. Kimura (2019) Citizen Science in Post-Fukushima Japan: The Gendered Scientization of Radiation Measurement, *Science as Culture*, 28:3, 327-350, <https://doi.org/10.1080/09505431.2017.1347154>





protect their families. Others saw it as important to arm themselves with science when the broader social discourse portrayed contamination concerns as irrational and harmful to food producers, and stereotyped women as overreacting due to their scientific illiteracy. Some women also became empowered and productive citizen scientists, influenced by the popular idea of women-in-science. Women's motivations to participate in CRMOs were closely connected to the expanding scientization—the increasing role of science in defining and prescribing social problems. The concept of gendered scientization highlights how the turn to science in dealing with environmental threats might result in gendered opportunities and challenges in collective mobilization by citizens.

Another theme from the research considered the potential of citizen science. Based on a study in Switzerland this study looked at why citizen science projects have mostly attracted people that are highly educated, mostly male and already have very positive attitudes towards science.<sup>5</sup> Based on nationally representative survey data (N = 1051), this study explores the potential of citizen science in Switzerland. It shows that attitudes towards science are significant antecedents of respondents' interest in participating in citizen science - but that gender and education are not. Overall, the study suggests that citizen science's potential is far higher than previous projects were able to realize.

In a different vein, another research project considered the gendered participation in OpenStreetMap (OSM) and had a more technology focus.<sup>6</sup> This paper presents the results of an exploratory quantitative analysis of gendered contributions to the online mapping project OSM, in which previous research has identified a strong male participation bias. The results reveal that volumes of overall activity as well editing and tagging actions in OSM remain significantly dominated by men. They also indicate subtle but impactful differences in men's and women's preferences for modifying and creating data, as well as the tagging categories to which they contribute. Discourses of gender and ICT, gender relations in online VGI environments and competing motivational factors are implicated in these observations.

The importance of environmental education is a strong focus of research. One study examined data from 2 regional naturalist programs to understand participant motivations, barriers, and perspectives as well as the actions they take to advance science, stewardship, and community engagement.<sup>7</sup> These programs provide certification-based natural history and conservation science training for adults that is followed by volunteer service in citizen science, education, and stewardship. Studies in California and Virginia include quantitative and qualitative evaluation data collected through pre- and postcourse surveys, interviews, and long-term tracking of volunteer hours. Motivations of participants focused on learning about the local environment and plants and animals, connecting with nature, becoming certified, and spending time with people who have similar interests. In general, participants in these naturalist programs increased their content knowledge about ecosystems, had greater confidence in conserving them, and continued to engage as citizen scientists after completing the program. Over half the

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<sup>5</sup> Füchslin T, Schäfer MS, Metag J. Who wants to be a citizen scientist? Identifying the potential of citizen science and target segments in Switzerland. *Public Understanding of Science*. 2019;28(6):652-668.  
<https://doi.org/10.1177%2F0963662519852020>

<sup>6</sup> Gardner, Z., Mooney, P., De Sabbata, S. et al. Quantifying gendered participation in OpenStreetMap: responding to theories of female (under) representation in crowdsourced mapping. *GeoJournal* 85, 1603–1620 (2020).  
<https://doi.org/10.1007/s10708-019-10035-z>

<sup>7</sup> Merenlender, A.M., Crall, A.W., Drill, S., Prysby, M. and Ballard, H. (2016), Evaluating environmental education, citizen science, and stewardship through naturalist programs. *Conservation Biology*, 30: 1255-1265.  
<https://doi.org/10.1111/cobi.12737>



participants surveyed were over 50 years old, two-thirds were women, and a majority reported household incomes of over \$50,000 (60% in California, 85% in Virginia), and <20% of those surveyed in both states described themselves as non-white. Thus, these programs need to improve participation by a wider spectrum of the public.

The relationship between gender and age has also been examined, and one project examined contribution of Multimedia to Girls' Experience of Citizen Science.<sup>8</sup> The mixed methods randomized experimental study assessed a model of engagement and education that examined the contribution of SciGirls multimedia to fifth grade girls' experience of citizen science. The treatment group (n = 49) experienced 2 hours of SciGirls videos and games at home followed by a 2.5 hour FrogWatch USA citizen science session. The control group (n = 49) experienced the citizen science session without prior exposure to SciGirls. Data from post surveys and interviews revealed that treatment girls, compared to control girls, demonstrated significantly greater interest in their FrogWatch USA session and significantly greater learning about the unique features of the practice of citizen science. Treatment girls felt that SciGirls multimedia showed them the process and practice of citizen science, demonstrated the fun of citizen science, and presented peers with whom they could identify. Incorporating multimedia is recommended as an effective method for influencing girls' citizen science interest, self-efficacy and learning.

### 2.1.2 Open Access

Attitudes toward open access, open peer review, and altmetrics among contributors to Spanish scholarly journals was considered by a team of researchers.<sup>9</sup> This paper aims for a better understanding of the perspectives of contributors to Spanish academic journals regarding open access, open peer review, and altmetrics. Specifically, it explores how age, gender, years of professional experience, and perception and use of social media influence authors' opinions of these developments in scholarly publishing. A sample of 295 contributors to Spanish academic journals participated in a survey about the aforementioned topics. They were found to hold a favourable opinion of open access but were more cautious about open peer review and altmetrics. The responses of younger and female scholars indicated more reluctance to accept open peer review practices. A positive attitude toward social networks did not necessarily translate into enthusiasm for emerging trends in scholarly publishing.

A slightly different approach was taken by researchers in Italy who looked at an intersectional approach to analyse gender productivity and open access.<sup>10</sup> This paper represents a first exploration of the inter-linkages between gender and Open Access (OA) analysing the scientific production of researchers of the Italian National Research Council under a gender perspective integrated with the different OA publications modes. A bibliometric analysis was carried out for articles published in the period 2016–2018 and retrieved from the Web of Science. The results indicate that gender disparities in scientific production still persist particularly in STEM disciplines, while the gender gap is the closest to parity in medical and agricultural sciences. A positive dynamic toward OA publishing and women's scientific production is shown when

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<sup>8</sup> Flagg, B N 2016 Contribution of Multimedia to Girls' Experience of Citizen Science. *Citizen Science: Theory and Practice*, 1(2): 11, pp. 1–13, DOI: <http://dx.doi.org/10.5334/cstp.51>

<sup>9</sup> Francisco Segado-Boj, Juan Martín-Quevedo, and Juan José Prieto-Gutiérrez. Attitudes toward Open Access, Open Peer Review, and Altmetrics among Contributors to Spanish Scholarly Journals. *Journal of Scholarly Publishing* 2018 50:1, 48-70. <https://doi.org/10.3138/jsp.50.1.08>

<sup>10</sup> Ruggieri, R., Pecoraro, F. & Luzi, D. An intersectional approach to analyse gender productivity and open access: a bibliometric analysis of the Italian National Research Council. *Scientometrics* 126, 1647–1673 (2021). <https://doi.org/10.1007>



disciplines with well-established open practices are related to articles supported by funds. A slightly higher women's propensity toward OA is shown when considering Gold OA, or authorships with women in the first and last article by-line position.

Another key area of research focused on who supports OA. Based on findings in the UK this paper presents the findings from a survey study of UK academics and their publishing behaviour.<sup>11</sup> The results suggest that there were differences in the extent of OA practice between different universities, academic disciplines, age and seniorities. In general, men were more likely to have experience of using both Gold and Green OA publishing compared to women, although the differences were not large (less than 10%).

## 2.2 Awareness-raising actions related to education

The research team was advised and supported by the University of Helsinki's information and library service. Based on these discussions, the research team undertook its research using Scopus. Accordingly the following keyword searches were employed for this topic:

- Science or technology and education and under-representation
- Science or technology and education and "vulnerable groups"
- Science or technology and education and "citizen engagement" or "public engagement"
- Science or technology and education and "learning design" or "learning engagement"

Based on these keywords the following was undertaken:

- The literature review was conducted in English.
- The search involved both primary (abstract and title) and secondary (title) word search fields to limit the number of results.
- To refine the search research articles published over the 2010-2020 period and in the subject area of 'social sciences' were examined.
- The articles were prioritised according to the number of citations.
- All the abstracts for the keyword searches were reviewed and if considered relevant the entire article was assessed and summarised.
- A total of 180 articles were reviewed of which 32 were considered relevant and summarised below.

### 2.2.1 Science or technology and education and under-representation

Three sets of research were identified from the literature review covering Science or technology and education and under-representation. The first centres on the engagement of Black, Asian and Minority Ethnic (BAME) groups. For example, one project has explored whether people from BAME groups are under-represented in various UK medical research contexts.<sup>12</sup> Based on two

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<sup>11</sup> Who support open access publishing? Gender, discipline, seniority and other factors associated with academics' OA practice

Zhu, Y. Who support open access publishing? Gender, discipline, seniority and other factors associated with academics' OA practice. *Scientometrics* 111, 557–579 (2017). <https://doi.org/10.1007/s11192-017-2316-z>

<sup>12</sup> The under-representation of minority ethnic groups in UK medical research Smart, Andrew; Harrison, Eric ISSN:



waves of the Wellcome Trust Monitor (WTM), which focuses on questions about science education, engagement with medical research and public attitudes towards biotechnologies, the researchers found there was patchy evidence that those in the BAME group were slightly less willing to participate; the evidence that those in the BAME group were less likely to have participated was greater, stronger and more consistent. This evidence suggests that the problem of under-representation is not primarily about willingness to participate (WP), which supports arguments against blaming 'marginalised people' for patterns of unequal participation.

A second set of research has considered the gender aspect in participating in certain subjects. For example, one project examined the processes that lead to a gender gap among girls in developing countries undertaking information technology subjects in the post-compulsory years of education which has remained persistently low.<sup>13</sup> The main finding here is that there has been little impact upon the numbers of girls following the pathway to tertiary study of information technology and the numbers of girls studying IT in schools are actually trending down. Importantly, one of the key findings includes the need to provide more accurate and timely career advice and subject information, to counter common misconceptions. In particular, it was seen as important to differentiate between the different kinds of IT career pathways and the need to emphasise the relevance of senior IT subjects to university studies in software engineering and information technology.

A third set of research has explored different programmes to address under-representation. For example, one research project focusing on the US has considered medical centers that have developed educational outreach programs for students with the hopes of attracting a diverse cohort of talented young individuals to careers in STEM.<sup>14</sup> Here Stanford University developed an effective 5-week residential program (including classroom instruction, anatomy practicum, hospital field placements, and research projects) for low-income high school students in an attempt to meet this goal. Interestingly, this research highlighted how cardiac anesthesia is uniquely positioned as a subspecialty to advance the goal of promoting interest in STEM in diverse groups of young students. This is influenced by students often know family members who have undergone coronary or other surgical interventions and are curious about the details of these procedures. Lastly, cardiac anesthesiologists are generally enthusiastic about their career choice and the opportunities afforded.

## 2.2.2 Science or technology and education and “vulnerable groups”

A limited set of research was identified from the literature review covering Science or technology and education and “vulnerable groups”. One research project based in Peru looked at a programme of academic accompaniment for these students who belong to vulnerable groups was implemented aiming to improve their academic performance index.<sup>15</sup> However, the

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1355-7858 , 1465-3419; DOI: 10.1080/13557858.2016.1182126 Ethnicity & health. , 2017, Vol.22(1), p.65-82

<sup>13</sup> Reassembling the Problem of the Under-Representation of Girls in IT Courses Tatnall, Arthur; Rowan, Leonie; Bigum, Chris ISBN: 9781609601973 , 9781609601997; DOI: 10.4018/978-1-60960-197-3.ch014 Actor-Network Theory and Technology Innovation , 2010, p.208-222

<sup>14</sup> How Cardiac Anesthesiology Can Help “STEM” the Tide of Under-representation of Minorities in Science and Medicine Woodward, Elliott; Lai, Yvonne; Egun, Christyanna; Fitzsimons, Michael G ISSN: 1053-0770 , 1532-8422; DOI: 10.1053/j.jvca.2017.06.031 Journal of cardiothoracic and vascular anesthesia. , 2018, Vol.32(2), p.631-635

<sup>15</sup> Accompaniment program for university students from vulnerable groups at the Escuela Politécnica Nacional Sandoval, Ivan; Prócel, Galo; Sánchez, Joseph; Carrera, Iliana; Proaño, Andrés ISSN: 2414-6390; ISBN: 9780999344316; DOI: 10.18687/LACCEI2018.1.1.238 Proceedings of the 16th LACCEI International Multi-



students presented high dropout rate due to the economic problems, lack of time for students, and insufficient pedagogical training of the tutors. Here the virtual tutorials are a key element of the program, which allowed students to maintain direct communication with the tutors, and solve doubts immediately and efficiently. But it is necessary that the implementation of the program be integral, emphasizing face-to-face and virtual tutorials simultaneously. Any programme needs to be linked with a socioeconomic support system (government scholarships), in order to guarantee the permanence and success of students in vulnerable groups. In addition, the lack of attendance of students in the face-to-face tutorials because the tutors were not suitably experienced even though they were familiar with the subject.

### 2.2.3 Science or technology and education and “citizen engagement” or “public engagement

Literature covering the theme of Science or technology and education and “citizen engagement” or “public engagement” was extensive and had different dimensions. One project looked at the key messages for the theory and practice of environmental education from a review of recent research literature on climate change communication (CCC) and education.<sup>16</sup> It focuses on how learners of climate science understand messages on climate change, the communicative contexts for education on climate change, the barriers that can be found to public engagement with climate change issues, and how these barriers can be addressed. Interestingly, while studies of public understanding of climate change tend to rest on the so-called ‘information deficit model’, studies endorsing the public engagement in science perspective emphasize that increased scientific literacy is not a sufficient goal for CCC. Instead of being mere receivers of climate change messages, public engagement means that the public needs to actively take part in learning and action on climate change. Importantly, in line with the shifting focus in the CCC literature from public understanding to public engagement in climate change, there is also increasing focus on ways of communicating climate change that take into account the need for audience segmentation and involving different publics in dialogue and deliberation on causes, impacts and responses to climate change.

A similar theme was considered in a project that looked at the capacity for informal science learning centers (ISLCs; zoos, aquariums, national parks, museums, science centers, and nature centers) in the United States to catalyze public engagement with climate change through greater incorporation of the topic into their curriculum.<sup>17</sup> The main finding from the research was the importance of using educational interventions to promote increased public engagement with climate change. These findings contrast with popular suggestions to avoid directly discussing climate change in environmental communication and illustrate that the prevailing social narrative that climate change is a politically unpalatable topic for public discourse is unfounded.

A slightly different set of ideas centres on the particularities of a technology. One research project considered nanotechnology is an emerging technology poised to benefit society both

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Conference for Engineering, Education, and Technology: “Innovation in Education and Inclusion” , 2018, Vol.2018-July

<sup>16</sup> Enhancing learning, communication and public engagement about climate change – some lessons from recent literature Wibeck, Victoria ISSN: 1350-4622 , 1469-5871; DOI: 10.1080/13504622.2013.812720 Environmental education research. , 2014, Vol.20(3), p.387-41

<sup>17</sup> Catalyzing Public Engagement With Climate Change Through Informal Science Learning Centers Geiger, Nathaniel; Swim, Janet K; Fraser, John; Flinner, Kate ISSN: 1075-5470 , 1552-8545; DOI: 10.1177/1075547017697980 Science communication. , 2017, Vol.39(2), p.221-249



technically and socially, but as with any new advance, there is potential risk.<sup>18</sup> Here a novel deliberative exercise involving nanotechnology that engages the public in debate regarding the funding of nanotechnology-related research while also discussing potential risks and benefits of this emerging field of science. In a 2-h time frame, participants are provided with general background terminology and examples of advances in nanotechnology in 10 different research areas. The participants are then asked to reach consensus on how the funding should be distributed among these 10 areas. Overall, participants gained factual knowledge and confidence in their knowledge. They valued learning about nanotechnology and the opportunity to discuss a real-world relevant topic with others. Importantly, increased support for nanotechnology was not an objective of this exercise, nor should it be expected.

Another broader theme centred on questioning the idea of 'the public' being hailed as a homogenous mass.<sup>19</sup> Attending to publics encourages health humanities scholars to shift the unit of analysis from the official texts of biomedicine to the practices that various groups use in contributing to and altering biomedical and health practices (see Hauser 1999; Pezzullo 2003). This methodological turn therefore implies that traditional rhetorical hermeneutics and close textual reading might profitably benefit from including participant observation, ethnography, interviewing, and other social science methods in order to capture the complex texture of public action and understanding. The resulting shift from elite representation to public performances and enactments mirrors recent calls to examine multiple health practices rather than focusing exclusively on the competing epistemologies of medical institutions, experts, and publics.

On a more practical level the link between school science laboratory classes and hands-on public engagement activities was also highlighted, especially in terms of how they share many common aims and objectives in terms of science learning and literacy. One research project in the UK considered the development and evaluation of a microbiology public engagement activity, 'The Good, the Bad and the Algae', from a school laboratory activity.<sup>20</sup> The school activity was developed as part of an educational resource which aimed to promote practical microbiology in the classroom. The public engagement activity was derived locally for National Science and Engineering Week 2011 and was subsequently adapted for a national science and engineering fair (The Big Bang 2012). Usefully, the removal of classroom science limitations (such as time, equipment or expertise) means that when delivering science in an informal setting such as a science fair, science communicators can utilise novelty, choice and social interaction to enhance their engagement with participants.

Various studies have also explored public outreach. For example, one study in the US considered public outreach effort to collect geotagged photographs and on close collaboration with an outdoor science school that was well-positioned to collect the needed data.<sup>21</sup> The project was initiated by a team of two university researchers at the University of Washington, and evolved

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<sup>18</sup> Using a Deliberative Exercise To Foster Public Engagement in Nanotechnology Jones, Angela R; Anderson, Ashley A; Yeo, Sara K; Greenberg, Andrew E; Brossard, Dominique; Moore, John W ISSN: 0021-9584 , 1938-1328; DOI: 10.1021/ed400517q Journal of chemical education. , 2014, Vol.91(2), p.179-187

<sup>19</sup> Public Engagements with Health and Medicine Keränen, Lisa ISSN: 1041-3545 , 1573-3645; DOI: 10.1007/s10912-014-9275-7 Journal of medical humanities. , 2014, Vol.35(2), p.103-109

<sup>20</sup> Transforming a school learning exercise into a public engagement event: 'The Good, the Bad and The Algae' Redfern, James; Burdass, Dariel; Verran, Joanna ISSN: 0021-9266 , 2157-6009; DOI: 10.1080/00219266.2013.801872 Journal of biological education , 2013, Vol.47(4), p.246-252

<sup>21</sup> Challenges and successes in engaging citizen scientists to observe snow cover: from public engagement to an educational collaboration Dickerson-Lange, Susan; Eitel, Karla; Dorsey, Leslie; Link, Timothy; Lundquist, Jessica ISSN: 1824-2049; DOI: 10.22323/2.15010201 Journal of science communication : JCOM. , 2016, Vol.15(1)





into collaboration between three universities and a K12 outdoor science school. Participants commented that they thought they understood what observations to collect in the field, but then were unsure when it came time to fill out the form upon their return. Needed to streamline the data collection and submission process, to provide more explicit instructions, and to recruit more participants. Mismatch between the level of engagement and the numbers of participants needed for the dataset originally envisioned. Two key lessons emerged from this project. Firstly, the data collection needed for the investigation needs to align with the strengths of the citizen science approach. Secondly, the level of participation needed from the audience needs to align with both the regular activities and interests of the audience and the type of data being collected.

Focusing more on the role of scientists, one science communication project aimed to enhance culture change in engineering by developing communication skillsets of early-career engineers, particularly supporting female engineers as role models.<sup>22</sup> Engineers received training in storytelling to present at live events, enhanced by peer group social persuasion and vicarious modelling. A science communication coordinator and senior management endorsement removed barriers to participation. Evaluation showed engineers' self-efficacy levels significantly increased. Qualitative data highlighted a developing culture of engagement but purposive selection of women proved controversial. Thus the project had two overlapping aims: to enhance the organizational culture of PE within the engineering laboratory, and to enable female engineers to act as role models for the wider public, particularly girls. Several conclusions emerged from the research including the importance of direct learning experiences were provided through training in storytelling to improve communication skills, and then experiencing success at live public science events, thus providing positive emotional arousal to enable a feeling of mastery when remembering previous performances. Furthermore, purposive recruitment in male-dominated fields is incredibly important to normalize female role models in STEM and also to broaden implicit societal messaging about which careers are appropriate for girls. Research that indicates that boys are not "put off" by seeing female role models in male-dominated sectors.

The support for public engagement programmes, or science in society, in the UK continues to grow and be recognised, and has acted as a model for many other countries in Europe because of the involvement of such institutions as the British Science Association ( [www.britishscienceassociation.org](http://www.britishscienceassociation.org) ) which was founded in 1831 and is a charity which 'exists to advance the public understanding, accessibility and accountability of the sciences and engineering in the UK', and the National Co-ordinating Centre for Public Engagement ( [www.publicengagement.ac.uk](http://www.publicengagement.ac.uk) ). One research project focused on a 2-hour interactive workshop entitled 'Food Addiction: Fact or Fiction?' was accepted into the festival programme under the general heading of 'Talks and Debates', as a joint initiative between project partners from the University of Aberdeen Rowett Institute and the University of Duisburg-Essen, Germany.<sup>23</sup> Here it was shown that there is clearly a public appetite for engagement events. In particular, events related to real-life health issues such as obesity, and diet and nutrition, are well received. The audience appeared to be receptive to new information and clarification of issues, making it a positive experience for both presenters and, as judged by evaluation, the audience, although it

<sup>22</sup> "Robots Vs Animals" Fogg-Rogers, Laura; Sardo, Margarida; Boushel, Corra ISSN: 1075-5470 , 1552-8545; DOI: 10.1177/1075547017696169 Science communication. , 2017, Vol.39(2), p.195-220

<sup>23</sup> Getting Science to the Citizen - 'Food Addiction' at the British Science Festival as a Case Study of Interactive Public Engagement with High Profile Scientific Controversy Bird, Sue P; Murphy, Michelle; Bake, Tina; Albayrak, Özgür; Mercer, Julian G ISSN: 1662-4025 , 1662-4033; DOI: 10.1159/000349916 Obesity facts : the European journal of obesity. , 2013, Vol.6(1), tel. 103-10



is obviously difficult to judge whether any audience members went away with a changed opinion. Another point of discussion could have been whether the use of such terminology is helpful or stigmatizing to people with overeating and weight problems looking for practical solutions in their everyday lives. The food composition activity was intended to provide some help in this direction.

The use of particular types of technology, such as Virtual reality (VR) technology has been capturing the public imagination for decades. One article looked at how VR software applications that allow for interactive immersion are emerging as a renowned medium in many areas, including educating the public in biochemistry-related subjects via public engagement events.<sup>24</sup> The focus is on an immersive, interactive and educational virtual reality (VR) game named Bug Off Pain that increases scientific literacy about chronic pain and spider venoms among the public and high school students. Here, VR was shown to be an innovative and fun approach to learning and public engagement in biochemistry. Bug Off Pain places the viewer inside the brain and shows the molecular system that allows people to sense pain. Possible reasons for its valuable educational benefits include not only correctly using critical thinking skills and problem-solving abilities, but also framing individual creativity and selfdirection, all of which stand out as the less-tangible, nonacademic benefits. Importantly, the game is not intended as a total replacement for any current effective pedagogy but may be valuable additions to the teaching toolbox that educators can leverage to engage the modern learner.

Developing further the idea of the use of a particular tool from social media one article looked at how it could be used in science museums.<sup>25</sup> Overall science museums are missing an opportunity to promote informal education, scientific literacy, public engagement and public visibility of scientists outside of museum walls via Instagram. With an analysis of 1,073 Instagram posts, museums are using Instagram as a promotional broadcasting tool, with a focus on end results of collections and curation work over communication of museum-led discovery and science as a process. The most well-represented were zoology / animal science / wildlife conservation. Only 11% of the posts including a human element depicted identifiable science professionals (scientists, researchers, engineers, museum curators or curatorial interns, astronauts or other subject experts. 77% included Caucasian science professional(s), while only 6% included Black science professional(s). A majority or 70% of the posts were promotional in nature, being dominated by content that promoted the museum or an exhibit, event, facility, staff activity. Only 12% of the posts depicted meaningful public engagement or participation with science, for example museum audiences engaging with scientists, engaging with science or the natural world, speaking to a scientist or attending a science talk, participating in a science demonstration or doing a hands-on science activity. Most of the posts containing any science-related content presented science as a product as opposed to a process. A consistent lack of robust scientific material, science-related hashtags and scientists' faces, among other elements that might help communicate science or encourage public participation with it. Nearly a third of the posts contained no obviously science-related content at all. By approaching Instagram less as a one-way promotional tool and more as a conversation-starting, inspirational visual space to bring museum researchers and the public together, museums might address their public engagement goals in new ways. Importantly, science museums should create more Instagram

<sup>24</sup> Bug Off Pain: An Educational Virtual Reality Game on Spider Venoms and Chronic Pain for Public Engagement Bibic, Lucka; Druskis, Justinas; Walpole, Samuel; Angulo, Jesus; Stokes, Leanne ISSN: 0021-9584 , 1938-1328; DOI: 10.1021/acs.jchemed.8b00905 Journal of chemical education. , 2019, Vol.96(7), p.1486-1490

<sup>25</sup> Instagram and the science museum: a missed opportunity for public engagement Brown Jarreau, Paige; Dahmen, Nicole Smith; Jones, Ember ISSN: 1824-2049; DOI: 10.22323/2.18020206 Journal of science communication : JCOM. , 2019, Vol.18(2)





posts that offer educational information and visibility of exhibit creation and museum researchers' work behind the scenes.

The importance of responsible research initiatives (RRI) was also highlighted in the literature. One case study described here suggests that even brief interactions with the public through science engagement activities such as "Speed-Date-a-Scientist" can contribute towards affirmation of choice of career, students' motivation as researchers and shaping of their identity as scientists, important processes in their own learning to become scientists. Students also indicated a greater sense of motivation to do research that benefits the public, resonating with RRI learning outcomes.<sup>26</sup> One of the core challenges to embedding RRI is that it is not viewed as a simple box ticking exercise, or enacted in a manner that only serves to satisfy the requirements of a funding policy, as this is unlikely to bring about desired qualities of responsibility and responsiveness. As framed through the lens of the RRI programme, and for the purposes of this study, much scope exists to explore ways to embed public engagement (PE) between science students and the public (using biotechnology as a case study in a South African higher education setting), that could result in attributes deemed desirable in the unfolding of the society-centred biotechnology framework in the country.

Focusing back on the public, different types of initiatives have been highlighted in the research. For example, café scientifique refers to a grassroots public science initiative that, according to the café scientifique website ([www.cafescientifique.org/](http://www.cafescientifique.org/)), is currently running across 42 cities in the UK and cities in other countries.<sup>27</sup> The background rationale for café scientifique can be located in the gap between expert knowledge and an increasingly fragmented public sphere. The risk society reflects public scepticism about the role of science in relation to contentious public issues, such as nuclear power, genetically modified (GM) crops and the environment. At a political and policy level, there is a perceived need to get publics 'on side' in relation to scientific innovation. The science café is therefore implicated in a broader set of policy and political issues than the image of the café as 'meeting place' immediately suggests. Here of paramount importance are the pragmatic issues involved in initiating and developing a public engagement initiative of this sort and registering the sheer good will and, most importantly, the social values and commitments of those colleagues and participants in events.

Picking up on the role of social media, one article looked at the role of TikTok a social media video-based phone application which enables creative and engaging videos to be shared on social media platforms worldwide. TikTok has been applied to create fun, exciting, and engaging 15–60 s long chemistry outreach educational videos, to encourage public dissemination of science with a systems thinking approach. One article explore the creation of an online TikTok account called "The Chemistry Collective" by undergraduate students, 16 educational videos were created, with approximately 8,500 views.<sup>28</sup> Upon surveying participants, viewers of these TikTok videos strongly agreed that they had learned something new about chemistry since watching these videos (4.66/5.00) and had an increased interest in chemistry (82.7% agreed). As

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<sup>26</sup> Putting responsible research and innovation into practice: a case study for biotechnology research, exploring impacts and RRI learning outcomes of public engagement for science students Limson, Janice ISSN: 0039-7857 , 1573-0964; DOI: 10.1007/s11229-018-02063-y Synthese. , 2018

<sup>27</sup> Public engagement and social science S. S. Maile ISBN: 9781447306863 , 130682379X , 1447306872 , 144731154X , 9781306823791 , 9781447306870 , 9781447311546 Public engagement and social science / , 2014, p.1-255

<sup>28</sup> "Making Every Second Count": Utilizing TikTok and Systems Thinking to Facilitate Scientific Public Engagement and Contextualization of Chemistry at Home Hayes, Clare; Stott, Katherine; Lamb, Katie J; Hurst, Glenn A ISSN: 0021-9584 , 1938-1328; DOI: 10.1021/acs.jchemed.0c00511 Journal of chemical education. , 2020, Vol.97(10), p.3858-3866



such, TikTok can be used to enhance public and undergraduate student engagement with chemistry and science education, together with facilitating the ability of the public to understand how chemistry can be fun, can be performed at home, and is part of our daily lives.

In a very different vein one article looked at Cape Town's current position regarding a Smart City by means of determining what Smart City initiatives are implemented in other Smart Cities and what Smart City initiatives are implemented within Cape Town.<sup>29</sup> And then to explore how visitors of Cape Town experience the initiatives. The objectives of the research are to analyse and determine how aligned the cities implemented Smart City initiatives are to those of its' citizens and visitors with a goal of informing city planning before the end of 2015, of the alignment. The most important conclusion, according to the results Cape Town has implemented the appropriate Smart City Initiatives and have included them in appropriate strategies with focus related to citizen and visitor needs promoting socio-economic development and improved quality of life with substantial buy in, and recommend that after a survey with greater scope and pending their results match, Smart City initiatives be implemented across the whole South Africa and from a national government level as certain initiatives are beyond the scope of what one city can do. Moreover, the article showed that there needs to be more visibility and education of the initiatives as a few interview respondents were not aware of some. There has been no prior confirmation or suggestion when it comes to which Smart City Initiatives to be implemented in Cape Town or South Africa and thus the significance of the research contributes as a starting point for further research. Further research regarding Education initiatives needs to be done, indicated by a significant amount of negative responses.

#### 2.2.4 Science or technology and education and "learning design" or "learning engagement"

The promise of using games for learning is a strong theme in much of the research covering Science or technology and education and "learning design" or "learning engagement". One article looked at the affective and cognitive facets of learning engagement in gaming.<sup>30</sup> It was based on the idea that a common motivation for using digital games to support learning is a belief that games can act as rich primers for active and deeper learning engagement with subject matter, by providing an engaging and contextualized setting for authentic problem solving. The article concluded that Gamebased learning engagement occurs in a multiphase development that proceeds from a pure affective engagement, to a cognitively engaged, psychological experience, and potentially to a conscious and necessitated interaction with the gaming-situated learning content. The finding also suggested that game-based learning engagement is an integrated and continuing process that advances from affective engagement driven by optimal challenge, cognitive engagement situated in playfulness, to potentially gameaction-based content engagement.

A different area of research focused on the key drivers for learner satisfaction are in blended and online courses. One research project looked at learner satisfaction at the Open University in the UK (the largest higher education provider of online distance education in Europe).<sup>31</sup> The

<sup>29</sup> Citizen engagement in Cape Town's transition towards a smart city Kloppers, Jozua ISBN: 1-5090-1955-3 , 1-905824-55-6; DOI: 10.1109/ISTAFRICA.2016.7530614 2016 IST-Africa Week Conference , 2016, p.1-13

<sup>30</sup> Game-based learning engagement: A theory- and data-driven exploration Ke, Fengfeng; Xie, Kui; Xie, Ying ISSN: 0007-1013 , 1467-8535; DOI: 10.1111/bjet.12314 British journal of educational technology. , 2016, Vol.47(6), p.1183-1201

<sup>31</sup> Modelling and Managing Learner Satisfaction: Use of Learner Feedback to Enhance Blended and Online Learning



research found that for undergraduate continuing learners, satisfaction with the teaching materials provided on the module is the most important driver of overall satisfaction. In addition, proxies for learning design had a strong and significant impact on overall satisfaction for both new and continuing learners. Learners who were more satisfied with the quality of teaching materials, assessment strategies, and workload were significantly more satisfied with the overall learning experience. Interestingly, it also highlighted that individual learner characteristics do not play a more pronounced role in predicting overall learner satisfaction. While some research indicates that ethnic minority students (Richardson, 2013) and women (Herman, 2014) seem less successful in online learning settings, our large scale study seems to indicate that learner characteristics play only a minor role in learner satisfaction.

A more specific area of research focused on the RASE (Resources-Activity-Support-Evaluation) learning design model developed as a framework to assist teachers in designing learning modules.<sup>32</sup> Central to RASE is the emphasis on the design of activities where students engage in using resources and in the production of artifacts that demonstrate learning. The paper also emphasizes the importance of 'conceptual models' as a special type of educational multimedia resource, and its role in assisting learning and application of concepts, as opposed to the 'information transfer' models. RASE is beginning to emerge as a powerful framework for transformation of teachers and their traditional practices to contemporary, relevant student-centered practices. The model is also an effective framework for productive uses of information technology in education. The main conclusion from the research was that before beginning to build a learning unit, teachers need to: ensure that specific course learning outcomes are aligned with overall programme learning outcomes; identify learning units required to achieve learning outcomes; and align assessment, learning units and learning outcomes. Teachers need a learning design model to assist their instruction planning in a way that will help them overcome such challenges.

Another study from the US focuses on e-learning and how pre-training socialization and task complexity affected learning in an online environment.<sup>33</sup> The sample for this study consisted of 143 individuals (78 males, 63 females, 2 participants did not indicate gender), drawn from a required core undergraduate business course. The mean age of the sample was 19.8 years (range ¼ 18e52). Most of the participants used computers on a daily basis (96%), had over 4 years of experience with computers (95%), and had completed at least three courses that used the Blackboard Learning System (91%). The results indicated that those who received face-to-face socialization performed better than those who received either online socialization or no socialization. There was no learning difference between the online and no socialization condition. Those who received simpler training performed better than those who received more complex training. Socialization and complexity were not interactively related. Implications for research and practice are discussed. In addition, trainers, teachers, and professors should consider the level of difficulty of learning content. One way to address this is by dividing challenging material into smaller, simpler modules. Modularizing training allows trainees to concentrate on mastering smaller sets of information before moving on to the next module. Another mechanism that could assist trainers is through the use of virtual mentors and

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Experience Li, Nai; Marsh, Vicky; Rienties, Bart ISSN: 1540-4595 , 1540-4609; DOI: 10.1111/dsji.12096 Decision sciences journal of innovative

<sup>32</sup> Learning design for science education in the 21st century Churchill, Daniel; King, Mark; Fox, Bob ISSN: 0579-6431 , 1820-9270; DOI: 10.2298/ZIP1302404C Zbornik Instituta za pedagoška istraživanja. , 2013, Vol.45(2), p.404-421

<sup>33</sup>An empirical examination of e-learning design: The role of trainee socialization and complexity in short term training Yanson, Regina; Johnson, Richard D ISSN: 0360-1315 , 1873-782X; DOI: 10.1016/j.compedu.2016.05.010 Computers & education , 2016, Vol.101, p.43-54



interactive videos. On-demand videos can be made available that provide trainees with additional information or supplemental illustrations on specific topics. These tools can provide trainees with the ability to go back and review more difficult or detailed information at their convenience, reducing the pressure to retain everything at once during training.

The aim of another qualitative case study was to explore the use of stories as tools for learning within formal and informal learning environments in Denmark.<sup>34</sup> In this study, students were engaged in a themed exhibit about human and animal senses at a public science centre. A story was created to support students' engagement and interaction with the themed exhibit. The story was specially designed to provide opportunities for designing and conducting inquiry-based investigations in pre- and post-activities at school and at the science centre. The aim of this study was to explore the use of a specially designed story as a tool for learning about senses within the contexts of a school and a science centre. The analysis of the data illustrated two main things: (a) stories have a great potential as a learning tool in science and (b) the way a story, as other tools, is used is totally dependent on the teacher's personal philosophy about science teaching and learning. Importantly, the findings of this study showed that the story acted as a means for motivation and immersion into the learning activity. The ways in which the students used the story seemed to be dependent on how the teachers adopted and used stories in their instructional practices.

Another study in Denmark considered the teachers' role is challenged by a number of issues in relation to the growing use of blended and online learning, e.g. the task of facilitating the learning processes of the participants in new ways; a higher degree of exposure as the teacher often becomes the sole point of contact in online environments; communication skills needed to facilitate dialogue and collaboration in an online environment.<sup>35</sup> Furthermore, involvement of teaching staff in co-creation of new learning designs require skills which many lecturers do not have when they enter the design team for the first time, among others skills to articulate their pedagogical principles and technological imagination. Developed, tested and refined a technique for user involvement in the design work, and teachers now work with our professional learning designer and course producer on redesigning courses or creating new module or courses. The research found that teachers need facilitation by professional learning designers to be able to build a bridge between technology and pedagogical issues, which teachers face in the re-design process. Different challenges have been identified in relation to involving teachers in learning design processes: Limited IT-knowledge and experience; lack of technological imagination, lack of confidence when trying out new designs; and the need for a clear organizational framing of the design work are some of the more dominant ones. Usefully cultural change will have to take into consideration key questions at both the strategic, tactical and operational level in the organisation to achieve a dynamic organisation characterized by a learning culture.

In contrast, one study from the US looked at design elements for online education in the STEM fields.<sup>36</sup> Most of the literature in this area consists of either broad meta-analyses of pedagogical

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<sup>34</sup> Animals, Emperors, Senses: Exploring a Story-based Learning Design in a Museum Setting Murmann, Mai; Avraamidou, Lucy ISSN: 2154-8455 , 2154-8463; DOI: 10.1080/21548455.2012.760857 International journal of science education. , 2014, Vol.4(1), p.66-91

<sup>35</sup> A Learning Design Methodology for Developing Short Learning Programmes in Further and Continuing Education Buus, Lillian; Georgsen, Marianne ISSN: 1365-893X , 1365-893X; DOI: 10.5334/jime.469 Journal of interactive media in education : JiME. , 2018, Vol.2018(1)

<sup>36</sup> Exploring Best Practices for Online STEM Courses: Active Learning, Interaction & Assessment Design Chen, Baiyun; Bastedo, Kathleen; Howard, Wendy ISSN: 2472-5749 , 2472-5730; DOI: 10.24059/olj.v22i2.1369 Online Learning ,



best practices for STEM education in general or case studies based on specific online courses or online course components. This study is a unique large-scale survey research of many online courses across multiple STEM disciplines. Some of the findings included student engagement has been shown to be a factor in student retention in the STEM fields. All students, including underrepresented minorities, could benefit from well-designed online courses that improve access and learning. Online STEM instructors should be clear, concise, and consistent about instructions, assignments, assessments, due dates, course pages, and office hours and make every effort to improve communication with students. Perception of assessment method efficacy is the most significant factor that was correlated with students' perception of learning and learning satisfaction for all student demographic categories. Importantly, instructors and instructional designers need to focus on integrated active learning, interactive engagement strategies, robust assessment design, and UDL principles in designing effective, inclusive, and engaging online STEM courses.

Maintaining the theme of e-learning one UK study considered the importance of coherent alignment of current theory from cognitive psychology with practice and policy in training and education institutions developing e-learning materials and present recommendations emphasising the human factor within processes.<sup>37</sup> Many institutions fail to maintain updated e-learning strategy and policy resulting in a negative impact on practice and the learner experience. When deciding on the training priorities for a task or job role, it is beneficial to have an understanding of the type of knowledge, skills and attitudes (KSA) that are required to competently and successfully perform a task to the standard required following the job analysis stage, the KSA analysis is performed. An understanding of the cognitive mechanisms that underpin learning is important when designing technology to support skill acquisition and maintenance, which must be congruent with the cognitive capabilities of the user. In general, the coherence and quality of interactions between actors involved in policy and the systems within which they sit are essential to successful implementation and maintenance of policy. With respect to e-learning policy, alignment of all factors requires committed leadership, individuals willing to embrace evidence-based practice, and collaborative, mindful effort at all levels.

In the field of technology-enhanced learning (TeL), accessibility has been recognized as a key design consideration for TeL systems ensuring that learners with diverse needs and preferences (such as learners with disabilities) can access technology-supported resources, services, and experiences in general. One study in the UK examined an online educational portal, namely the Inclusive Learning Portal that aims to support open access to teaching and learning of people with disabilities. It found that the issue of accessibility in TeL is very important, so as to ensure that technology does not introduce more barriers to the inclusion of people with disabilities.<sup>38</sup> Several initiatives have emerged worldwide that aim to tackle accessibility considerations of technology-supported resources, services, and experiences in general. The main target of the Inclusive Learning Portal is to create and sustain a network of teachers of people with disabilities, who will be developing and sharing their own accessible LOs used in training organizations around Europe.

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2018, Vol.22(2), p.59-7

<sup>37</sup> The human factor in learning design, research, policy, and practice Gregory S Anderson, Dr; MacLean, Piers; Cahillane, Marie ISSN: 2056-4880 , 2056-4899; DOI: 10.1108/IJILT-12-2014-0029 The international journal of information and learning technology. , 2015, Vol.32(3), p.182-196

<sup>38</sup> [Supporting Open Access to Teaching and Learning of People with Disabilities](#)

Cognition and Exploratory Learning in the Digital Age Conference (2012)

ISBN: 9783319022635 , 3319022636 , 3319022644 , 9783319022642; DOI: 10.1007/978-3-319-02264-2\_5

Digital systems for open access to formal and informal learning : research from CELDA 2012 / , 2014, p.57-68





In contrast one article explored the ways in which educators describe how open education is impacting their pedagogical designs. Using a phenomenological approach with self-identifying open education practitioners, explore how open educational practices (OEP) are being actualised in formal higher education in the context of British Columbia (BC), Canada.<sup>39</sup> Participants shared how educational materials were deliberately selected to ensure free and open access to learning resources. Commitment to ensuring diversity and multiple perspectives were being considered throughout the curriculum. Promoting a critical lens on knowledge production was also cited as a motivator for engaging with OEP. This study confirmed that the term OEP carries with it many different associations and meanings for both practitioners and researchers. The study reinforces the importance of inviting learners to be creators and contributors to openly accessible public knowledge, while raising awareness of the stakes in doing so, and enabling learners to make informed decisions about engaging publicly. There is a growing need to establish literacies around open education, copyright, social media and networked learning as a foundational skill. Open technologies were used to support and enable active learning experiences, presenting and sharing learners' work in real-time, allowing for formative feedback, peer review, and ultimately, community-engaged coursework. Inviting learners to share their work more widely, demonstrates to them that their work has inherent value beyond the course and can be an opportunity for them to engage directly with their community.

The emerging technologies, such as social networking, interactive media and game technology, have expanded a new dimension of self – 'technoself' driven by socio-technical innovations and taken an important step forward in lifelong learning through the Technology Enhanced Learning (TEL). The TEL encourages learners as producers to embed personalized knowledge and collective experience on individualized learning within professional practice. It becomes more personal and social than traditional lifelong learning, especially about the 'learning as socially grounded' aspects. This paper studies the development of technoself system during lifelong learning and introduces technoself enhanced learning as a novel sociological framework of lifelong learning to couple the educational dimension with social dimension in order to enhance learner engagement by shaping personal learning focus and setting.<sup>40</sup> The technoself system has great potential to support user centered active learning with constructive engagement, which is seen to be strongly valued to all participants in lifelong learning. However, the emerging technologies also raise challenging research issues about ethics, trust, even safety in lifelong learning. The after-effects including how online behaviors affect personal behaviors offline in real life have subsequent implications on the evolving 'technoself' in terms of emotions, personalities, and health statuses. Some emerging technologies are only for the more tech-savvy users due to the level of difficulty for ease of use.

The e-Yantra project at a major technical institute in India (Indian Institute of Technology Bombay) conducts a massive Online Robotics Competition known as eYantra Robotics Competition annually, with the objective to develop ground-breaking digital pedagogy to indulge students in the domain of Robotics and Embedded Systems through hands-on practical medium of Project Based Learning (PBL). This paper analyzes and discusses the outcomes of the

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<sup>39</sup> Open Education and Learning Design: Open Pedagogy in Praxis Paskevicius, Michael; Irvine, Valerie ISSN: 1365-893X , 1365-893X; DOI: 10.5334/jime.512 Journal of interactive media in education : JiME. , 2019, Vol.2019(1)

<sup>40</sup> Developing a technoself system to improve lifelong learning engagement Jin, Li; Huang, Wei; Wen, Zhigang ISBN: 1-4673-9227-8 , 1-4673-9226-X; DOI: 10.1109/TALE.2015.7386024 Teaching, Assessment, and Learning for Engineering (TALE), 2015 IEEE International Conference on , 2015, p.102-107



data collected over a three-year period (2016-2018) and draws inferences from it. It successfully demonstrates that students in an online Project Based Learning environment receive a functional upgrade in the knowledge of robotics.<sup>41</sup> The e-Yantra Robotics Competition has been successful in its method of enabling Project Based Learning (PBL) approach to teach students concepts of Robotics and Embedded Systems.

Educating inpatients and their family members regarding patient safety and protection is an important and challenging task for nursing staff. One study considered a learning engagement-promoting model is proposed for developing interactive e-book systems for patient education. An experiment was conducted to explore the effects of the system on the learning outcomes and perceptions of inpatients' family members.<sup>42</sup> It was found that the use of the e-book did not have a significant influence on the patients' or their families' anxiety. For patients and their families, their anxiety may be mainly affected by the patient's condition; therefore, it might take longer for them to learn to cope with the anxiety via patient instruction, as indicated by several previous studies. But learning with authentic contexts can help learners realize the meanings and values of the learning content, and hence improve their learning engagement and outcomes. Here the interactive e-book system not only reduces the clinical nurses' burden but also increases the accuracy and integrity of the instruction and enhances the patients' and families' care ability.

The use of technology to support learning is becoming ubiquitous in Africa. However, technology is more often used to distribute information rather than as a tool to mediate learning. The work presented here on a programme for Zambian community school teachers (non-traditional students) illustrates how learning design allied to appropriate theoretical concepts make use of technology to mediate learning.<sup>43</sup> The objective of this course was to support Zambian community school teachers, with little formal teacher education, to use interactive methods to support their teaching practices. The unique advantage of the use of video in the design of learning activities, is that while the demonstration in the video makes use of one of the local languages, the professional development activities related to the video are in English. In a multilingual African context, teaching has typically been instructivist, without opportunities for students to use their own linguistic resources for meaning making. This work illustrates how to create opportunities for learning together using all available language resources. The work illustrates how a distance education paper-based course design is enhanced by the use of contemporary learning theory and digital technology to model good interactive classroom practice.

An interesting area of research has looked at how students from different cultural and linguistic backgrounds encounter online learning environments, and to assess the extent to which cultural factors impact on learners' engagement with online learning. One study in Australia explores

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<sup>41</sup> Analyzing Learning Outcomes for a Massive Online Competition through a Project-Based Learning Engagement IEEE Global Engineering Education Conference. ISSN: 2165-9559 , 2165-9567; ISBN: 9781728109305 , 978-1-7281-0930-5; DOI: 10.1109/EDUCON45650.2020.9125379 IEEE Global Engineering Education Conference : [proceedings]. , 2020, Vol.2020-April, p.1246-125

<sup>42</sup> Facilitating inpatients' family members to learn: A learning engagement-promoting model to develop interactive e-book systems for patient education H. H. Huang ISSN: 1436-4522 , 1176-3647 Educational technology & society : journal of International Forum of Educational Technology & Society and IEEE Learning Technology Task Force. , 2019, Vol.22(3), p.74-87

<sup>43</sup> Learning design for multiple modes of provision: the Zambian community school teacher development programme Amory, Alan; Bialobrzaska, Maryla; Welch, Tessa ISSN: 0158-7919 , 1475-0198; DOI: 10.1080/01587919.2018.1457950 Distance education. 2018, Vol.39(2), p.241-25



how a culturally diverse cohort of students engage with the organisational, technological and pedagogical aspects of online learning. A total of 241 students in online learning programs in a large university in South Australia were surveyed, yielding a response rate of 65 percent.<sup>44</sup> Analysis indicated that cultural differences do have an impact on participant satisfaction with organisational and technological issues, with local respondents indicating significantly more positive perceptions than international respondents. Significant also was a reported lack of peer engagement and intercultural communication. Students whose first language was English had significantly more positive perceptions when compared with students whose first language was not English. Native speakers of English had significantly higher mean scores than other respondents. These differences in reported engagement with online learning reflect differences in students' experience of online courses as culturally inclusive, and have implications for the quality of online education. These reported experiences may be linked to the amount of communicative interaction among students.

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<sup>44</sup> Cultural diversity online: student engagement with learning technologies Hannon, John; D'Netto, Brian ISSN: 0951-354X , 1758-6518; DOI: 10.1108/09513540710760192 The international journal of educational management. , 2007, Vol.21(5), p.418-432





### 3. SOCIAL MEDIA ANALYTICS

#### 3.1 Overview

The DoA (p.10) stated that in March 2021 (M6) started the Social Media Analytics. According to the GA (p.138) this analysis aimed to:

“provide information about how citizens interact in social media, focusing on the areas of gender and education (O1, O2, O3 & O4). For this analysis, social networks such as Facebook, Twitter, Instagram and Reddit will be considered. The focus will be on how citizen participation in science can be enhanced through online awareness-raising initiatives which link social advancements to the scientific research which led to them.”

For this purpose, ALLINTERACT consortium has followed the Social Impact in Social Media methodology (Pulido et al., 2018)<sup>45</sup>, which consists of the identification of quantitative and qualitative evidence of the impact of research shared on social media. This report contains the Social Media Analytics for topic b) Citizen awareness of the impact of scientific research.

#### 3.2 Methodology

ALLINTERACT Social Media Analytics is based on the Social Impact in Social Media methodology (Pulido et al., 2018)<sup>1</sup>, which allows access to the social impact of science. This research has conducted a quantitative and qualitative analysis. The social networks selected, the methodological procedure, and the analysis of the messages obtained through the SMA protocol are detailed below.

##### 3.2.1 Social Media Analytics (SMA)

#### Selection of the social networks for the Social Media Analytics

SMA aimed to reach citizens' voices, paying special attention to vulnerable groups and young citizens<sup>46</sup>. For this reason, different social networks were included in this analysis. Considering that each social network has specific characteristics, Table 1 compiles the main characteristics of each social network that were considered before the SMA.

*Table 1. Characteristics of the social networks.*

| Network  | Options | Characteristics   |
|----------|---------|---|
| Facebook | Pages   | Most Facebook pages are not individual initiatives, but they belong to organizations, associations, media or campaigns. Citizens like or follow these pages, so they can see on their home page the contents shared by these pages. When pages share their content, citizens interact with this content through likes, sharing or comments, so this is one way to access citizens' voices |

<sup>45</sup> Pulido, C. M., Redondo-Sama, G., Sordé-Martí, T., & Flecha, R. (2018). Social impact in social media: A new method to evaluate the social impact of research. *PloS one*, 13(8).

<sup>46</sup> Pulido Rodriguez, C. M., Ovseiko, P., Font Palomar, M., Kumpulainen, K., & Ramis, M. (2021). Capturing Emerging Realities in Citizen Engagement in Science in Social Media: A Social Media Analytics Protocol for the Allinteract Study. *International Journal of Qualitative Methods*, 20, 16094069211050163.



|           |                     |         |  |
|-----------|---------------------|---------|--|
|           | Groups              | Public  | Public groups include the voices of citizens, as all those users who are members of the group can post in the group and interact with the shared content. Users who are not part of the group can find the group (as long as the group is visible) and can see the content and interactions shared within the group, but they can only interact with the content through likes (they cannot publish a new post or comment in existing posts).  |
|           |                     | Private | ALLINTERACT will not access private groups.  |
|           | Individual profiles |         | <p>One option to search what individual citizens post in their timelines is to browse by hashtags (e.g. #gender). The results will show only those posts containing the hashtag, which are public, including pages and those citizens with a public Facebook profile.</p> <p><b>NOTE:</b> It is important to ensure that the results obtained through this search are representative of society, because the use of hashtag is not broadly normalized yet and most users do not post using hashtags. In fact, the use of hashtags is more common in pages or institutional profiles than in individual profiles.</p> <p><b>NOTE:</b> Most citizens do not have their profiles in a public option, so it is difficult to get the whole picture in a search using hashtags.</p> <p>The second option is to use the keyword instead of the hashtag (without the #) in the browser and refining by “publications”. However, the results in this search show only publications containing the keyword posted by your friends or public pages. Therefore, this is not a real alternative, as it is impossible to see the whole picture in these results.</p> |
| Twitter   | Individual profiles |         | The search can be carried out through hashtags and the results will show all public posts posted by individuals using the hashtag. Interactions with other citizens can be analysed through RT, comments or likes.   |
| Instagram | Individual profiles |         | The search can be carried out through hashtags and the results will show all public posts posted by individuals using the hashtag. Interactions with other citizens can be analysed mainly through likes. This social network is the most visual of all and users share pictures with hashtags and sometimes, a brief description. Therefore, it contains fewer written interactions among users.  |
| Reddit    | Subreddit           |         | <p>When you conduct a search on Reddit, you can obtain results by posts and communities/users. As Reddit does not use #, the results of the post show all posts that use the keyword in every public Reddit.</p> <p>When the search is refined by communities, you obtained all communities that mention that word (sorted by relevance, new... and filtered by a period of time). In the communities, users share posts and comment posts about different topics. Some communities have categories to filter the posts (e.g.: by topic, type of post, location...)</p>  |
|           | Individual users    |         | Individual users can join Reddit communities and post or comment on existing posts   |

Source: ALLINTERACT SMA protocol



## Data collection for the Social Media Analytics

The procedure carried out for the SMA is based on the ALLINTERACT Social Media Analytics Protocol (Flecha & Pulido, 2021)<sup>47</sup> and summarized in Figure 1.

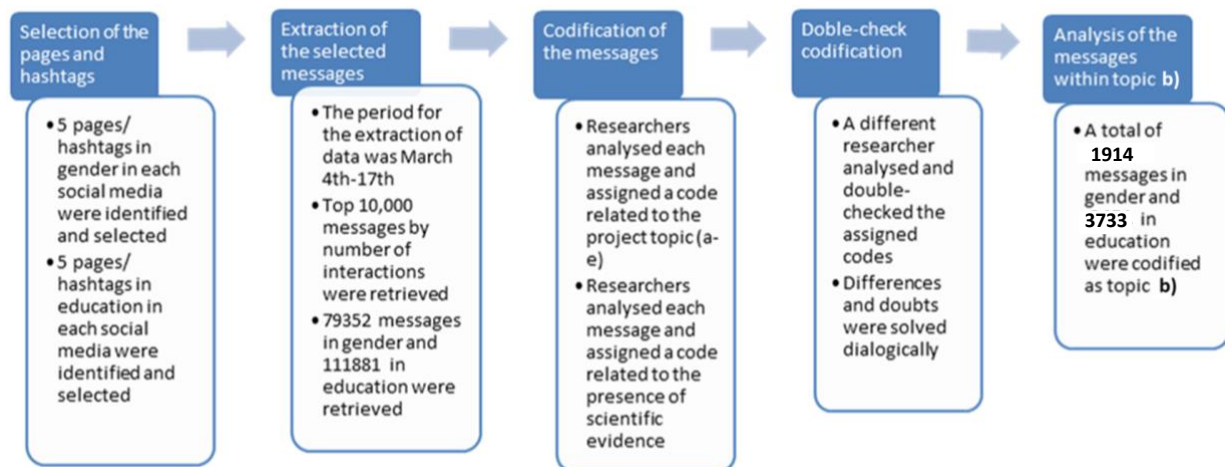


Figure 1. Procedure for ALLINTERACT Social Media Analytics

According to this protocol, the SMA has followed a twofold strategy:

- **Top-Down:** this approach consists in the definition of keywords related to gender/education and the topics of the project to contrast if these topics are expressed by citizens in their opinions, comments and post expressed in social media.
- **Bottom-Up:** this approach consists in the identification of topics that emerge from those keywords and hashtags most used by citizens on Twitter. Then the emerging topics are contrasted with the topics defined by the project and analysed if they cover all aspects proposed by the project and/or there are some additional issues that were not covered initially by the project.

### 3.2.2 Social Media Analytics Sample

From the 5647 messages extracted<sup>48</sup>, 333 messages were discarded from the analysis, as detailed in Table 2.

Table 2. Sample

| Topic  | Social Media | TOTAL | Included | Excluded |
|--------|--------------|-------|----------|----------|
| Gender | Twitter      | 1778  | 1682     | 96       |

<sup>47</sup> Flecha, R., & Pulido, C. (2021). Allinteract - Social Media Analytics Protocol is licensed under a Creative Commons Attribution - NonCommercial - ShareAlike 4.0 International License is available in [https://archive.org/details/@crea\\_research](https://archive.org/details/@crea_research)

<sup>48</sup> The complete data set can be found in Zenodo Repository. Soler-Gallart., M (2021). D1.1.ALLINTERACT\_RawData (Version v1.0.0) [Data set]. Zenodo. <http://doi.org/10.5281/zenodo.4729725>



|           |                     |      |      |     |
|-----------|---------------------|------|------|-----|
|           | Reddit              | 5    | 5    | 0   |
|           | Instagram           | 73   | 65   | 8   |
|           | Facebook            | 1    | 1    | 0   |
|           | Twitter (Bottom-Up) | 57   | 45   | 12  |
| Education | Twitter             | 2848 | 2753 | 95  |
|           | Reddit              | 22   | 13   | 9   |
|           | Instagram           | 283  | 243  | 40  |
|           | Facebook            | 2    | 2    | 0   |
|           | Twitter (Bottom-Up) | 578  | 505  | 73  |
| TOTAL     |                     | 5647 | 5314 | 333 |

The main reasons for this discard were:

- Broken links or not having access to the content, which made impossible the categorization
- Not being related to areas of study that are gender and education
- Not falling in the scope of topic c

Therefore, the final sample included a **total of 5314 messages**.

#### 2.1.4. Social Media Analytics - Analysis

The analysis of the selected messages for topic b) "Citizen awareness of the impact of scientific research" was also based on the SMA protocol, as can be detailed in the following Table 3:

*Table 3. Analysis grid for Topic b "Citizen awareness of the impact of scientific research".*

| Awareness-raising initiatives succeeding at engaging citizens in scientific participation, including the Open Access movement |                       |  |   |                       |                              |                               |                               |               |
|---|-----------------------|--|---|-----------------------|------------------------------|-------------------------------|-------------------------------|---------------|
|   | Aim of the initiative | Promoting organization (i.e. aim; private/ public) | Level of intervention (i.e. local/ national/ international) | Field of intervention | Audience (targeted and real) | Role of the targeted audience | Access to scientific evidence | Social Impact |
| TD  |                       |  |   |                       |                              |                               |                               |               |
| ED  |                       |  |   |                       |                              |                               |                               |               |

TD: Transformative Dimension

ED: Exclusionary Dimension

First, it is important to conceptualize all the defined categories and dimensions, as detailed in the following Table 4:

*Table 4. Definitions of dimensions for topic b.*

|            |  |
|------------|--|
| Dimensions | Transformative dimension: includes those messages that evidence what facilitates the implementation of initiatives that raise citizens' awareness of the impact of scientific research |
|            | Exclusionary dimension: includes those messages that show barriers   |



|  |   |
|--|---|
|  | hindering the implementation of initiatives that raise citizens' awareness of the impact of scientific research |
|--|---|

### 3.2.3 Social Media Communicative Observation

The SMCO has aimed at further exploring which awareness-raising initiatives are succeeding at enhancing citizen participation in science, regarding the SDGs of quality education and gender equality, with gender also being considered transversely throughout all SDGs.

The distribution of the task was the following:

- Posts identified in mentioning successful awareness-raising initiatives were further explored, to identify which of them refer to actions that **succeed as well in engaging citizens in active science participation**. Researchers reviewed them one by one and classified them following the above-mentioned categories (Citizen awareness of the impact of scientific research, Awareness-raising initiatives succeeding at engaging citizens in scientific participation, including the Open Access movement, awareness-raising actions that foster the recruitment of new talent in the sciences, and policies that promote awareness-raising actions and citizen engagement in science). The success rate of the identified initiatives was also calculated.
- How the content of the posts of users participating in the discussion changed once evidence of the social impact of research was introduced were analysed. To that end, from the extracted data in this WP, all posts directly or indirectly interacting or referencing the introduced evidence were selected. Researchers have analysed post threads to identify changes in the debate.
- The correlation between awareness of the social impact of research and engagement in science were also analysed.

### Selection of the Facebook and Reddit Groups

This research has selected the social media groups/pages considering the most used words when talking about gender and education identified in WP1. Based on these words, groups were searched for on the social networks Facebook and Reddit. Specifically, 61 groups were searched, 29 for gender and 32 for education (Table 5).

*Table 5. Summary of the groups that were pre-selected and subsequently contacted for gender and education:*

| Social Media    | Pre-selected Groups  | Pre-selected Groups  |
|-----------------|--|--|
|                 | Gender   | Education  |
| <b>Facebook</b> | CAMPAIGN AWARENESS AGAINST GENDER-BASED VIOLENCE & GENDER INEQUALITY!, UNI-Mentors | Parents for children's education / Parents union from all around the world, School teacher and administrator |



|        |   |   |
|--------|---|---|
|        | in Violence Prevention, The Feminism Platform, Gender equality in the Red Cross and Red Crescent Movement, ETUC Gender Equality, Global Youth Movement Against Gender Based Violence, LGBT Advocacy, EMPOWER EQUALIT. CHILD RIGHT AND GENDER EQUALITY SUPPORT, Gender-based Violence Campaign Group., Gender Based Violence SOLUTIONS, Gender Equity and Reconciliation International, Equality 4 Women, LGBTQ+ Protest Group | educational resources, Child Care' Development, Education & Parenting, Our Voice: Communities for Quality Education Group, International Special Needs Teachers/ Learning Support Teachers, Amazing Educational Resources, Special Education Community, Quality Early Childhood Education and Care, PARENTS, TEACHERS AND STUDENTS FORUM, All Teachers' Unity Platform, Teachers and Students, Teachers Throwing Out Grades, The Quality Education Project, Special Education Community, FAME - Families Against Mis-Education. |
| Reddit | r/feminism, r/feminisms, r/FeMRADebates, r/PurplePillDebate, r/bisexual, r/SRSFeminism, r/AskFeminists, r/Equality, r/TwoXChromosomes, r/AskWomen, r/relationships, r/SexualHarassment, r/GenderIssues, r/MeToo, r/LGBTeens, r/women  | r/education, r/ScienceTeachers, r/ApplyingToCollege, r/teaching, r/science, r/Teachers, r/college, r/parenting, r/ParentTeacherGroups, r/ECEC, r/FutureTeachers, r/ScienceEducation, r/highschool, r/specialed, r/Teacher, r/Children.  |

We contacted the administrators of these groups to participate in the research, of which four replied, two of them decided to participate. However, it was not carried out because they did not provide the ethical consent created to participate in the research.

In parallel, the research team decided to create and search for other social media groups/pages. In the area of gender, five groups on Facebook and five on Reddit were created and selected again, while in the area of education, 5 Reddit groups were created and 5 Facebook groups/pages were contacted where scientific evidence in education was already being discussed.

Table 6 below shows the names of the gender groups and in which language they are spoken in the group.

*Table 6. Facebook and Reddit groups created on gender:*

| Facebook | Reddit |
|----------|--------|
|----------|--------|



| Selected Groups  | Language | Origen   | Selected Groups         | Language | Origen  |
|--|----------|----------|-------------------------|----------|---------|
| Contra el acoso que reciben quienes apoyan a las víctimas / VG Aisladora | Spanish  | Created  | r/Contra_SOSH           | Spanish  | Created |
| Against the harassment of victim supporters / IGV                        | English  | Created  | r/Against_SOSH          | English  | Created |
| Our right to fall in love  | English  | Created  | r/OurRigthToFallInLove  | English  | Created |
| Grup de Dones Sherezade: Dialogant el Feminisme                          | Catalan  | Selected | r/genderviolence        | English  | Created |
| Social Impact Science Platform   | English  | Created  | r/science_gender_sappho | English  | Created |

Table 7 below lists the names of the education groups and in which language the group speaks.

*Table 7. Facebook and Reddit groups or pages created about education:*

| Facebook  |          |          | Reddit                |          |         |
|---|----------|----------|-----------------------|----------|---------|
| Selected Groups   | Language | Origen   | Selected Groups       | Language | Origen  |
| Comunidades de Aprendizaje. Schools as Learning Communities | Spanish  | Selected | r/GruposInteractivos  | Spanish  | Created |
| Tertulias Literarias y Musicales Dialógicas                 | Spanish  | Selected | r/InteractiveGroups   | Spanish  | Created |
| Actuaciones Educativas de Éxito. Comunidades de Aprendizaje | Spanish  | Selected | r/TertuliasDialogicas | Spanish  | Created |
| Comunidade de Aprendizagem /                                | Spanish  | Selected | r/DialogicGatherings  | English  | Created |





|   |         |          |                      |         |         |
|---|---------|----------|----------------------|---------|---------|
| Comunidad de Aprendizaje  |         |          |                      |         |         |
| Inclusividad NEE en CdA. Inclusion SEN in Schools as Learning Communities | Spanish | Selected | r/EducacionInclusiva | Spanish | Created |

In these groups, posts were written in relation to the results of the ALLINTERACT research, in which users could interact with the content. The groups were also used to provide information and consent for those who wished to participate. The selected groups were informed, and consent was obtained from the administrators and the users whose comments were analysed.

### Selection of Social Impact Platforms Forums

ALLINTERACT research has been involved since the beginning, in October 2020, in the creation of two Social Impact Platforms, one in gender and the other in education. So, the ALLINTERACT team at the University of Barcelona has decided to incorporate these in the current SMCO analysis.

These platforms are led by the Research Group in Sociological Theory and Impact of Research (TSIR). The two platforms are non-populist participatory platforms, available to everyone, both to consult and to contribute. They are contributing to deepen, on the one hand, in the development of sociological theory at the international level and, on the other hand, to the analysis and improvement of the social impact of research.

These platforms are built with a bottom-up approach that brings together not only researchers and practitioners, but all citizens, both to consult and to contribute. These participatory instruments are committed to promoting an egalitarian dialogue based on validity claims and the sharing of scientific evidence with all citizens. Thus, these platforms are Open Access platforms available to everyone. Any citizen who wants to participate will be able to sign in and contribute. Participation will be totally voluntary.

These platforms are:

- SAPPHO scientific evidence platform is focused on Gender SDG. (<https://socialimpactsience.org/gender/>)
- ADHYAYANA scientific evidence platform is focused on SDG Quality Education, from a multicultural perspective. It will deepen, on the one hand, the development of sociological theory at the international level and, on the other hand, it will contribute to the analysis and improvement of the social impact of research. (<https://socialimpactsience.org/education/>)

The research team contacted the platforms' administration team to inform them of the selection and obtained consent. We also contacted the people selected for the study and obtained





consent (Online consent form  
<https://forms.office.com/Pages/ResponsePage.aspx?id=qzwxosOxOk-7ESFXRH3btA8lqcPRmYtGj4JVP3l6T1ZUQ1VIVkFIMUVGN1hCN1hHQ1pBQjITMiE4Ry4u> )

## Data collection

The information collected has been carried out from May 2021 to December 2021 (6 months) for the social networks Facebook and Reddit. While the information from the Social Impact Science forums has been collected from October 2020 to December 2021 (15 months).

**A total of 21,322 members** made up the 20 groups selected/created (10 in gender and 10 in education) and the two Social Impact Science Platforms. **A total of 1,383 posts related to the research objective** have been made, which have had **3,397 interactions (reactions and sharings)** and **576 comments** have been made.

### Data collection on gender

In the field of gender, a **total of 885 posts have been made in relation to the research on Facebook, Reddit, and Social Impact Science on Sappho**. Of the **3,171 members who are part of the groups/pages or forums have interacted (reactions and sharings) 1,882 times** and made **158 comments**.

Details are given below:

#### Facebook Gender

In relation to the 5 Facebook groups/pages, **486 posts** related to the results of the research project have been published and a total of **600 members have joined**, of which **1,875 have interacted and made 38 comments** (Table 8).

*Table 8. Detailed table of the gender-related Facebook groups/pages studied.*

| Facebook   |                            |                      |                     |                 |
|--|----------------------------|----------------------|---------------------|-----------------|
| Group/Page   | No. members of / followers | No. of Research Post | No. of Interactions | No. of Comments |
| Contra el acoso que reciben quienes apoyan a las víctimas / VG Aisladora | 110                        | 106                  | 400                 | 3               |
| Against the harassment of victim supporters / IGV                        | 77                         | 110                  | 175                 | 10              |
| Our right to fall in love  | 25                         | 45                   | 71                  | 2               |



|  |     |     |       |    |
|--|-----|-----|-------|----|
| Grup de Dones Sherezade:<br>Dialogant el Feminisme | 65  | 10  | 20    | 0  |
| Social Impact Science Platform<br>(Gender)         | 323 | 215 | 1,209 | 23 |

### Reddit Gender

In the case of Reddit, 5 sub-communities were created, of which **a total of 313 posts** were made about the project and a total of **45 members took part, of which 7 interactions and 4 comments were made.**

In January 2021, when we looked at this data again, we realised that Reddit administrators had deleted around 276 comments in January 2022. So, there are currently 37 public comments left in 2021 (Table 9).

*Table 9. Detailed table of Reddit groups on gender*

| Reddit                  |                |                      |                     |                 |
|-------------------------|----------------|----------------------|---------------------|-----------------|
| Group                   | No. of members | No. of Research Post | No. of Interactions | No. of Comments |
| r/Contra_SOSH           | 13             | 98 (6)               | 3                   | 2               |
| r/Against_SOSH          | 12             | 98 (7)               | 2                   | 2               |
| r/OurRighToFallInLove   | 8              | 65 (6)               | 0                   | 0               |
| r/genderviolence        | 3              | 22(14)               | 1                   | 0               |
| r/science_gender_sappho | 9              | 30 (4)               | 1                   | 0               |

### Social impact Platform Gender

The **2,526 members** of the platform have made **86 related posts** of which other members have made **116 comments** in which they discuss the scientific evidence on gender. People have contributed reflections, scientific articles, experiences, or statistical data (Table 10).

*Table 10. Detailed table of members, comments, and feedback on Sappho Platform*



| Sapfo Platform |             |                 |
|----------------|-------------|-----------------|
| No. of members | No. of Post | No. of Comments |
| 2,526          | 86          | 116             |

### Data collection on education

In the field of education, **a total of 498 posts** have been made in relation to the research on Facebook, Reddit, and Social Impact Science on Adhyayana. Of the **18,151 members** who are part of the groups/pages or forums have interacted (reactions and sharings) **1,515 times** and made **418 comments**.

### Facebook Education

In the 5 selected Facebook groups/pages on education, about **90 posts** related to the results of the research project have been published. There are **17,527 members** in these groups, of which **1,506 interactions** and **8 comments** have been made (Table 11).

*Table 11. Detailed table of the education Facebook groups/pages surveyed*

| Facebook  |                          |                      |                     |                 |
|---|--------------------------|----------------------|---------------------|-----------------|
| Group/Page  | No. of members/followers | No. of Research Post | No. of Interactions | No. of Comments |
| Comunidades de Aprendizaje. Schools as Learning Communities | 4,947                    | 28                   | 338                 | 1               |
| Tertulias Literarias y Musicales Dialógicas                 | 1,107                    | 7                    | 30                  | 0               |
| Actuaciones Educativas de Éxito. Comunidades de Aprendizaje | 2,617                    | 35                   | 972                 | 7               |
| Comunidade de Aprendizagem / Comunidad de Aprendizaje       | 8,631                    | 8                    | 135                 | 0               |



|   |     |    |    |   |
|---|-----|----|----|---|
| Inclusividad NEE en CdA.<br>Inclusion SEN in Schools as<br>Learning Communities | 225 | 12 | 31 | 0 |
|---|-----|----|----|---|

## Reddit Education

In the case of Reddit, 5 sub-communities were created, of which **a total of 203 posts** were made about the project and a total of 49 members took part, of which **9 interactions and 3 comments** were made (Table 12).

*Table 12. Detailed table of Reddit groups on education.*

| Reddit                |                |                      |                     |                 |
|-----------------------|----------------|----------------------|---------------------|-----------------|
| Group/Page            | No. of members | No. of Research Post | No. of Interactions | No. of Comments |
| r/GruposInteractivos  | 13             | 72                   | 3                   | 0               |
| r/InteractiveGroups   | 9              | 70                   | 2                   | 2               |
| r/TertuliasDialogicas | 12             | 55                   | 1                   | 1               |
| r/DialogicGatherings  | 9              | 45                   | 3                   | 0               |
| r/EducacionInclusiva  | 6              | 33                   | 0                   | 0               |

\*These Reddit groups are no longer accessible.

In January 2022, when we looked at this data again, we realised that the Reddit administrators have removed the five sub-communities.

## Social Impact Science Adhyayana

The **575 members** of the platform have made **133 related posts** of which other members have made **407 comments** in which they discuss the scientific evidence on gender. People have contributed reflections, scientific articles, experiences, or statistical data (Table 13).

*Table 13. Detailed table of members, comments, and feedback on Adhyayana Platform.*

|                    |
|--------------------|
| Adhyayana Platform |
|--------------------|



| No. of members | No. of Post | No. of Comments |
|----------------|-------------|-----------------|
| 575            | 133         | 407             |

### Final Research Sample

For the final analysis, the first 5 posts on education and 5 on gender that are related to scientific evidence were selected. Finally, **76 comments were analysed (20 on gender and 56 on education)**.

### Social Media Communicative Observation - Analysis

The analysis of the Social Media Communicative Observation consisted in exploring the effects of introducing scientific evidence in the interactions.

The selected groups have been studied in detail using the software MAXQDA2020, to explore which of the selected actions have succeeded at enhancing participation in science.

The comment threads were listed according to the order of appearance (E1, E2, E3,...), while listing the participants (1, 2, 3...) who made contributions that were related to the object of study. Finally, **57 comments were analysed (21 on gender and 36 on education)**.

The messages have been categorised by the following selected actions and we have identified for each category the transformative and the exclusionary dimensions. The categories we have analysed are: 1) Aim of the enhancing-participation action; 2) Promoting organisation (i.e., aim; private/public); 3) Level of intervention (i.e., local/national/international; bottom-up/top-down); 4) Field of intervention; 5) Participants (targeted and real); 6) Type of participation (i.e., role of participants); 7) Level of access to scientific evidence; and 8) Social impact.

For each of these categories, the transformative dimension (i.e., what facilitates the implementation of the targeted actions) and the exclusionary dimension (i.e., obstacles hindering the implementation of the targeted actions) were identified.

The SMCO analysis has consisted mainly of a review one by one of the posts, classifying them and identifying and selecting the actions that succeed in active science participation. The consent form has been obtained from the participating members of the analysed posts.

Then we have identified the changes in the debate after the scientific evidence was introduced in the discussion.

Once data has been categorised, we have calculated the correlation between the two variables "citizen awareness of the social impact of research" and "citizen engagement in science".



### 3.3 RESULTS OF THE SOCIAL MEDIA ANALYTICS

The following sections include the main results obtained on the social networks Twitter, Facebook, Instagram and Reddit on gender and education issues, based on the top-down and bottom-up strategies.

#### 3.3.1 Social Media Analytics on Gender

Following the ALLINTERACT SMA protocol, the SMA in gender has implemented a twofold strategy, including a top-down and a bottom-up approach.

##### 3.3.1.1. Top-Down

As abovementioned, the top-down strategy was conducted in Twitter, Facebook, Instagram, and Reddit, with a total of 1854 messages, distributed as follows.

*Table 14. Average number of retweets and likes obtained across social networks*

| Social network   | Hashtag   | Total messages | Total messages with RT/ likes | Average of RT / likes |
|------------------|---|----------------|-------------------------------|-----------------------|
| <i>Twitter</i>   | #Equality, #Gender, #GenderEquality, #WomenRights and #HeForShe                   | 1775           | 92,07%                        | 12,90                 |
| <i>Instagram</i> | #womenempowerment, #domesticviolence, #womenrights, #feminism and #genderequality | 73             | 95,89%                        | 14,29                 |
| <i>Facebook</i>  | Never Alone, NOH8 Campaign, World Wide Women, Women Rights News and Equality Now  | 1              | 0                             | -                     |
| <i>Reddit</i>    | r/PurplePill, r/bisexual, r/FEMRADebates, r/Feminism and r/Feminisms.             | 5              | 80%                           | 3,2                   |

On Instagram, due to the characteristics of the social network, the analysis in this case considered as a unit of analysis the whole post, including the text and the image. Regarding Facebook, according to their descriptions, the aim of the two first pages is to raise awareness about sexual abuse in the first case and LGBT discrimination in the second. The other three are pages where news related to gender issues and women's rights are shared.

Almost all the identified messages were included in the transformative dimension (99.72%) and included examples of initiatives to encourage citizen participation in science in the field of gender:

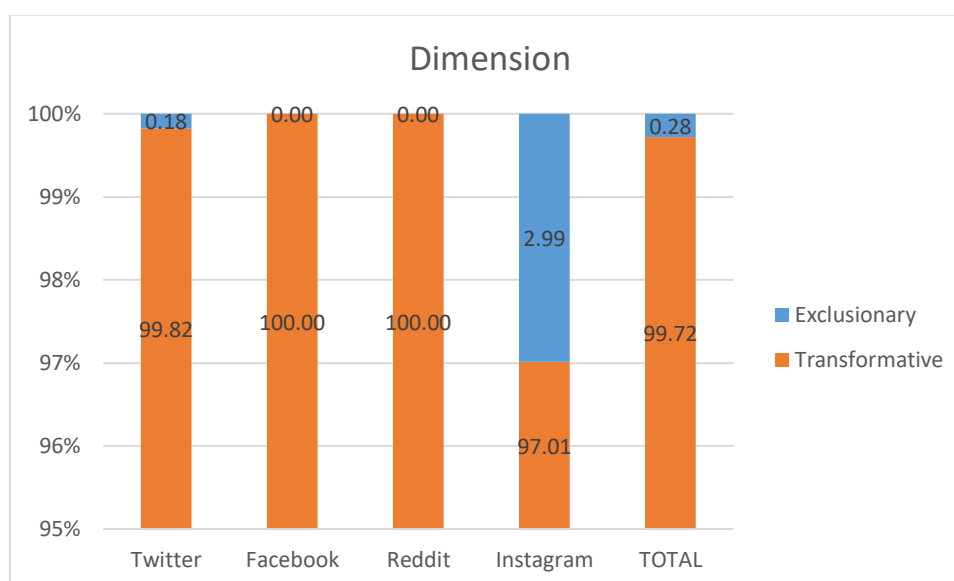


Figure 2. Distribution of dimensions (Gender-TD)

On all social networks, more than 95% of the messages corresponded to initiatives that foster citizen participation in science. Only 5 messages (3 on Twitter and 2 on Instagram) were identified as exclusionary. The 5 messages in the exclusionary dimension include examples of barriers to citizen engagement in science, such as undervaluing feminist contributions to science or cutting funding to scientific research.

#### *Aim of the initiatives (top-down)*

The initiatives identified in Twitter mainly aimed to raise citizens' awareness about gender-related issues, to share evidence-based strategies to overcome gender inequalities and to increase the visibility of the impact of scientific research:

- **Call for:** The most common aim of the identified messages was to announce opportunities for researchers and scientists to participate in conferences or to publish in scientific journals, by submitting abstracts or papers about their works. There were also job vacancies and courses about gender violence, sexuality, criminology, feminism and intersectionality, among others. Most of the job vacancies were offers within the academia and were referred to research projects about gender. There were also call for research projects, in which researchers were expected to send their proposals of projects in order to get funding.
- **Invitation to conferences:** The tweets within this group were examples of invitations to diverse online events, such as conferences, symposiums, webinars, discussions, trainings, workshops, interviews, panels, forums or roundtables, among others. Most of these messages contained information about the event as well as the registration link and encouraged citizens to participate in the event, but there were also messages in which a participant shared their perspective and reflections about the event. The main objective of these events was to involve citizens in science about gender issues, by sharing the results of existing research or enhancing citizens' scientific knowledge on



diverse topics. One of the events that was present across social networks was the Commission of the Status of Women (65CSW), an event organized by the UN between March 15<sup>th</sup> and 26<sup>th</sup>. In these messages, diverse agents of society encouraged citizen participation with a focus on democracy, religious diversity, intergenerational inclusion, participation of women in politics and presence of women in technology. Messages with invitations to conferences were found on those social networks with relevant samples, in terms of size (Instagram and Twitter)

- **Recruitment for research:** The aim of these messages was to look for and recruit potential participants for research on climate, medicine, racism, wellbeing and mental health, gender stereotypes, inclusion, nutrition, housework or gender dysphoria, among others. In some cases, the researchers conducting the study specify the needed profile, which included women and girls, parents who raise gender-neutral children, practitioners, BIPOC and BAME women in science or teachers, among others. Additionally, they included the link to the anonymous survey in case of questionnaires or contact information to schedule an interview in case of qualitative research. These messages were found across all social networks.
- **Campaigns:** The messages in this category included, on the one hand information about campaigns that had improved citizens' lives and, on the other hand, call for donations or support for in-course campaigns. These campaigns were promoted by international organizations (such as the UN or the ILGA) or by NGOs and their focus was girls' education, the overcoming of gender violence and the promotion of human rights. Among the campaigns that had already finished, there were examples of donations of menstrual kits to girls in order to avoid that they had to miss high school due to the lack of these products.
- **Open Access knowledge:** The objective of these initiatives was to share scientific advances in the field of gender in open access with society, through scientific articles in open access, podcasts, series of episodes, evidence-based resources and repositories of free webinars & trainings. Although most of these initiatives were promoted by the scientific community, the presence of media, NGOs, companies and citizens' association was notable, demonstrating the transference of scientific research. These initiatives were only found on Instagram and Twitter due to the small size of the sample on Reddit and Facebook (n=5 and n=1)
- **Hackathons:** It was not frequent to find this type of initiatives, but they are explained for the importance of these hackathons in terms of active role of participants and co-creation of scientific knowledge. In the identified hackathons, participants worked together to respond to society's challenges, by providing and designing innovative, sustainable and effective social solutions. These initiatives were top-down and included a competition and an award for the winner team.

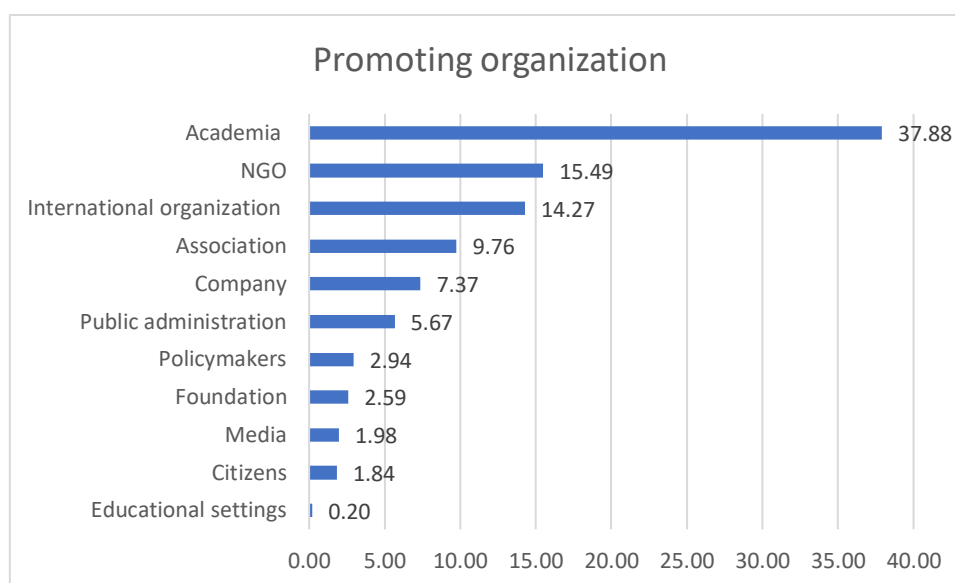




Regarding the social impact of the identified initiatives, very few of the messages (1.25%) included a mention of the social impact achieved. This does not necessarily imply that the initiative did not achieve social impact, but that citizens and institutions are still not used to collecting evidence of the social impact achieved. Among those that include evidence of the social impact there were messages the number of girls and women who improved their lives, health, work and education after a specific program. The initiatives were mainly promoted by NGOs.

### *Promoting organization*

The identified initiatives were promoted by a wide diversity of social actors, as shown in Figure 2.



*Figure 3. Promoting organizations (Gender-TD)*

As this Figure 3 reflects, the most common promoting organization was the academia (37.88%), including scientists, universities and research centres, scientific journals and editorials, research projects and scientific conferences, followed by NGOs (15.49%) and international organizations such as UN, ILGA, WHO, among others (14.27%). It is relevant that, although most of these initiatives are top-down (led by the scientific community or international organizations), bottom-up initiatives that emerged from society, including NGOs and associations are also present. The least common promoting organizations in these messages were media (1,98%), individual citizens (1,84%) and educational settings (0,20%).

### *Level and field of intervention*

On the one hand, regarding the level of intervention, almost 6 out of 10 (59.04%) of the identified initiatives were international initiatives, as shown in Figure 4. National initiatives were also relevant while local initiatives were the least common:

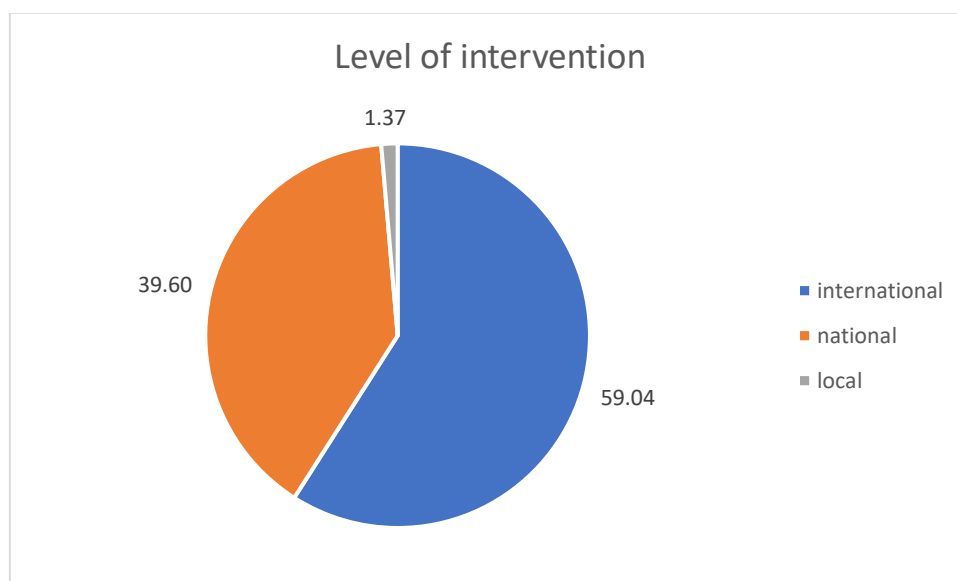


Figure 4. Level of intervention (TD – Gender)

National initiatives were implemented across 45 countries around the world, as presented in the following map. India is the country where more initiatives were identified ( $n=105$ ), followed by the UK ( $n=104$ ), Eritrea ( $n=104$ ) and the USA ( $n=80$ ). While in India, UK and USA a lot of different initiatives were identified, in Eritrea there were a few initiatives promoted by NGOs that obtained a high number of retweets.

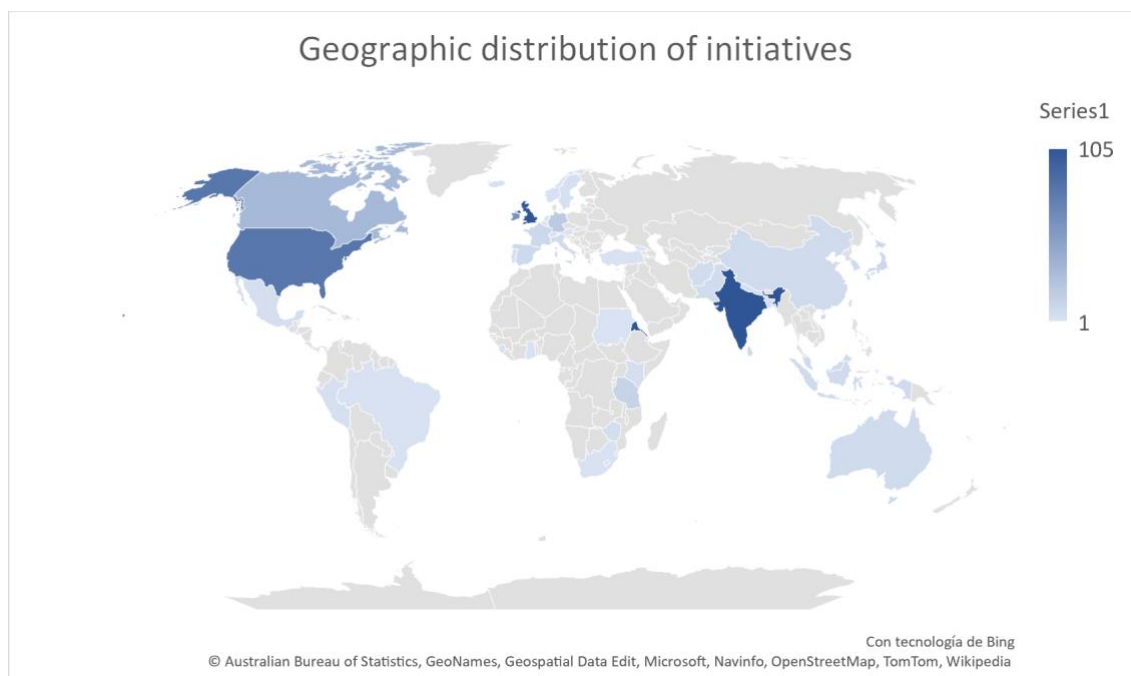


Figure 5. Geographic distribution of national initiatives (Gender-TD)

On the other hand, the field of intervention of the identified initiatives was diverse and included topics such as gender violence, climate, health, racism, leadership, resilience, data science or



the consequences of COVID-19 in women, among others. Figure 6 presents the main field of intervention covered by the identified initiatives:



Figure 6. Topics addressed by the identified initiatives (Gender – Top-down)

It is important to mention that most of the messages referred to how gender intersects with other disciplines, such as STEM, energy, climate, research, education, security, data science, politics, migration or sustainability, among others, showing the increasing awareness of society about the interdisciplinarity of scientific research.

### Audience and access to scientific evidence

Most initiatives (75.70%) were addressed to society as a whole or did not mention an explicit target audience. However, there were initiatives that targeted specific sectors of society:

- **Vulnerable groups:** among this groups, there were initiatives targeting girl and women (including female Black, Asian and Minority Ethnic (BAME) anaesthetists, BIPOC women in science or Pakistani and Bangladeshi women), youth (including students), people with disabilities, parents who raise neutral-gender children, aboriginal communities and rural men and women, among others.
- **Specific professional profile:** within this category there were initiatives targeting researchers (with special attention to early researchers) and educational professionals, such as teachers, parents and educators, practitioners, trainers. Other professionals, including employees, policymakers and journalists were also targeted.
- **Institutions:** some of the actions were focused on institutions and included companies, NGOs, governments or schools.



Regarding the role of the target audience, most initiatives (71.26%) did not include an active role of the participants, who were expected to be the audience, read, learn or discuss. However, some initiatives required a more active role from participants. First, there were initiatives calling for scholarships to study abroad in which participants were expected to apply and calls for submissions to scientific journals or conferences that included sending abstracts, papers, proposals of projects and also articles for the dissemination of science. Second, in those messages aiming to recruit participants for a research, participants were expected to participate mainly by filling a questionnaire or participating in an interview, and also sharing experiences of success co-creating and consolidating and sharing evidence to identify emergent issues and close data gaps. Third, some initiatives included campaigns, in which participants were called to join, including on some occasions support and donations. Finally, despite not being very widespread, there were hackathons that imply working together to find solutions for some of society's biggest challenges and leading initiatives to transform education for gender equality.

Almost 8 out of 10 (79.74%) of the initiatives did not mention whether participants had access to scientific evidence or not. In those initiatives in which scientific evidence was shared with participants, the scientific source was not present on the tweet or message itself, but on the conference, webinar or event that were referring to. For this reason, as the following figure shows, in average, more than 90% of the messages did not include scientific evidence, compared with 7.31% of supposed scientific evidence and 0.97% of certified scientific evidence (published in Scopus or Journal Citation Reports). The results of Facebook and Reddit have limited implications due to the small number of messages retrieved (n=1 and n=5 respectively).

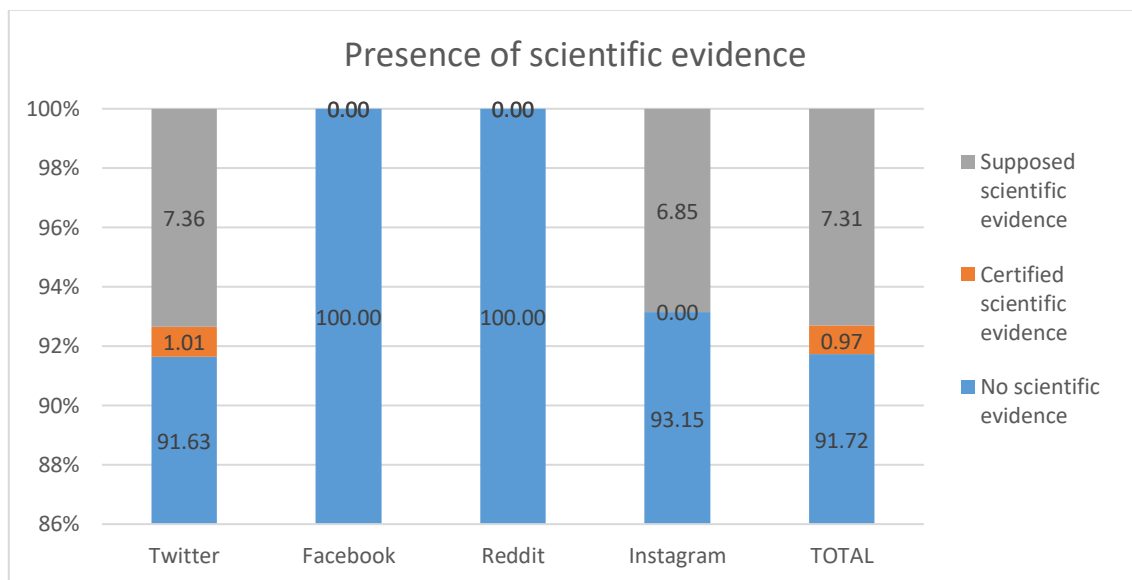


Figure 7. Use of scientific evidence (TD – Gender)

### 3.3.1.2. Bottom-Up

The bottom-up strategy in SMA was implemented on Twitter and included hashtags that were retrieved from the daily trending topics in all European countries. This section contains the SMA on Twitter and includes the hashtags #IStandWithLinda, #EqualPayDay, #WiMINConference21, #ReclaimTheStreets and #EnoughisEnough and a total number of 45 tweets. 91.11% of the



messages were retweeted at least once, obtaining an average of 4.31 retweets. The analysis of the dimensions concluded that all the messages identified on Twitter (bottom-up) corresponded to the transformative dimension, which means that contained examples of initiatives to encourage citizen participation in science in the field of gender.

#### Aim of the initiatives on Twitter (bottom-up)

Most of the tweets aimed to raise awareness about gender-related issues, but there were also examples of proposals of evidence-based methodologies:

- **Invitation to webinars and conferences:** The posts within this category aimed to invite citizens to webinars and conferences related to gender pay gap and the presence of women in medicine.
- **Recruitment of participants for research:** The messages in this group included posts that were looking for potential participants for research on gender violence. In this line, the research aimed to assess the prevalence of gender violence in the UK in response to recent situations of sexual and gender violence. In the message, the link to the anonymous survey was included.

None of the analysed tweets contained any evidence of social impact achieved by the initiatives. However, this does not mean that the actions did not have social impact, but citizens and researchers are still not used to collecting evidence of the social impact achieved.

#### Promoting organization

The initiatives identified in the bottom-up strategy were promoted by diverse social agents, as presented in Figure 8:

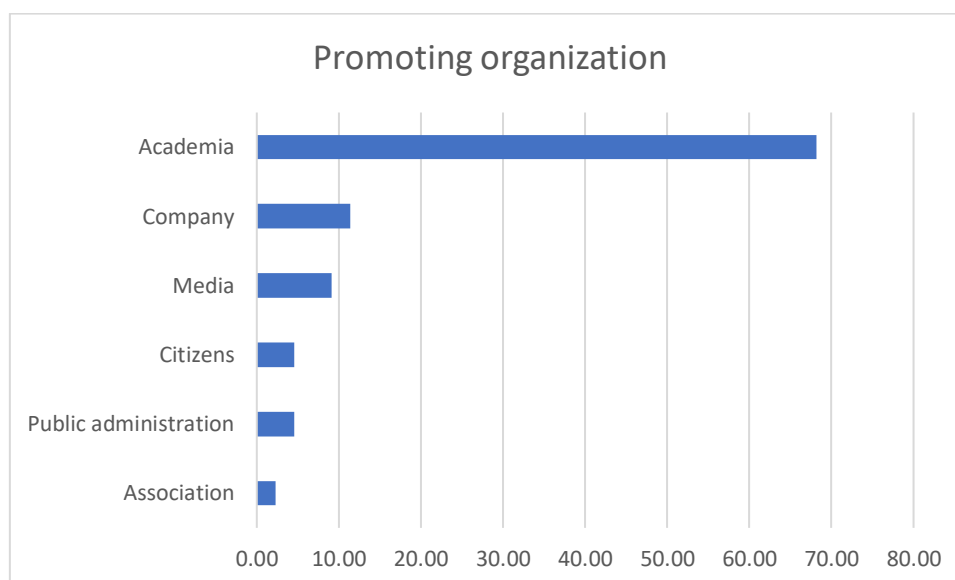


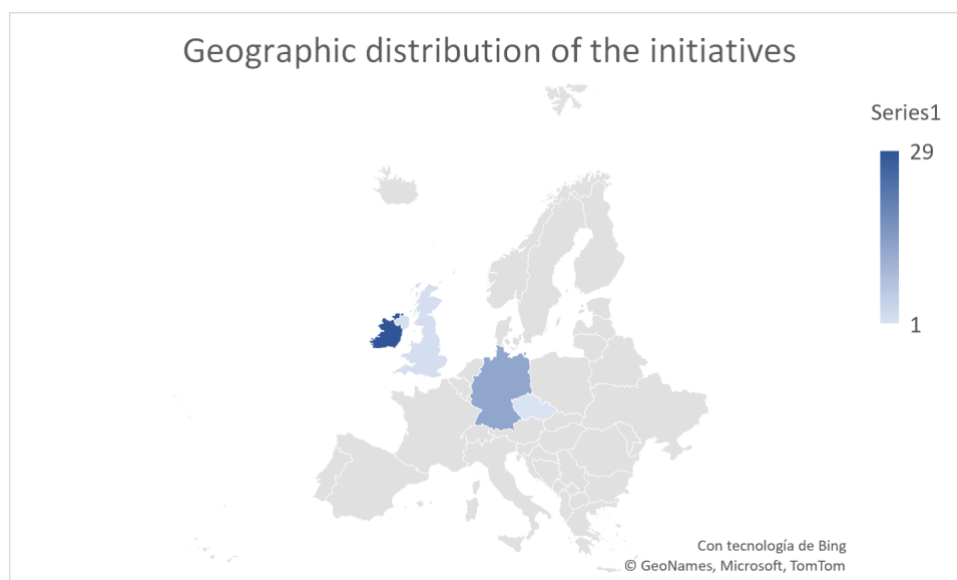
Figure 8. Promoting organization (Bottom-up)



The figure represents how more than 9 out of 10 of the initiatives are top-down, with more than two thirds of the initiatives (68.18%) promoted by the academia. These messages were all related to the scientific conference Women in Medicine of Ireland. On the contrary, bottom-up initiatives promoted by citizens and associations represented 4.55% (citizens) and 2.27% (associations). In this case, the citizens promoting these initiatives were victims of gender violence who were conducting a survey about the prevalence of gender violence.

#### Level and field of intervention

As abovementioned, an important proportion of messages were related to the conference Women in Medicine in Ireland, which was implemented at the national level. In the same line, the period of the extraction coincides with the Equal Pay Day in Germany. Therefore, 100% of the messages corresponded to initiatives implemented at the national level. The following figure presents the geographic distribution of the analysed initiatives.



*Figure 9. Geographic distribution of national initiatives (Gender-BU)*

As for the field of intervention, the initiatives addressed topics such as women in medicine, the gender pay gap or sexual violence, as shown in Figure 10.

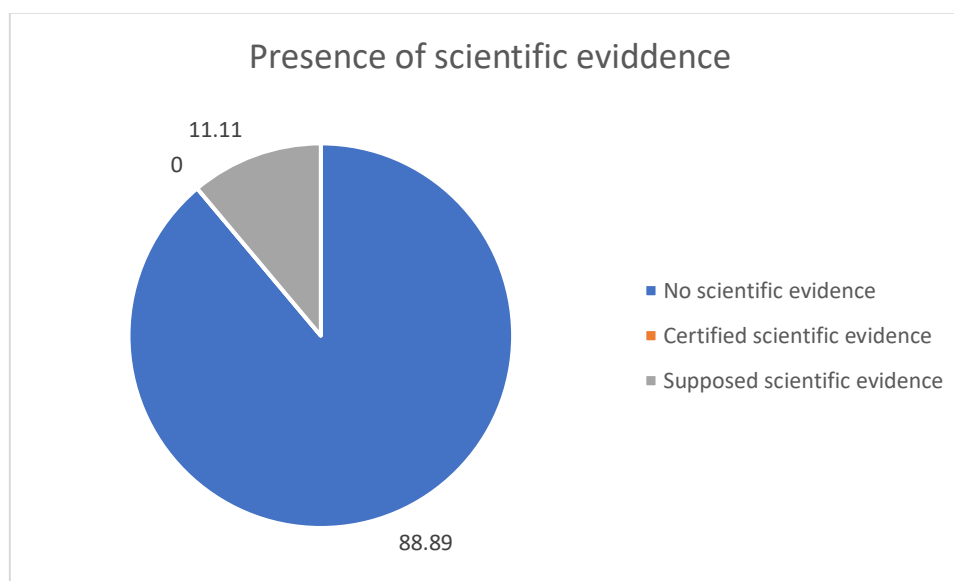


Figure 10. Topics addressed by the identified initiatives (Gender – Bottom-up)

#### Audience and access to scientific evidence

The target audience mainly included on the one hand scientists who participated in the Women in Medicine conference and on the other hand, citizens and society from Germany involved in the Equal Pay Day. In both cases the expected role of the target audience was to discuss and debate around the topics covered by the initiatives. In the hashtag #ReclaimTheStreets the two analysed messages contained an invitation to participate in a survey and the target audience were women, who were expected to answer the questionnaire. Regarding the access of participants to scientific evidence, although the presence of scientific evidence in the analysed messages was not widespread, participants did have access to scientific evidence in the conference that was announced in the messages. This way, scientific evidence was not provided in Open Access, as it was necessary to registrate into the conference to have access to scientific content. The following figure represents the presence of scientific evidence in the analysed tweets:





*Figure 11. Access to scientific evidence (Gender – Bottom-up)*

### 3.3.2 Social Media Analytics on Education

The SMA in education, as well as in gender, has followed a twofold strategy, including a top-down and a bottom-up approach.

#### 3.3.2.1. Top-Down

The top-down strategy was conducted on four social networks: Twitter, Facebook, Instagram, and Reddit, with a total of 3011 messages included in the final analysis. The following table summarizes the messages included on each social network:

*Table 15. Average number of retweets and likes obtained across social networks*

| Social network | Hashtag   | Total messages | Total messages with RT/ likes | Average of RT / likes |
|----------------|---|----------------|-------------------------------|-----------------------|
| Twitter        | #PublicEducation, #School, #Students, #Learning and #Education                | 2740           | 98,80%                        | 28,77                 |
| Instagram      | #QualityEducation, #StopBullying, #ScienceEducation, #Learning and #Education | 240            | 95,42%                        | 69,49                 |
| Facebook       | Teacher2Teacher, WeAreTeachers, Edutopia, MindShift, and Education Week       | 2              | 0                             | -                     |
| Reddit         | r/Teachers, r/Teaching, r/ApplyingToCollege, r/Science and r/Education        | 13             | 69,23%                        | 1,45                  |



On the one hand, on Facebook, the first two are spaces of dialogue among teachers and educational professionals; whereas the other three are pages where educational news are shared. On the other hand, on Reddit three of the communities are mostly constituted by teachers or educational professionals that share debates related to their professional experience. One of the others is formed by students and the other includes citizens from all sectors and countries. It is important to mention that on Reddit communities there are two types of messages: posts and comments. Both types of messages are shared by individual users who can propose specific topics for the debate, ask for advice or share news with other members of the community. Finally, due to the characteristics of the social network, the analysis of Instagram includes not only the content of the post, but also the image.

On all social networks, more than 98% of the messages contained examples of initiatives to foster citizens participation in science in gender and were included in the transformative dimension. Overall, 99.47% of the messages were transformative, in comparison with 0.53% of exclusionary.

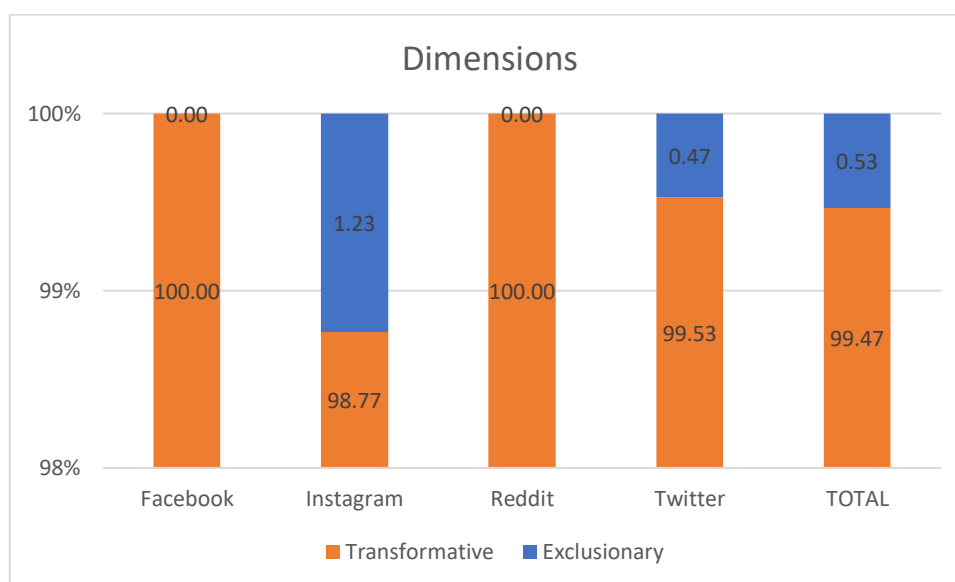


Figure 12. Distribution of dimensions (Education-TD)

#### Aim of the initiative on Twitter (top-down)

The analysis of the aims of the initiatives brought 5 main objectives:

- **Science and technology courses:** The tweets in this group share recommendations of courses about science and technology, mainly related to big data, machine learning, artificial intelligence, coding and computer science. Although there were both courses in open access and under payment, most of under-payment courses were free for a limited time. These initiatives were mainly found in Twitter, but they were also found on Instagram.
- **Donation campaigns:** These messages include on the one hand existing campaigns that donated books and educational and technologic materials to children and schools in



need around the world and were promoted by NGOs at international level. On the other hand, in-course campaigns that were calling for donations of school material and books. These messages were shared by both, NGOs and individual citizens from diverse parts of the world. These initiatives were found on Twitter and Instagram because Reddit and Facebook only had 13 and 2 messages respectively.

- **Invitation to conferences:** The tweets within this group were examples of invitations to diverse online events, such as conferences, webinars, conversations, trainings, workshops, interviews, panels or live talks, among others. Some of these events were online and targeted an international audience and some were face-to-face and targeted a local audience. These events were organized by diverse organizations, such as the scientific community, associations, NGOs and companies. The aim of these events was to involve citizens in science, by sharing the results of existing research or enhancing citizens' scientific knowledge on diverse topics. These messages were found on those social networks with relevant samples, in terms of size (Instagram and Twitter).
- **"Call for":** The messages in this group included scholarships to start university studies and to study abroad that target youth, call for projects, papers and abstracts for scientific journals and conferences (targeting researchers), job offers and call for collaborations and partnerships.
- **Resources to promote scientific literacy:** Some of the initiatives aimed to promote science education in society, by increasing the levels of scientific literacy and fostering citizen science. Three types of initiatives were identified in this group: 1) some initiatives included coding challenges that citizens could join and learn some of the coding algorithms, 2) hands-on activities and experiments as well as didactic games and resources for children related to STEM and 3) share in Open Access the latest scientific advances to citizens to increase the visibility and the participation of citizens in scientific research.
- **Recruitment for research:** The messages in this group included posts that were looking for potential participants for research on gender violence, on children education at home during COVID-19, informal learning, e-commerce, mental health, or Artificial Intelligence in schools, among others. In the message, they included the link to the anonymous survey in case of quantitative data collection techniques or contact information to schedule an interview in case of qualitative research.
- **Hackathons:** Although these initiatives were not as frequent as the previous ones, it is relevant to mention the presence of hackathons and other co-creation initiatives for the active role that participants play in them. In these cases, participants have to work together during a limited period of time to identify a relevant challenge and provide and design an effective solution. Usually, there was a competition and an award for the winner team. These initiatives were mainly top-down and were implemented at the international level. Some of the topics of these hackathons include design, artificial intelligence, science and image recognition, among others.



Finally, it is important to remark that almost 9 out of 10 of the initiatives (89.33%) did not include a mention to the social impact achieved. This does not necessarily imply that the initiative did not achieve social impact but that citizens are still not used to collecting evidence of the social impact achieved. Among those that include evidence of the social impact there were messages about the amount of educational material given to underserved populations and the number of people who were improving their education after a specific program. In this last case, the initiatives were mainly promoted by NGOs and ranged from 2 lakh children in India to 40,000 adults in Eritrea, demonstrating that social impact of research is important even in those cases in which only one life is improved.

### Promoting organization

Almost 4 out of 10 initiatives (39.73%) were promoted by companies that were announcing that, for a limited time they were offering free and open access courses about coding, machine learning and big data. The presence of initiatives from the academia, (including scientific journals and publishers, conferences, scientist associations, laboratories, research centres, college and universities, scientific consortiums and partnership, and individual researchers and science communicators) and public administration were also remarkable (20.89% and 7.35% respectively). In contrast, bottom- up initiatives were mainly promoted by NGOs (12.17%), citizens (6.63%), associations (5.34%) and educational settings (3.79%), including schools, libraries, cultural centres and museums. There were no significant differences across social networks, and the distribution of promoting organizations was similar in the four studied networks. The only difference is the overrepresentation of initiatives promoted by companies on Twitter. Figure 13 presents the diversity of social agents that promoted the identified initiatives:

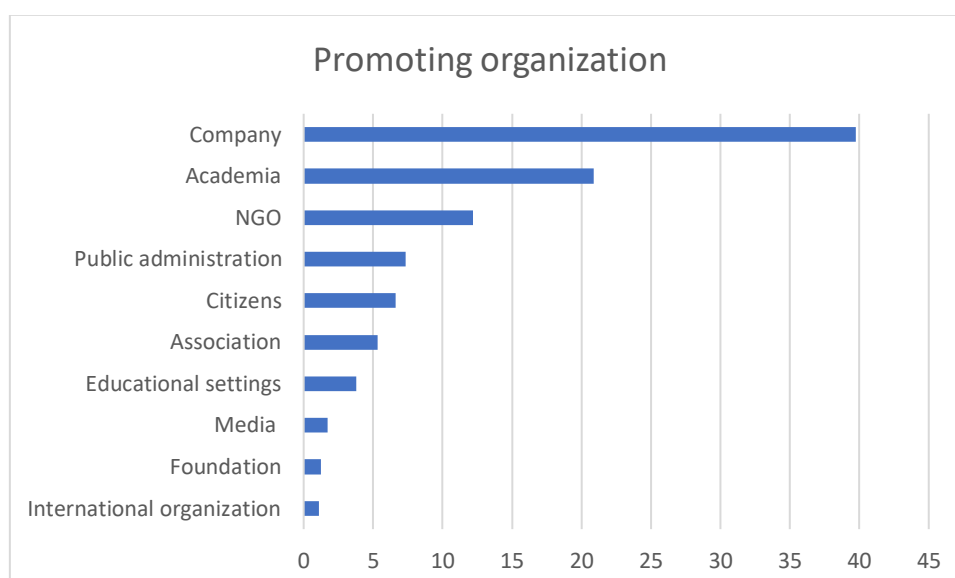


Figure 13. Promoting organization (Top-Down – Education)



### Level and field of intervention

Regarding the level of intervention, the identified messages included initiatives implemented at local, national, and international levels, as seen in Figure 14:

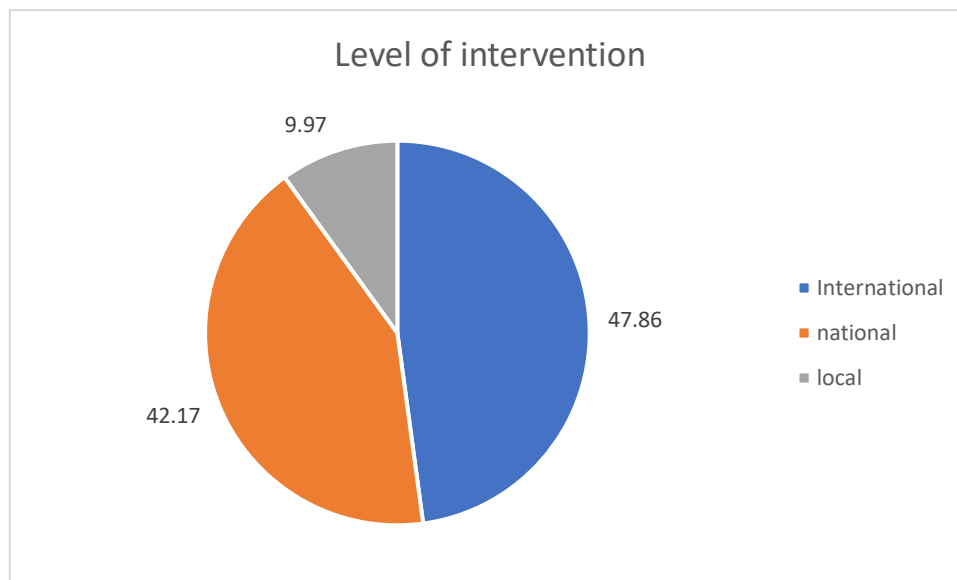


Figure 14. Level of intervention (Top-Down – Education)

Almost half of the initiatives are implemented whether at international or at national level, with more than 40% each. Local initiatives on the other hand, represent less than 100% of the initiatives. Regarding national initiatives, they are distributed across 45 countries around the world, as presented in the following figure.

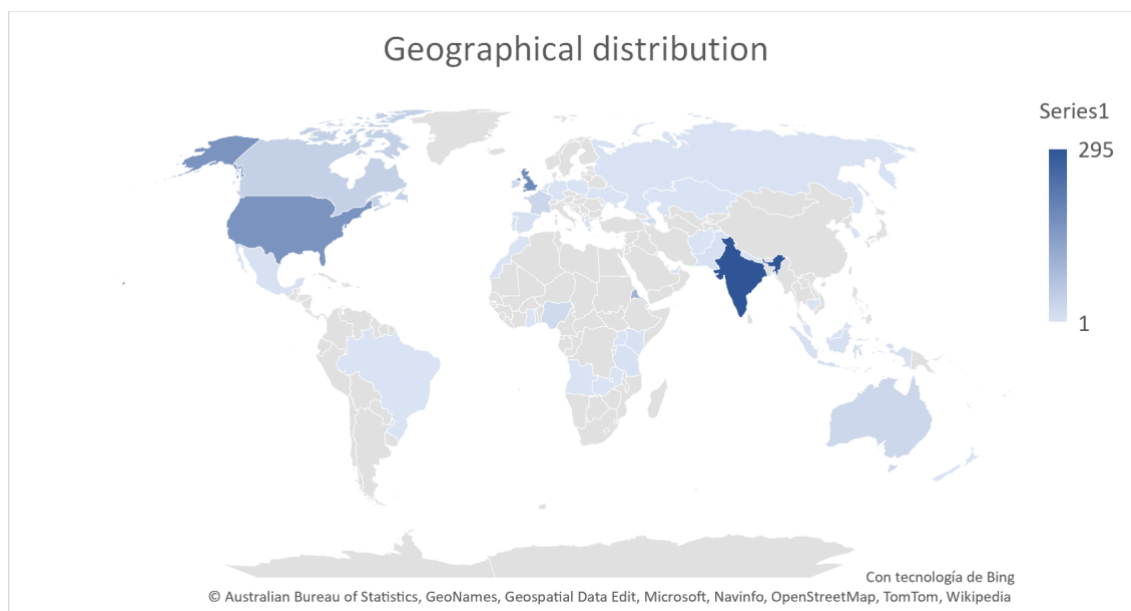


Figure 15. Geographic distribution of national initiatives (Education -TD)

As observed in the gender analysis, the country where more initiatives are identified is India with 295 messages of initiatives to foster citizen participation in science, followed by UK with





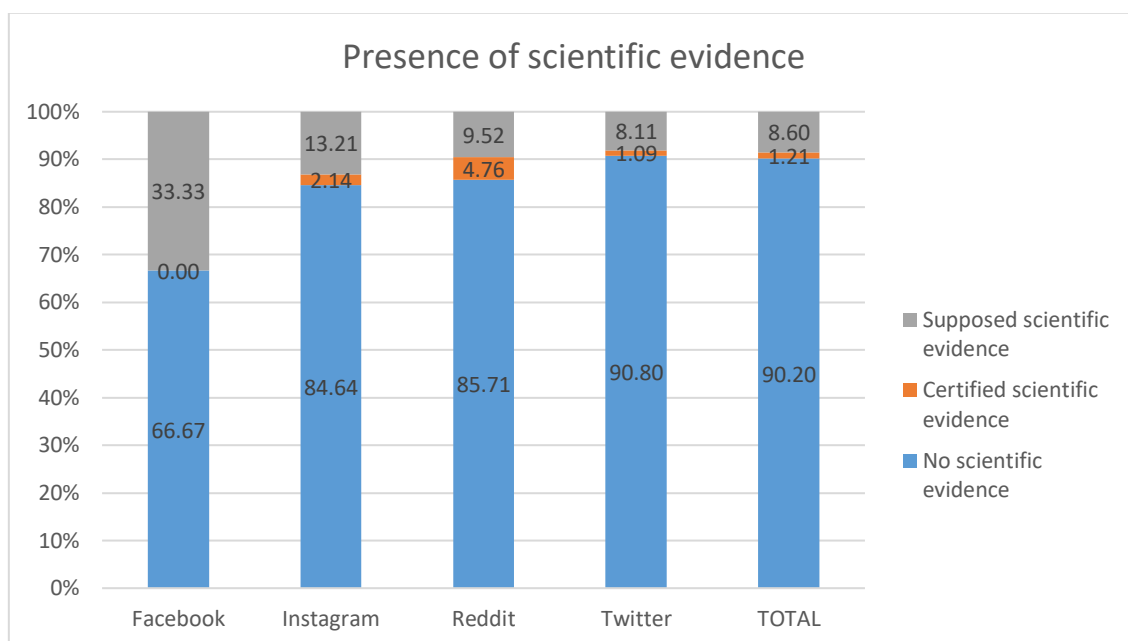
such as teachers, parents and educators, practitioners, trainers. Other professionals, including health professionals, nurses, policymakers, architects, writers and journalists were also targeted.

- **Institutions:** some of the actions were focused on institutions and included companies, NGOs, educational institutions (such as schools, universities, high schools, STEM Clubs).

Regarding the role of the target audience, most initiatives did not include an active role of the participants, who were expected to be the audience, read, learn or discuss. However, some initiatives required a more active role from participants. First, there were initiatives calling for scholarships to study abroad in which participants were expected to apply and calls for submissions to scientific journals or conferences that included sending abstracts, papers, proposals of projects and also articles for the dissemination of science. Second, in those messages aiming to recruit participants for a research, participants were expected to participate mainly by filling a questionnaire or participating in an interview, and also sharing experiences of success co-creating and consolidating and sharing evidence to identify emergent issues and close data gaps. Third, some initiatives included campaigns, in which participants were called to join, including on some occasions support and donations. Fourth, some initiatives were spaces of mutual help, where users either were asking for advice or providing recommendations or resources mainly related to STEM activities in educational settings or questions about COVID-19 and schools. Fifth, active participation had also a relevant presence on the identified initiatives and on the one hand it implied hands-on activities for children or teens (mainly on the Instagram hashtag #ScienceEducation) and on the other hand, co-creation initiatives (mainly on Twitter). These co-creation initiatives are mainly Makeathons and other type of science challenges, where participants have to work together to identify a relevant challenge and provide and design an effective solution.

Almost three quarters (74.86%) of the initiatives did not mention participants access to scientific evidence and in those initiatives that shared scientific evidence with participants, scientific evidence was not present on the tweet or message itself, but on the conference, webinar or event that were announcing. For this reason, as the following figure shows, in average, 90% of the messages did not include scientific evidence, compared with 8,60% of supposed scientific evidence and 1.21% of certified scientific evidence (published in Scopus or Journal Citation Reports).





*Figure 17. Presence of scientific evidence (Education- TD)*

It was frequent among those initiatives that share scientific evidence with participants to share scientific evidence on Open Access, via YouTube videos, scientific articles in open access or podcasts about science.

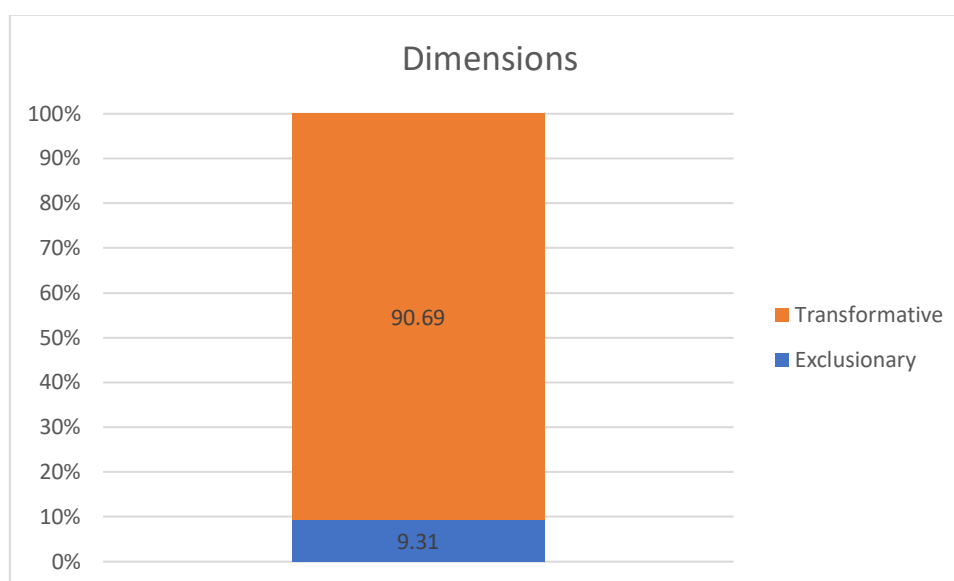
### 3.2.2.2. Bottom-Up

The bottom-up strategy was implemented on Twitter and included hashtags related to education that were retrieved from the daily trending topics in all European countries. The SMA in Twitter using a bottom-up strategy consisted of the analysis of the hashtags #books, #Wikipedia, #FutureOfEurope, #DigitalDecade and #Schools. A total of **505** tweets were included in the final analysis. Almost nine out of ten (84.16%) were retweeted at least once, as shown in the following table:

*Table 16. Average number of retweets and likes obtained across hashtags*

| Hashtag         | Total messages | Total messages with RT/ likes | Average of RT / likes |
|-----------------|----------------|-------------------------------|-----------------------|
| #books          | 178            | 100%                          | 36.80                 |
| #wikipedia      | 294            | 72.79%                        | 69.49                 |
| #FutureOfEurope | 19             | 100%                          | 66.69                 |
| #DigitalDecade  | 4              | 100%                          | 1                     |
| #schools        | 10             | 100%                          | 173.7                 |

Figure 18 presents the proportion of messages that were included in each dimension:



*Figure 18. Distribution of dimensions on Twitter – Bottom-up (education)*

As Figure 18 shows, more than 9 out of 10 of the messages (90.69%) were included in the transformative dimension because included examples of initiatives that fostered citizen participation in science. The 9.31% that were considered exclusionary included voices that undervalued scientific contributions or that claimed that Wikipedia was not a trustworthy source, did not provide any argument and they attacked the encyclopaedia and all the people who use Wikipedia.

#### **Aim of the initiatives on Twitter (bottom-up)**

This section presents the aims of the identified initiatives, which can be classified into 5 groups: books recommendations, donation campaigns, invitation to conferences, organization of edit-a-thons, and value of open science:

- **Book recommendation:** The tweets in this group share recommendations of books, both in open access and under payment, mainly related to big data, machine learning, artificial intelligence, coding and computer science.
- **Donation campaigns:** These messages include on the one hand existing campaigns that donated books and educational and technologic materials to children and schools in need around the world. On the other hand, in-course campaigns that were calling for donations of school material and books. These messages were mainly found in the hashtags #books and #DigitalDecade.
- **Invitation to conferences:** The tweets within this group were shared by diverse organizations, including the scientific community, associations, NGOs and companies who organized or shared the invitation to diverse online events, such as conferences, webinars, conversations, trainings, etc. The aim of these events was to involve citizens



in science, by sharing the results of existing research or enhancing citizens' scientific knowledge on diverse topics.

- **Organization of edit-a-thons:** The tweets in this group are related to the organization of events in which all citizens were invited to write and contribute to Wikipedia encyclopaedia. Most edit-a-thons have as one of their main objectives to contribute to the visibilization of women's contributions in diverse fields, such as music, science, journalism, archaeology, history or physics, among others. Some of these initiatives include the creation of new content and others the translation of existing entries into different languages. Additionally, some initiatives put the focus on the overpresence of male editors on Wikipedia and encourage women to be engaged in these initiatives. Finally, other tweets mentioned resources to edit Wikipedia, launched open editable programs or share codes of conduct to edit Wikipedia.
- **Value of open science:** there were also discussions where users valued Wikipedia and open science for their accurateness and reliability. In these debates, there were users who undervalued science and Wikipedia, which represents a barrier to the awareness of scientific contribution. However, these users only based their arguments on personal opinions and attacks to encyclopaedia and all the people who use it. On the contrary, citizens who defend the accurateness of Wikipedia defended the value of the encyclopaedia as a source of open science and remarked on the one hand the presence of certified scientific evidence at the end of each article and on the other hand the scientific advances that are made possible thanks to co-creation.

Although more than 7 out of 10 of the messages (72.67%) did not include any message about the social impact achieved by the identified initiatives, there were examples of how these initiatives were contributing to the participation of citizens in science. Some of the evidence of social impact includes the number of pages created on Wikipedia (ranging from 4 pages in individual initiatives to more than 1000 in collective edit-a-thons) or the number of books donated to underprivileged schools and children.

### Promoting Organization

The identified initiatives emerged from social actors from all sectors of society, as represented in Figure 19:

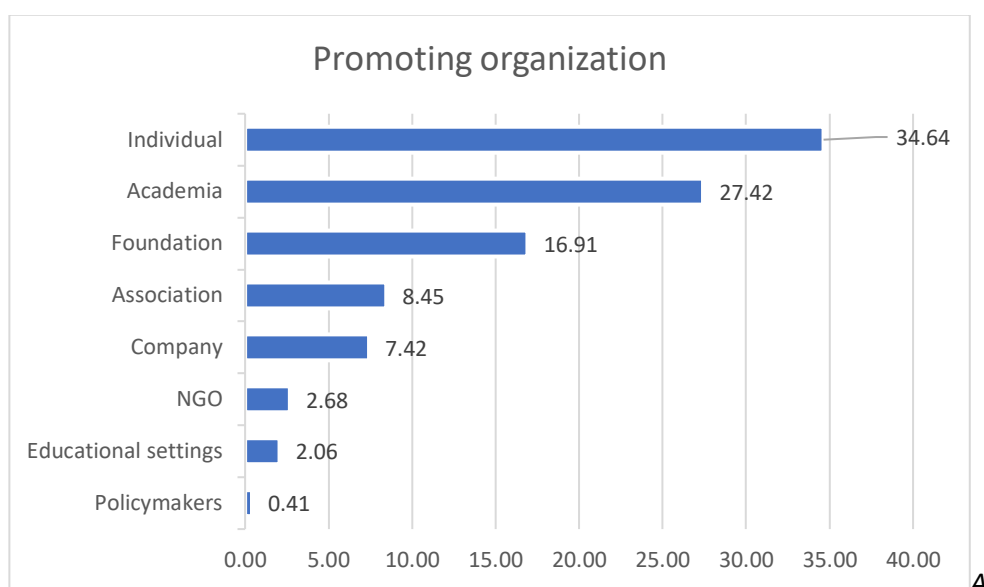


Figure 19. Promoting organization (Twitter – Bottom-up)

In this case, bottom-up initiatives are more common than top-down. It is remarkable that more than one third (34.64%) of the initiative are promoted by individual citizens, 16.91% by foundations and 8.45% by associations. In contrast, top-down initiatives are promoted by members of the academia and the scientific community (27.42%) companies (7.42%) and policymakers (0.41%).

#### Level and field of intervention

Regarding the level of intervention, most messages (94.26%) corresponded to initiatives implemented at the international level, mainly due to Wikipedia edit-a-thon initiatives. National (1.58%) and local (4.16%) initiatives had less presence in the analysed tweets:

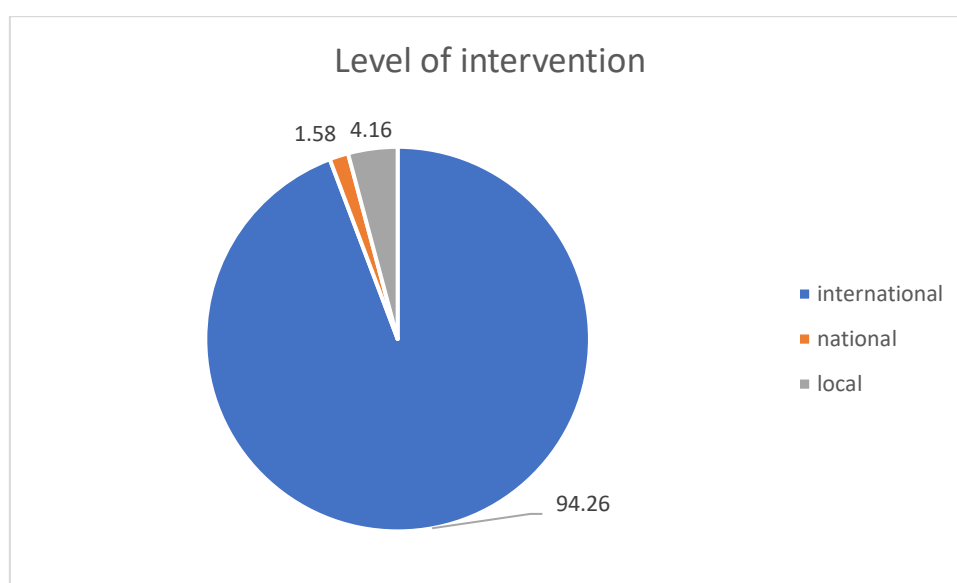


Figure 20. Level of intervention (Twitter – Bottom-up)

Among those initiatives implemented at the national level, there were initiatives implemented in 4 different countries: UK, USA, Spain and India, as presented in the following map.

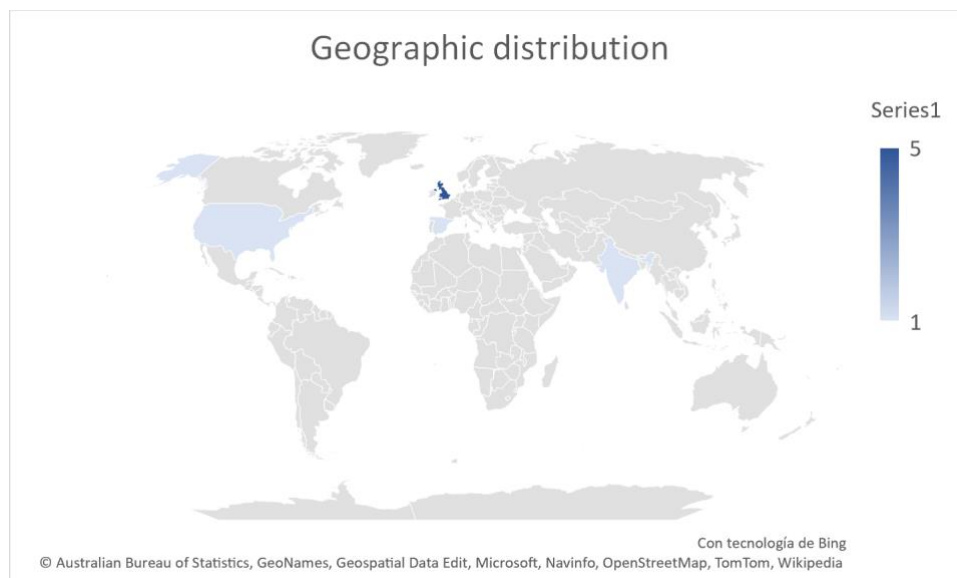


Figure 21. Geographic distribution of national initiatives (Education – Bottom-Up)

The fields covered by the initiatives were also diverse and diverged from one hashtag to the others. Some common topics across hashtags include open science, open access, machine learning, big data, books; STEM or co-creation, which were found both in #books and in #wikipedia. The main topics that emerged from the analysis are represented in the figure:



Figure 22. Topics addressed by the identified initiatives (Education– Bottom-up)



In addition, each hashtag provided examples of initiatives in different fields. This way, the hashtag #wikipedia contained examples of “open science” and “co-creation”, #books of “machine learning” or “big data”, #FutureOfEurope was centred on “AI” (Artificial Intelligence), #DigitalDecade on “Digital Transformation” and #schools on “education”. This variety of topics was possible due to the bottom-up approach in the selection of the hashtags, which were retrieved from the daily trending topics.

#### Audience and access to scientific evidence

Most messages (77.62%) were addressed to the whole society and did not specify a target audience. However, there were differences across hashtags. For example, in #books there were messages with recommendations of books for children, teenagers and parents, in #DigitalDecade, companies were an important target group, in #schools there were webinars and online activities for teachers and school staff and in #wikipedia there were edit-a-thons that target specifically journalists. In most cases, the target audience were expected to be the audience of scientific events. Nevertheless, there were initiatives that imply a more active role from citizens, such as Wikipedia Edit-a-Thons, where citizens gather and contribute to the advance of science and the visibilization of scientific contributions by co-creating and writing wiki content or translating content from Wikipedia to other languages. Other initiatives with an active role from the target audience include job offers, where candidates are expected to work, call for application to university scholarships or donations of books or educational material.

Regarding the access to scientific evidence, in most messages it was not possible to clarify if participants had access to scientific evidence. In other cases, the use of scientific evidence was present in the message itself. This way, 64.53% of the messages did not contain scientific evidence, compared with 25.95% of supposed scientific evidence and 9.52% of certified scientific evidence. It is important to mention that, within the messages without scientific evidence there were examples of initiatives that were contributing to enhance citizens’ access to scientific knowledge, such as conferences, courses, books or Wikipedia edit-a-thons. The following figure represents the presence of scientific evidence in the analysed messages:

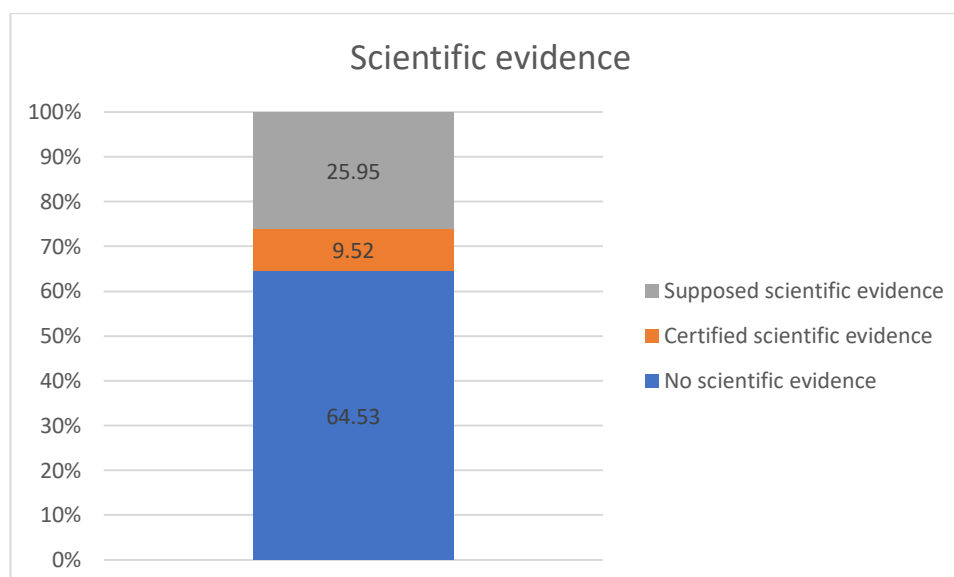




Figure 23. Access to scientific evidence (Twitter – Bottom-up)

In addition, in some cases when messages include access to scientific evidence, citizens tend to interact more with the message and to value it positively. In consequence, the average number of retweets varies depending on the access to scientific evidence, as presented in Table 19:

Table 17. Average number of interactions by access to scientific evidence.

| Level of access to scientific evidence | Average number of retweets |                              |                               |
|--|----------------------------|------------------------------|-------------------------------|
|  | No scientific evidence     | Supposed scientific evidence | Certified scientific evidence |
| #books                                 | <b>9.26</b>                | <b>31.35</b>                 | <b>87.32</b>                  |
| #FutureofEurope                        | 3.69                       | 2.33                         | -                             |
| #DigitalDecade                         | 1                          | 1                            | -                             |
| #Wikipedia                             | 75.69                      | <b>3.83</b>                  | <b>11.29</b>                  |
| #Schools                               | 173.7                      | -                            | -                             |

### 3.4 Conclusions

The main conclusions on the SMA analysis on awareness-raising initiatives that link citizens' benefits from science to the research that led to them are also succeeding in fostering citizen engagement in scientific research with impact echo findings in Reports 1 and 2. These include:

#### Main Findings between social networks

- Facebook and Reddit were the social networks where users could interact more with other users. For this reason, it was more common to find discussions and debates between users or users asking for help and advice.
- Whereas in Facebook, the administrators of the page shared the posts (e.g. press articles and blog entries), in Reddit all users are invited to post and propose a topic for the debate.
- In Twitter and Instagram there were not examples of community discussions. However, in Twitter, there were interactions between users, mainly through comments replying to previous messages.





#### Main Findings between strategies

- Although some differences were found between the Top-Down and Bottom-Up strategy, the most significant differences were found across different social networks.
- The selection of hashtags following a twofold strategy (top-down and bottom-up) brought different results.
- On the one hand, hashtags obtained from the bottom-up strategy were related to specific recent events and news and exemplified the response of citizens and society to these events.
- On the other hand, hashtags obtained from the top-down strategy were related to more general topics and included, not only the voices of citizens but also NGOs, governments, policymakers, companies, experts and associations, among others.

#### Main Findings between categories

- A common finding in all social networks was that most of the messages in the scientific impact category, contained real examples of the impact of research.
- This trend was not usually found in the political and social impact, where in most cases there is no evidence of the real impact of research. In these cases, it was more common to find examples that could bring to a potential impact of research.
- The examples of real social impact of research were mostly related to how citizens were able to incorporate the advances provided by scientific research in their lives and to use this knowledge in discussions.
- There were also examples of real impact of research that consisted of actions promoted by NGOs and were explicitly linked to the achievement of SDGs.

#### Main Findings between dimensions

- In all social networks, citizens tend to share transformative examples of how citizens' benefit from research.
- Specific results were found in Reddit, where users tended to downvote more exclusionary comments, and Instagram, where exclusionary posts earned less likes than transformative posts.
- The social network where more exclusionary messages were found is Reddit

### 3.5 Results of the Social Media Communicative Observation

#### 3.5.1 Posts identified in relation to topic c

The following are the results obtained from the Social Media Communication Observation on gender and education issues related to topic C.

The comments analysed in this SMCO show that users participating in the groups/pages or platforms have benefited from knowing the scientific evidence, especially the results on education and gender.

The virtual participation of the participants has increased their scientific knowledge. At the same time, it has allowed them to reflect, argue, motivate them to learn more and to engage in virtual dialogue with other users about what they have found in scientific



articles, their experiences, or their point of view.

Through their comments, we observe that users indicate that they have benefited from the scientific evidence, not only by increasing their knowledge but also because it has allowed them to question their practises and apply the scientific evidence to their environment.

Comments in relation to policy impacts have appeared less frequently and refer to how policies benefit from scientific advances.

In relation to comments on the benefits of scientific impact (i.e., scientific research that has contributed to the advancement of science with social impact), they have had more presence in social media. Users have pointed out how scientific theories and evidence have had an impact on their environment, which favours scientific progress in both education and gender.

The comments analysed show that the people who have written them have argued their opinions on many occasions with Open Access scientific articles and open scientific documentation on the Internet. This shows that the groups/pages or platforms that have been implemented during this time are an example of initiatives that engage citizens in science participation.

In addition, some users have mentioned in their comments that they participate in other scientific events such as the Tertulias Dialógicas [Dialogic Gatherings] where they discuss scientific topics. So, there are people who, although they are not scientists, show a high interest in science and are aware of scientific initiatives for citizen participation.

Through their analysed comments, users show how participating in these social media groups promoted and supported by the ALLINTERACT research, makes them aware of the importance of striving for inclusive education, promoting science through their educational practises, applying educational and social actions based on scientific evidence, knowing, and differentiating those practises that are being carried out and are based on occurrences.



Table 3.13. Results of TOPIC c) Awareness-raising initiatives succeeding at engaging citizens in scientific participation, including the Open Access movement

| TOPIC c) Awareness-raising initiatives succeeding at engaging citizens in scientific participation, including the Open Access movement |   |                        |                          |                       |                                |  |  |               |
|--|---|------------------------|--------------------------|-----------------------|--------------------------------|--|--|---------------|
|  | Aim of the enhancing-participation action   | Promoting organisation | Level of intervention    | Field of intervention | Participants (targeted & real) | Type of participation (i.e., role of participants) | Level of access to scientific evidence | Social Impact |
| TD*  | E1.1: Therefore, scientific evidence should be collected and disseminated to promote the importance of these efforts to achieve inclusive education, and argue from a human rights approach, so that education is a right available to all.   | Public                 | International; bottom-up | Education             | Real                           | Participant  | Medium                                 | Yes           |
|  | E1.5: As mentioned in the discussion, peer support and communication are factors that foster social inclusion and the reduction of educational inequalities, thus favouring academic success. In view of this, it is important to emphasise social participation as a relevant occupation in the educational context.   | Public                 | International; bottom-up | Education             | Targeted                       | Participant  | Low                                    | Yes           |
|  | E1.5: Taking this into account, the profession can encourage participation, which has a positive impact on social inclusion, as mentioned by Da Fonseca et al. (2018).  | Public                 | International; bottom-up | Education             | Targeted                       | Participant  | Low                                    | No            |
|  | E1.6. Under the same premise mentioned at the beginning of this text, although contexts and environments are fundamental for participation in education, there are also factors intrinsic to each student, which will influence the way they participate and develop in this occupation. According to Kutcher and Tuckwillet in 2019 (As cited in Moriña and Biagotti, 2021) setting clear goals, being proactive and autonomous, as well as having the ability to make their own decisions are student characteristics that will lead to success in the classroom, another important component is feelings of self-sufficiency in order to carry out the tasks corresponding to the occupation of education. | Public                 | International; bottom-up | Education             | Targeted                       | Participant  | Low                                    | No            |



|     |  |        |                             |           |        |             |        |     |
|-----|--|--------|-----------------------------|-----------|--------|-------------|--------|-----|
| ED* | E3.15: Today, after participating in a Pedagogical Dialogue on the article by López de Aguilera and Soler-Gallart (2021) "Ausubel's Significant Learning and Educational Segregation", I have decided to share my own transformative experience. I studied in EGB and at that time no practices of content reduction were applied, nor were any children removed from the classroom for social reasons, such as coming from an uneducated family or from a dysfunctional family.   | Public | International;<br>bottom-up | Education | Real   | Participant | Medium | Yes |
|     | E4.12: A successful educational action that includes the so-called "bystander intervention" is the Zero Violence Brave Club. This action is applied in more and more schools worldwide with significant improvements to stop bullying and achieve children's well-being.   | Public | International;<br>bottom-up | Education | Real   | Participant | High   | Yes |
|     | E5.30: In line with what this article quotes we have decided to refer to this other article which refers to the influence of teachers' perceptions on pupils. It also deals with a large, representative, longitudinal study in the United States. Kellys,S. & Carbonaro,W.(2012).Curriculum tracking and teacher expectations: evidence from discrepant course taking models. Social psychology of education, 15,3, 271-294.<br><a href="http://10.1007/s11218-012-9182-6">http://10.1007/s11218-012-9182-6</a>   | Public | International;<br>bottom-up | Education | Target | Participant | Medium | No  |
|     | G5.15: I work in a school and on a daily basis, I can see that through the implementation of the dialogical model of conflict prevention the intervention of witnesses has increased both to stop direct aggression and to tell or look for help when they find out or see something. Children are safe to intervene and no longer look the other way or encourage the aggressor because they know that protecting and acting is courageous and they will not be alone. Coexistence has improved, reducing the intensity of the violence and managing to stop it from the first moments. | Public | International;<br>bottom-up | Gender    | Real   | Participant | Medium | Yes |
| ED* |  |        |                             |           |        |             |        |     |

\*TD = Transformative Dimension; ED= Exclusion Dimension



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### 3.5.2 Analysis of the post of the users who participated in the debate and produced a change once evidence of the social impact of the research was introduced.

From the comments analysed we observe that users show some reaction when scientific evidence is introduced. These reactions appear in two different ways:

On the one hand, it is observed that by introducing scientific evidence, users reaffirm their opinion. Some of the users affirm their argumentation after the comments, others look for other evidence or documents to further enhance their comments, others show their agreement with the scientific evidence, make further reflections, and explain their life experiences.

On the other hand, we have observed that after introducing comments with scientific evidence, users change their opinion, generally to an opinion in favour of the scientific evidence. In their comments, these users state that it has made them rethink their decisions on a specific issue or they reflect on the issue and later end up agreeing with the scientific evidence shown above.

In short, users, when shown scientific evidence, reflect, search for other sources, comment and interact, generally showing their agreement with the scientific evidence shown.



*Table 3.14. Results of the analysis of the post of the users who participated in the debate and produced a change once evidence of the social impact of the research was introduced.*

| Chance in the content of the messages. |   |                        |                          |                       |              |                       |  |               |
|--|---|------------------------|--------------------------|-----------------------|--------------|-----------------------|--|---------------|
|  | Aim of the action targeting new talent for science  | Promoting organisation | Level of intervention    | Field of intervention | Participants | Type of participation | Level of access to scientific evidence | Social Impact |
| TD*                                    | E1.3. In relation to the initial comment on the factors that favour academic success, we can point out that Article 18 of the Convention on the Rights of the Child (1989) establishes that in the States Parties, education must be recognized as a right that children have. In this sense, under the framework of the Convention on the Rights of Persons with Disabilities (2006), and according to Article 24, the States Parties must ensure access for Persons with Disabilities [in Chile the terminology of Persons with Disabilities (PWD) is used, because according to the National Disability Service (SENADIS, n. d.), disability is defined as the right to education. f.), disability should be placed in the interaction with barriers and not in the person] to educational establishments and provide equal opportunity conditions so that they can progressively exercise education as they reach the different educational levels. | Public                 | International; bottom-up | Education             | Targeted     | Participant           | Low                                    | No            |
|  | E1.5: As mentioned in the discussion, peer support and communication are factors that foster social inclusion and the reduction of educational inequalities, thus favoring academic success. In view of this, it is important to emphasize social participation as a relevant occupation in the educational context.  | Public                 | International; bottom-up | Education             | Targeted     | Participant           | Low                                    | Yes           |
|  | E1.7: In relation to the comment made above, we believe that it is important to promote inclusive education for all students, given that this will allow them to develop the necessary tools for optimal performance in the educational sphere. This, in turn, will allow for development in social areas, promoting occupational participation. Inclusive education allows students to have equal opportunities in the education system.   | Public                 | International; bottom-up | Education             | Targeted     | Participant           | Low                                    | Yes           |





|  |   |        |                             |           |          |             |        |     |
|--|---|--------|-----------------------------|-----------|----------|-------------|--------|-----|
|  | E1.11: But in relation to the recently uploaded post, there is one aspect that is not mentioned as much and is often left aside. There are children with disabilities who need more attention and a more dynamic educational plan, but just like the others, they have the right to learn and therefore, the teaching team has the obligation to teach, using other methods and focusing on the pedagogical design plan.  | Public | International;<br>bottom-up | Education | Targeted | Participant | Low    | No  |
|  | E1.18: From the scientific evidence I am involved in researching, but also from my own experience, I can affirm that Bourdieu's reproductionist model is surpassed every day from different corners of the world, from different neighbourhoods, from different families, like mine, and from so many educational communities that work hard to offer a quality education, a transformative education like the one my parents wished for me.  | Public | International;<br>bottom-up | Education | Real     | Participant | High   | Yes |
|  | E3.15: Today, after participating in a Pedagogical Dialogue on the article by López de Aguilera and Soler-Gallart (2021) "Ausubel's Significant Learning and Educational Segregation", I have decided to share my own transformative experience. I studied in EGB and at that time no practices of content reduction were applied, nor were any children removed from the classroom for social reasons, such as coming from an uneducated family or from a dysfunctional family.  | Public | International;<br>bottom-up | Education | Real     | Participant | Medium | Yes |
|  | E3.15: Now, as a teacher, I have been able to see how theories such as Ausubel's, Bourdieu's or Althusser's have "pulled children to the bottom of the sea" who needed a hand to push them upwards and not downwards. Now I am also aware of the transformative theories that are at the basis of the successful educational performances that are making it possible for students who come from uneducated families to achieve the success that some of us achieve. That is why, as a teacher, I will never again base my practice on reproductionist theories, even if they continue to be promoted at university or in training courses (which are not based on evidence). | Public | International;<br>bottom-up | Education | Real     | Participant | Medium | Yes |
|  | E3.21: The other day I was lucky enough to be with Sara at the same Tertulia and the evidence was overwhelming: no to ideas based on discrimination against people.   | Public | International;<br>bottom-up | Education | Real     | Participant | High   | Yes |
|  | E3. 19. Income gaps are mainly due to the difference in early education investment. Subsidizing early education is the most effective public policy to release income   | Public | International;<br>bottom-up | Education | Real     | Participant | Medium | Yes |



|  |  |        |                             |           |        |             |        |    |
|--|--|--------|-----------------------------|-----------|--------|-------------|--------|----|
|  | inequality.<br><a href="https://www.sciencedirect.com/science/article/abs/pii/S1043951X15001637">https://www.sciencedirect.com/science/article/abs/pii/S1043951X15001637</a>   |        |                             |           |        |             |        |    |
|  | E4.22: The role of bystanders against bullying. All members of the group are in agreement on this issue, as we believe that bystanders are an indispensable source to end bullying and all that goes with it.  | Public | International;<br>bottom-up | Education | Target | Participant | Medium | No |
|  | E4.25: Therefore, I believe that bystander intervention is essential to stop bullying as long as it does not involve intervening in a bad way but rather by going to an adult who can stop the bullying, as sometimes victims do not defend themselves because they feel alone and sometimes they need someone who can help them or advise them on what to do in these situations.   | Public | International;<br>bottom-up | Education | Target | Participant | Low    | No |
|  | E5.27: Research by Robert Manzano and others has found that when we expect a lot from our students, we treat them differently. We ask them more often, give them more time to respond and let them explain their answers. Therefore, we motivate them more, we increase interactions in quantity, quality and frequency, and with that we increase the results, as students are kept active and awake, the protagonist and author of their own learning. | Public | International;<br>bottom-up | Education | Target | Participant | Low    | No |
|  | E5.28: I totally agree. This reminds me of the Pygmalion effect or self-fulfilling prophecy, that is an expectation that prompts people to act in ways that make the expectation come true. In other words, the final results end up being the mirror of what we expect from our students beforehand.  | Public | International;<br>bottom-up | Education | Target | Participant | Low    | No |
|  | E5.29: I agree with the post. I think that the teacher's expectations can influence an improvement in the student's results, this reminds me of what I studied in education theory about the Pygmalion effect. Low expectations on the part of the teacher attract low results on the part of the students, therefore, high expectations end up motivating the subjects and thus, achieving more positive results.                                       | Public | International;<br>bottom-up | Education | Target | Participant | Low    | No |
|  | E5.1: Indeed, teacher expectations influence academic success, and this also includes students belonging to ethnic groups - the higher the expectations, the higher the  | Public | International;<br>bottom-up | Education | Real   | Participant | Medium | No |



|  |   |        |                          |           |        |             |        |    |
|--|---|--------|--------------------------|-----------|--------|-------------|--------|----|
|  | achievement, and the lower the expectations, the lower the achievement. Flanagan, Cormier and Bulut (2020) show this in their research using 140 teacher surveys, even when teachers do not report different behaviour, they report lower expectations for indigenous students.   |        |                          |           |        |             |        |    |
|  | E5.30: In line with what this article quotes we have decided to refer to this other article which refers to the influence of teachers' perceptions on pupils. It also deals with a large, representative, longitudinal study in the United States. Kellys,S. & Carbonaro,W.(2012).Curriculum tracking and teacher expectations: evidence from discrepant course taking models. Social psychology of education, 15,3, 271-294. <a href="http://10.1007/s11218-012-9182-6">http://10.1007/s11218-012-9182-6</a> | Public | International; bottom-up | Education | Target | Participant | Medium | No |
|  | E5. 33: In my case, these comments were able to make me rethink the decisions I had to make. That is why I agree with the statement that low expectations are associated with lower academic performance, but high expectations are associated with higher academic performance, higher academic achievement. (E5.Teachers expectations influence educational achievement - Sc, P. 6: 1276)   | Public | International; bottom-up | Education | Target | Participant | Low    | No |
|  | E5.34: I totally agree. If teachers from day one have a passion and love for what they do, they will have very high expectations of their students. Expectations of teachers influence educational performance.   | Public | International; bottom-up | Education | Target | Participant | Low    | No |
|  | E5.36: In my view, I believe that this is a very true statement, because whatever the teacher requires of his pupils, taking into account his own expectations, will cause this maximum effort in pupils or not. If a teacher has higher expectations of his pupils, he will seek to give the maximum of them so that they will achieve better academic results, and if that is the case, the results will be lagging behind.   | Public | International; bottom-up | Education | Target | Participant | Low    | No |
|  | E5.38: From my point of view, it is true that students' academic performance is influenced by teachers' expectations. I will present two situations based on my experience as a student to demonstrate that the scientific evidence in the post is real.  | Public | International; bottom-up | Education | Target | Participant | Low    | No |



|  |        |                             |           |        |             |        |     |
|--|--------|-----------------------------|-----------|--------|-------------|--------|-----|
| E5.39: I agree with the post. The expectations of teachers towards pupils is a direct influence on them.(...) That is why it is important that if such expectations are created, they are created in a healthy way, with different goals for each pupil, because no one is identical, and for everyone. In this way we can produce a positive effect on all children and thus achieve a positive, motivating, hard-working and creative attitude for the new generations.  | Public | International;<br>bottom-up | Education | Target | Participant | Low    | No  |
| G1.153: In my personal experience, romantic love has in no way been a root of gender violence. I have a very romantic relationship with my girlfriend and after several years together she has never felt involved in a violent relationship according to her. Now, according to the evidence that I know, the root of gender violence are the social interactions that make us desire and choose violent people. To back this assertion I share a peer reviewed paper below.  | Public | International;<br>bottom-up | Gender    | Real   | Participant | Hight  | Yes |
| G1.156: The problem in these relationships is the difficulty in recognising threatening and/or risky situations that can lead to violence, as many of these are normalised and accepted by today's society. Therefore, the problem is not the fact of having relationships, whether sporadic or stable, nor the age of the participants, but the choice of the person or the permissibility of small everyday actions that can lead to violence in the future.   | Public | International;<br>bottom-up | Gender    | Target | Participant | Hight  | No  |
| G2.15: There is evidence of the SOSH that exists in universities and the permissive dynamics installed in them towards this violence that can even make the victims feel guilty for thinking that they are the ones who have caused this situation. These university contexts where this type of violence is permitted make the victims feel isolated by their peers which leaves them even more unprotected. I totally agree that it is urgent to defend those who support the ending of the sexual violence that still persists in universities. | Public | International;<br>bottom-up | Gender    | Real   | Participant | Medium | Yes |
| G3.161: Sexual orientation tells us about the romantic, sexual or affective attraction towards people of the opposite sex or gender, of the sex or gender, or of both sexes or more, in this case we speak of love or simple preference, on the other hand when we speak of pedophilia we see control and violence, we speak of an age-related   | Public | International;<br>bottom-up | Gender    | Target | Participant | low    | No  |



|  |   |        |                             |        |      |             |        |     |
|--|---|--------|-----------------------------|--------|------|-------------|--------|-----|
|  | “preference”, therefore we do not speak of love. You can find much more information through the following page where we can find an interesting article that studies pedophilia as a possible disorder.   |        |                             |        |      |             |        |     |
|  | G4.12: Even the studies that did find some correlation in the 1990s do not provide any causal relationship, what they say is that it could be considered a logical theoretical link between the experience of physical abuse in early life and the later development of aggressive behaviour; they do not claim that it exists, but that this is the approach of some theorists.  | Public | International;<br>bottom-up | Gender | Real | Participant | High   | No  |
|  | G4.14: This is so important for schools, educators and families, because it allows for more optimistic and transformative approaches and interventions. Thank you!  | Public | International;<br>bottom-up | Gender | Real | Participant | Medium | No  |
|  | G4.58: “Childhood exposure to violence and likelihood of adult perpetration of violence, particularly for boys”; please, if you have found this kind of evidence in some of the article you sent in your message, I would kindly like to ask you to point out which is this evidence and in which articles can be found. I have found correlations, but not causal relationships. I have also found statements about causal relations, but without support of scientific evidence. I was a victim of gender violence and I could transform myself into a survivor thanks to the help of men and women, some of whom had been exposed to violence when they were children. Children with exposure to violence are victims; projecting into them the suspicion that they will become perpetrators is revictimization. Besides, this projection also creates difficulties for the solidarity we need from them to transform ourselves from victims to survivors. | Public | International;<br>bottom-up | Gender | Real | Participant | High   | Yes |
|  | G5.158: Bystander Intervention is one of the evidence based interventions that has proven to reduce and prevent violence in all its forms at educational institutions from schools to universities. Its approach focuses on the empowerment of the witnesses to speak up and report the possible violence and harassment situations as an effective action to protect the victims. Now, evidence goes beyond demonstrating the efficacy of the program to prove that Bystander Intervention does not only have immediate effects in the short term but also in the long run.  | Public | International;<br>bottom-up | Gender | Real | Participant | High   | Yes |



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement num. 872396



|     |  |        |                             |        |      |             |        |     |
|-----|--|--------|-----------------------------|--------|------|-------------|--------|-----|
|     | G5.15: I work in a school and on a daily basis, I can see that through the implementation of the dialogical model of conflict prevention the intervention of witnesses has increased both to stop direct aggression and to tell or look for help when they find out or see something. Children are safe to intervene and no longer look the other way or encourage the aggressor because they know that protecting and acting is courageous and they will not be alone. Coexistence has improved, reducing the intensity of the violence and managing to stop it from the first moments. | Public | International;<br>bottom-up | Gender | Real | Participant | Medium | Yes |
| ED* |  |        |                             |        |      |             |        |     |



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement num. 872396



### 3.5.3 The correlation between awareness of the social impact of research and engagement in science

The correlation between awareness of the social impact of research and engagement with science is presented below. This analysis has taken as variables - citizen awareness of the social impact of research" and "citizen engagement with science". Thus, we have collected 57 whole comments. The correlation between both variables is cross-checked using the SPSS program. Since both variables are nominal and dichotomous, Phi, Cramer's V and the Contingency coefficient will be selected. The data shows that there is no correlation between the two variables.

The data are presented below:

## Cross tables

### Notes

|                |                   |                      |
|----------------|-------------------|----------------------|
| Output created |                   | 10-FEB-2022 13:17:29 |
| Comments       |                   |                      |
| Entrance       | Active dataset    | ConjuntoDatos1       |
|                | Filter            | <none>               |
|                | Weighting         | <none>               |
|                | Segmentar archivo | <none>               |





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57

| N of rows in the work data file |                           |   |
|---------------------------------|---------------------------|---|
| Management of lost values       | Management of lost values | Lost user-defined values are treated as lost.   |
|                                 | Cases used                | The statistics for each table are based on all cases with valid data in the specified ranges for all variables in each table.             |
| Syntax                          |                           | CROSSTABS<br>/TABLES=VAR00001 BY VAR00002<br>/FORMAT=AVALUE TABLES<br>/STATISTICS=CHISQ PHI UC CORR<br>/CELLS=COUNT<br>/COUNT ROUND CELL. |
| Resources                       | Processor time            | 00:00:00,02   |
|                                 | Processor time            | 00:00:00,00   |
|                                 | Requested dimensions      | 2   |
|                                 | Available boxes           | 524245  |



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## Case Processing Summary

| Cases               |       |            |      |            |       |            |
|---------------------|-------|------------|------|------------|-------|------------|
|                     | Valid |            | Lost |            | Total |            |
|                     | N     | Percentage | N    | Percentage | N     | Percentage |
| VAR00001 * VAR00002 | 57    | 100,0%     | 0    | 0,0%       | 57    | 100,0%     |

## Cross table VAR00001\*VAR00002

Recount

|          |      | VAR00002 |      | Total |
|----------|------|----------|------|-------|
|          |      | ,00      | 1,00 |       |
| VAR00001 | ,00  | 0        | 5    | 5     |
|          | 1,00 | 47       | 3    | 50    |
|          | 2,00 | 2        | 0    | 2     |
| Total    |      | 49       | 8    | 57    |



## Chi-square tests

|                              | Value               | df | Asymptotic (bilateral) significance |
|------------------------------|---------------------|----|-------------------------------------|
| Pearson's Chi-square         | 33,627 <sup>a</sup> | 2  | ,000                                |
| Likelihood ratio             | 23,542              | 2  | ,000                                |
| Linear-by-linear association | 24,953              | 1  | ,000                                |
| N of valid cases             | 57                  |    |                                     |

a. 4 boxes (66.7%) have expected a count of less than 5. The minimum expected count is .28.



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement num. 872396



## Directional measurements

|                    |                         |                    | Value | Standard asymptotic error | Approximate T <sup>b</sup> |
|--------------------|-------------------------|--------------------|-------|---------------------------|----------------------------|
| Nominal by Nominal | Uncertainty coefficient | Symmetrical        | ,485  | ,134                      | 2,670                      |
|                    |                         | VAR00001 dependent | ,463  | ,124                      | 2,670                      |
|                    |                         | VAR00002 dependent | ,509  | ,167                      | 2,670                      |

## Directional measurements

|  |                    |  | Approximate significance |
|--|--------------------|--|--------------------------|
| Nominal by Nominal Uncertainty coefficient | Symmetrical        |  | ,000 <sup>c</sup>        |
|  | VAR00001 dependent |  | ,000 <sup>c</sup>        |
|  | VAR00002 dependent |  | ,000 <sup>c</sup>        |

- a. The null hypothesis is not presupposed.
- b. Use of the standard asymptotic error that presupposes the null hypothesis.
- c. Chi-square probability of likelihood ratio.



## Symmetrical measurements

|                      |                      | Value | Standard asymptotic error <sup>a</sup> | Approximate T <sup>b</sup> | Approximate significance |
|----------------------|----------------------|-------|--|----------------------------|--------------------------|
| Nominal by Nominal   | Phi                  | ,768  |  |                            | ,000                     |
|                      | V of Cramer          | ,768  |  |                            | ,000                     |
| Interval by interval | R from Pearson       | -,668 | ,124                                   | -6,649                     | ,000 <sup>c</sup>        |
| Ordinal by ordinal   | Spearman correlation | -,676 | ,129                                   | -6,812                     | ,000 <sup>c</sup>        |
| N of valid cases     |                      | 57    |  |                            |                          |

- a. The null hypothesis is not presupposed.
- b. Use of the standard asymptotic error that presupposes the null hypothesis.
- c. It is based on normal approximation.



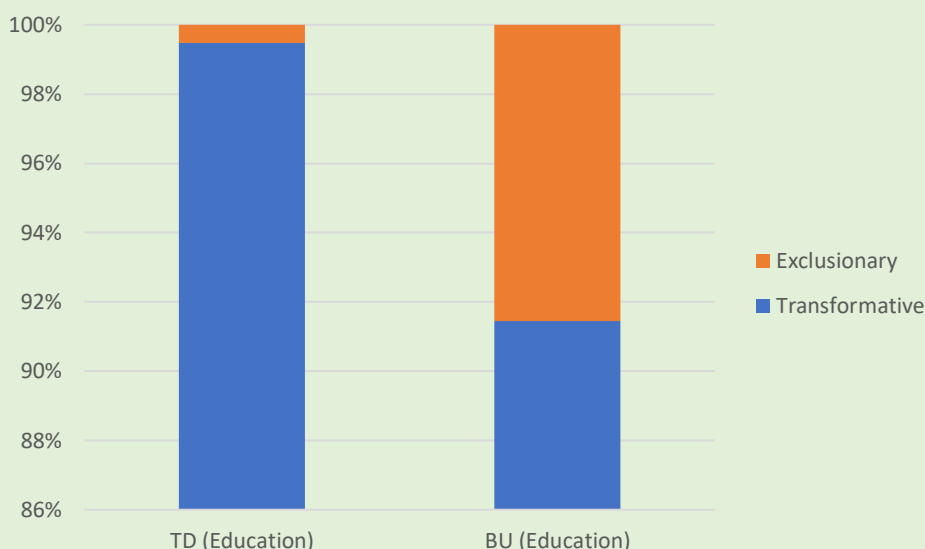
### 3.6 Conclusions of the Social Media Analytics

#### Main Findings between *social networks*

- The number of initiatives to foster citizens' interactions with science was higher on Twitter and Instagram. Only a few messages were identified on Facebook and Reddit.

#### Main Findings between *strategies*

- The use of scientific evidence is more widespread in the bottom-up approach than in the top-down approach. In the bottom-up, between 11.11% and 35.47% of the messages included some type of scientific evidence, while in the top-down the proportion ranged from 8.28% to 9.80%
- On average, 99,48% of the messages in the top-down strategies were transformative, compared with the 91,45% of the bottom-up approach.



- The selection of hashtags following a twofold strategy (top-down and bottom-up) brought different results. The bottom-up approach was more related to recent news and events, while in the top-down, emerged general topics (sometimes related to the SDG).
- In the top-down approach there was a wider representation of countries in the national initiatives, compared with the bottom-up approach.

#### Main Findings about *categories*

- **Aim of the initiatives:** although the objectives of the initiatives were diverse, a great extent of the initiatives aimed to invite citizens to scientific events, call for scholarships or applications, recruit participants for studies, share scientific knowledge on open access or organize hackathons and other co-creation projects.

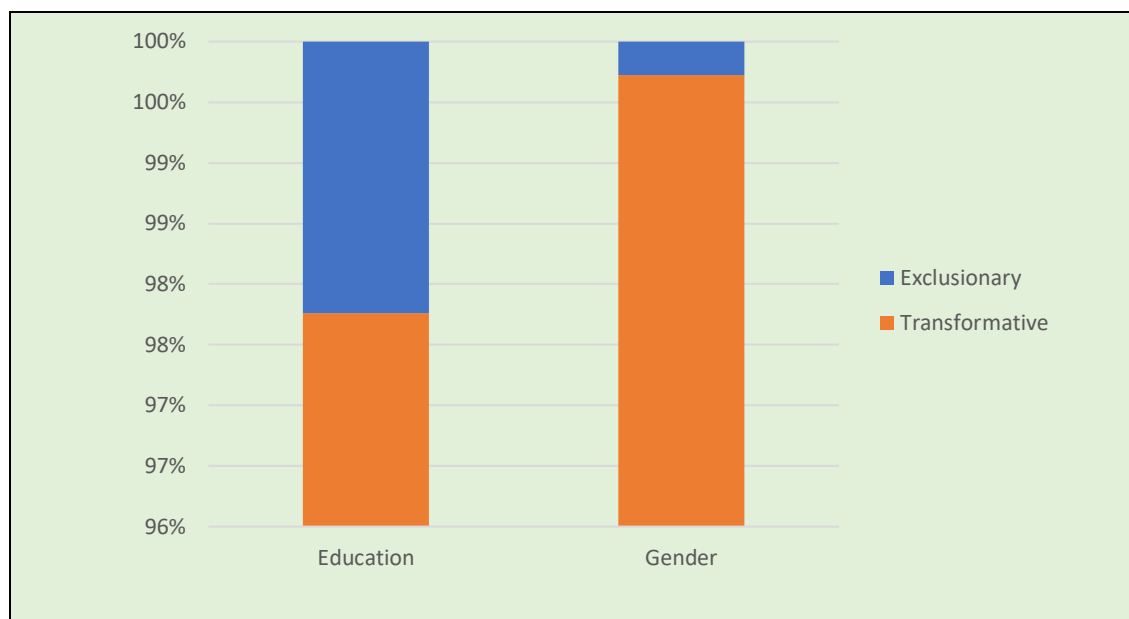


- **Promoting organization:** The most common promoting organization of initiatives to foster citizen participation in science across social networks and strategies was the scientific community, ranging from 20.89% to 68.18%. Bottom-up initiatives are also notable and mainly promoted by citizens, NGOs, associations and educational settings.
- **Level of intervention:** Globally, most of the messages included initiatives at international level. One of the underlying reasons could be the internationalization of social media. However, more than 60 different countries were present in the national initiatives, with relevant presence of India, United Kingdom and the United States
- **Field of intervention:** The fields of intervention were diverse and not limited to topics related to gender and education. This finding points to the increasing interdisciplinarity of scientific research that includes contributions from all scientific fields.
- **Target audience:** Most of the initiatives did not target specifically any group. However, some of the interventions were addressed to specific sectors of society, with emphasis on vulnerable groups, a specific professional group or institutions.
- **Role of the target audience:** In most of the initiatives, the target audience did not play an active role. However, in those initiatives in which participants were actively engaged, they could participate in research, apply for scholarships, submit scientific contributions or co-create scientific knowledge.
- **Social impact:** Between 72.67% and 100% of the messages did not contain any mention of the social impact achieved by the initiatives. However, this does not necessarily imply that the initiatives did not achieve social impact, but that society is still not used to collecting evidence of the social impact achieved by the initiatives.

#### *Main Findings between **dimensions***

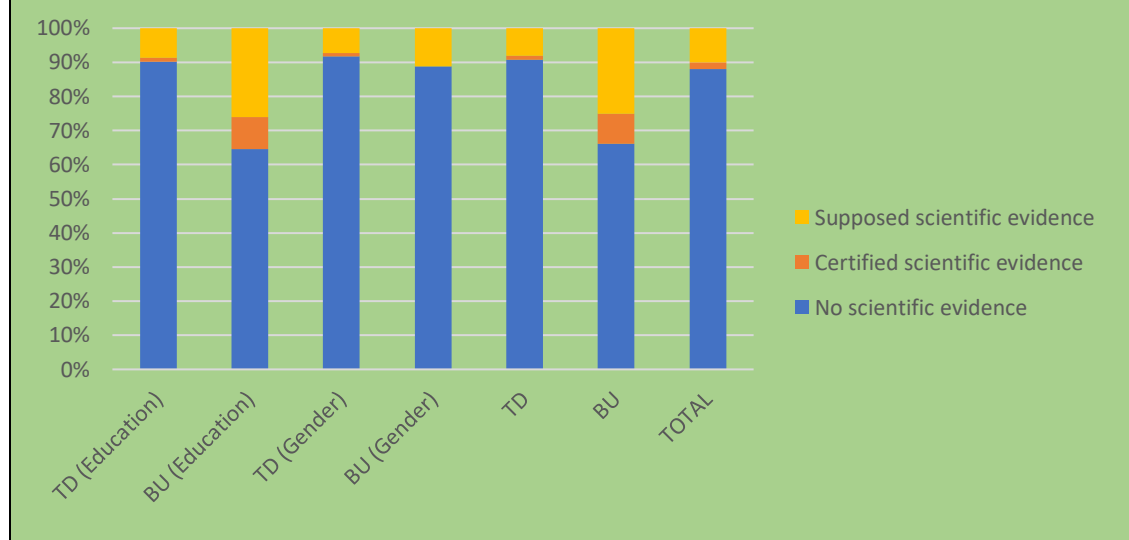
- In all social networks, citizens tended to share transformative examples of how citizens' benefit from research. The proportion of exclusionary messages ranged from 0 -9.31%.





#### Main Findings in the use of scientific evidence

- The use of scientific evidence is more widespread in education than in gender, ranging from 9.80%-35.47% in the first case and from 8,28% to 11,11% in the second.
- In most cases, the use of scientific evidence was mainly through the provision of data or statistics and it was not common to find evidence from articles of journals indexed in JCR or Scopus.
- Although most initiatives did not mention whether participants had access to scientific evidence or not, in most cases scientific evidence was not present on the tweet or message itself, but on the conference, webinar or event that were announcing. Among those that include scientific evidence, open access was common.



### 3.7 Social Media Communicative Observation - Conclusions



### **Conclusions for TOPIC c) Awareness-raising initiatives succeeding at engaging citizens in scientific participation, including the Open Access movement**

- The groups/pages or platforms that have been implemented during this time are an example of initiatives that engage citizens in science participation.

### **Conclusions for Analysis of the post of the users who participated in the debate and produced a change once evidence of the social impact of the research was introduced.**

- Users reaffirm their opinion when we introduce scientific evidence.
- Users change their opinion in line with scientific evidence after introducing comments with scientific evidence.
- The users reflect, search for other sources, comment and interact, generally showing their agreement with the scientific evidence shown previously.

### **Conclusions on the correlation between awareness of the social impact of research and engagement in science**

- The results do not show a correlation between awareness of the social impact of research and engagement in **science**.



## 4. FOCUS GROUPS

### 4.1 Overview

All partners have worked keeping in mind that a Focus Group (FG) “is a group of individuals selected and assembled by researchers to discuss and comment on, from personal experience, the topic that is the subject of the research” (Powell & Single, 1996, p. 499).<sup>49</sup>

The focus groups conducted by the UOXF, ISCSP-ULISBOA, UNIMIB, UB, UH, and RUG followed the guidelines established in the Focus Group protocol of the projects, as well as the individual and collective protection measures based in the country due to the COVID-19 pandemic. The distribution of focus groups relevant for Topic C<sup>50</sup> is detailed below:

| Gender  |               |     | Education               |         |     |
|---|---------------|-----|-------------------------|---------|-----|
| Profile of participants                               | Partner       | C/E | Profile of participants | Partner | C/E |
| Women (including vulnerable women) from women's group | UOXF          | C/E | Parents                 | UB      | C/E |
| Member of LGBTQI group                                | ISCSP-ULisboa | C/E | Teacher                 | UH      | C/E |
| Women (including Young women) from a women's group    | UNIMIB        | C/E | Students                | RUG     | C/E |

### 4.2 Gender

#### 4.2.1 Methodology

The focus groups conducted by the University of Oxford team followed the guidelines established in the ALLINTERACT Focus Group protocol, taking into account the UK good practice and guidelines on involving citizens in research as well as COVID-19 individual and collective protection measures. The application of the UK good practice and guidelines has resulted in two alterations. First, in line with UK good practice on involving citizens in research, FG participants were paid a honorarium for their involvement:

“Paying people for their involvement in research helps to support more equal partnerships between researchers and members of the public. It helps to support the

49 Powell, R. A., & Single, H. M. (1996). Focus groups. *International journal for quality in health care*, 8(5), 499-504.

50 TOPIC c) Awareness-raising initiatives succeeding at engaging citizens in scientific participation, including the Open Access movement



inclusion of people who might not otherwise be able to get involved, whether for financial or other reasons relating to access. Consequently, it widens the potential pool of people who might influence the course of research.”<sup>51</sup>

The rate of reimbursement was determined on the basis of the NIHR Centre for Engagement and Dissemination’s payment policy:

“£25: For involvement in a task or activity requiring little or no preparation and which equates to approximately one hour of activity or less. For example, participating in a focus group to provide feedback on a proposal.”<sup>52</sup>

Second, to minimise the transmission of Covid-19, participants were provided with the project participant sheet and consent form via email and were invited to sign the consent form electronically via DocuSign. The latter offers EU-compliant eSignatures solutions in line with the Regulation (EU) No 910/2014 (the eIDAS Regulation).<sup>53</sup>

In accordance with the distribution of FGs among partners, the University of Oxford team conducted two FGs on gender:

Table 4.1: FG distribution among partners – Gender Team

| Profile of participants                                 | Partner | Control/<br>Experimental |
|---|---------|--------------------------|
| Women (including vulnerable women) from a women’s group | UOXF    | C                        |
|   | UOXF    | E                        |
| Members of an LGBTQI group                              | ISCSP   | C                        |
|   | ISCSP   | E                        |
| Women (including Young women) from a women’s group      | UNIMIB  | C                        |
|   | UNIMB   | E                        |

C: Control Group; E: Experimental Group; UOXF: Oxford University; ISCSP: University of Lisbon; UNIMIB: University of Milano Bicocca.

In line with the objective of the ALLINTERACT project to widen and diversify citizens’ engagement in science, participants were recruited via the Public and Community Involvement, Engagement and Participation leads at NIHR Oxford Biomedical Research Centre and the NIHR Applied Research Collaboration for Oxford and the Thames Valley with a specific focus on including participants from diverse ethnic groups. One participant required English language translation, which was provided by their family member. Several participants identified themselves as neurodiverse.

<sup>51</sup> NIHR (2021) Payment guidance for members of the public considering involvement in research.

<https://www.nihr.ac.uk/documents/payment-guidance-for-members-of-the-public-considering-involvement-in-research/27372>

<sup>52</sup> NIHR (2021) Payment guidance for researchers and professionals <https://www.nihr.ac.uk/documents/payment-guidance-for-researchers-and-professionals/27392>

<sup>53</sup> DocuSign (2022) Electronic signature definitions in the EU <https://www.docusign.co.uk/learn/eidas-regulation-primer>



Altogether, 33 people expressed interest in participating in FGs. Based on the availability of the majority of the participants, 18 people were invited to participate in two FGs, one participant declined an invitation, and one participant did not attend. As a result, 16 people participated in two FGs.

During recruitment, potential participants were asked if they would be potentially interested in participating 1) in an intervention aimed at raising citizens awareness in order to promote and diversify citizens engagement in science, and 2) in a followed up focus group. Only those who indicated their potential interest in participating in the intervention were allocated to the Experimental Group. Those who did not indicate their potential interest in participating in the intervention were allocated to the Control group.

In line with the Deliverable D9.1H. Procedures and Criteria to Identify and Recruit Research Participants, all potential participants signed a consent form to participate in the FGs and prior to that had an opportunity to ask researchers questions regarding their potential participation.

The socio-demographic characteristics of the participants and their pseudonyms are detailed in Table 4.2 below.

Table 4.2. Socio-demographic characteristics and pseudonyms of participants, UOXF

| Focus Group number and type | Pseudonym | Age   | Race/ethnicity  |
|-----------------------------|-----------|-------|---|
| FG1 (Experimental)          | P1        | 51-60 | White (British, Irish, or any other White background)   |
| FG1 (Experimental)          | P2        | 51-60 | Mixed (White and Black Caribbean, White and Black African, White and Asian, any other Mixed background) |
| FG1 (Experimental)          | P3        | 61-70 | White (British, Irish, or any other White background)   |
| FG1 (Experimental)          | P4        | 20-30 | White (British, Irish, or any other White background)   |
| FG1 (Experimental)          | P5        | 51-60 | Black or Black British (Caribbean, African, or any other Black background)                              |
| FG1 (Experimental)          | P6        | 20-30 | White (British, Irish, or any   |



|                    |     |       |   |
|--------------------|-----|-------|---|
|                    |     |       | other White background)   |
| FG1 (Experimental) | P7  | 51-60 | Other   |
| FG1 (Experimental) | P8  | 61-70 | White (British, Irish, or any other White background)                               |
| FG1 (Experimental) | P9  | 70+   | Asian or Asian British (Indian, Pakistani, Bangladeshi, any other Asian background) |
| FG1 (Experimental) | P10 | 20-30 | Asian or Asian British (Indian, Pakistani, Bangladeshi, any other Asian background) |
| FG 2 (Control)     | P11 | 70+   | Asian or Asian British (Indian, Pakistani, Bangladeshi, any other Asian background) |
| FG 2 (Control)     | P12 | 51-60 | White (British, Irish, or any other White background)                               |
| FG 2 (Control)     | P13 | 70+   | White (British, Irish, or any other White background)                               |
| FG 2 (Control)     | P14 | 61-70 | White (British, Irish, or any other White background)                               |
| FG 2 (Control)     | P15 | 51-60 | White (British, Irish, or any other White background)                               |
| FG 2 (Control)     | P16 | 20-30 | Black or Black British (Caribbean, African, or any other Black background)          |

In line with the ALLINTERACT Focus Group protocol, FGs focussed on the following topics: a) How citizens' benefit from scientific research; b) Citizen awareness of the impact of scientific research; c) Awareness-raising initiatives succeeding at engaging citizens in scientific participation, including the Open Access movement; d) Awareness-raising actions that foster the recruitment of new talent in sciences; and finally, e) Policies that promote awareness-raising actions and citizen engagement in science.

In the beginning of each FG, the facilitator introduced the Communicative Methodology and provided everyone with opportunities to ask questions. During FGs, the facilitator encouraged everyone to contribute to the conversation and acted to ensure an egalitarian dialogue among participants.



All FGs were conducted in Microsoft Teams and recorded with consent from the participants. FG1 (10 participants) lasted 2 hours 50 minutes and FG2 (6 participants) lasted 2 hours 5 minutes including an introduction in the beginning and a 10 minute break in the middle of each FG. After the FGs, the recordings were transcribed using an automated transcription service (Sonix.ai) and then checked and corrected manually. To ensure confidentiality, names were replaced with pseudonyms. The recordings of the FGs and signed consent forms were stored securely in accordance with the University of Oxford ethics and data management procedures.

#### 4.2.2 Data analysis

Data analysis followed the dimensions and initial categories set out in the ALLINTERACT Focus Group protocol:

Table 4.3. Definitions of dimensions and categories for Focus Groups

|                   |   |
|-------------------|---|
| <b>Dimensions</b> | <b>Transformative dimension</b> includes those messages that evidence what facilitates the social/political/scientific impact mentioned.                |
|                   | <b>Exclusionary dimension</b> includes those messages that show obstacles hindering the achievement of the targeted social/political/scientific impact. |
| <b>Categories</b> | a) How citizens' <b>benefit</b> from scientific research  |
|                   | b) Citizen <b>awareness</b> of the impact of scientific research  |
|                   | c) Awareness-raising initiatives succeeding at <b>engaging</b> citizens in scientific participation, including the Open Access movement                 |
|                   | d) Awareness-raising actions that foster the <b>recruitment</b> of new talent in sciences   |
|                   | e) <b>Policies</b> that promote awareness-raising actions and citizen engagement in science.  |



### 4.2.3 Findings

Based on their personal experience, participants recollected and discussed a wide range of awareness-raising initiatives succeeding at engaging citizens in scientific participation. These included various university outreach activities, Open Days, Science Festivals, Women in Science Days, Science Museums, popular science shows, Citizen Science websites, online lectures and talks, and numerous individual projects that sought to involve citizens as public contributors. Although participants spoke of such initiatives and their experiences rather enthusiastically, there was an agreement that people who participated in them were often the same type of people, or “the usual suspects”. Participants acknowledged a challenge in getting involved those people who are excluded from science or do not show much interest in science. The most salient barrier to widening participation was perceived to be a lack of plain English summary of research. The majority of participants believed that Open Access was useful and they gave examples of accessing Open Access journals and articles. However, participants agreed that Open Access alone was not sufficient because the overwhelming majority of citizens would not understand scientific terms and jargon and would find the amount of information overwhelming.

Table 4.4. Results of the TOPIC c) Awareness-raising initiatives succeeding at engaging citizens in scientific participation, including the Open Access movement

| TOPIC c) Awareness-raising initiatives succeeding at engaging citizens in scientific participation, including the Open Access movement |   |                                   |                              |                                |                                |                              |   |                      |
|--|---|-----------------------------------|------------------------------|--------------------------------|--------------------------------|------------------------------|---|----------------------|
|  | <i>Aim of the enhancing/ participation action</i>   | <i>Promoting organization</i>     | <i>Level of intervention</i> | <i>Field of intervention</i>   | <i>Participants</i>            | <i>Type of participation</i> | <i>Level of access to scientific evidence</i> | <i>Social Impact</i> |
|  | "I've had some engagement with science festivals, there was a couple in Oxford, but even before that, there's Pint of Science. And like, I find that really fun and actually I would go when it was in a very like central location on my way back from like something else I was in town for. And it was really fun and useful to learn." P10 FG1  | University                        | National /Bottom-up          | Scientific research in general | Citizens interested in science | Participant                  | Medium  | Yes                  |
|  | "Yeah, there was one recently, women in science, women in research day even, that's a really good social media day rather than a collection of physical or virtual events where you can just go on your Twitter feed, for example, or whatever, and just see different charities shout out about some amazing accomplishments." P6 FG1  | Research performing organisations | National /Bottom-up          | Scientific research in general | Citizens interested in science | Participant                  | Medium  | Yes                  |
|  | "the Cheltenham Science Festival, which is great, but it's very expensive to attend and you are excluding probably your target audience... I think you need to demystify research and also don't get people to pay lots of money to go to these events." P8 FG1   | National Science Festival         | National /Bottom-up          | Scientific research in general | Citizens interested in science | Participant                  | Medium  | Yes                  |
|  | "I'm in a research project at the moment called a living library for mental health for the north of England, actually. And I think that's a way of using people's experience as science, if you like. And I don't think the two links very often. And I'm sure the people participating don't think of it as science, but that's what it is" P8 FG1   | Local project                     | Local/Bottom-up              | Scientific research in general | Citizens interested in science | Participant                  | Medium  | Yes                  |
|  | "I've also paired up with some researchers where we give the... it's like sort of an interview where we have the questions and then it's published online and then people can go and see it... I think the first time I did it, it was really nerve wracking. And but now I'm a lot more confident and I've had such positive feedback from other people and I think it should be done more. You know, people that are laypeople that are involved in research, having their experiences been talking about their experiences and recording that, putting that online so that other people can see and say, Oh, look, XXX's done this. YYYY's done something as well, maybe I could do that as well" P2 FG1 | Local project                     | Local//Bottom-up             | Scientific research in general | Citizens interested in science | Participant                  | Medium  | Yes                  |

|  |                          |                     |                             |                                |             |        |     |
|--|--------------------------|---------------------|-----------------------------|--------------------------------|-------------|--------|-----|
| <p>"I live in Oxfordshire and a lot of the large science facilities here hold open days on a regular basis... The one that I tend to go to and repeatedly go to is something called Fame Lab, which is where actually young researchers come and talk for three minutes on their science subject. And it is a competition. And that actually the final is hosted by Cheltenham Science Festival. But even the attendance at the final is free, which is really interesting. What I think is very interesting is 'IF Oxford', which is the Oxford Science Festival, has moved to a pay as you feel for their events so you can pay when you've been and then make a donation based on how you felt about how it went or you can not pay anything. So that makes it much more accessible for people." P1 FG1</p> | Science Festival         | Local /Bottom-up    | Scientific research general | Citizens interested in science | Participant | Medium | Yes |
| <p>"And something else I've been involved in recently is Zooniverse, where you can go to Citizen Science website, where you can go and translate stuff, or you can go and copy from old documents into records and things like that. And that's got a lot of citizen science projects on it where people can just get involved." P1 FG1</p>  | Citizen Science Alliance | National /Bottom-up | Scientific research general | Citizens interested in science | Participant | Medium | Yes |
| <p>"there were a lot of free online lectures now by researchers, so recently I went to one on Carti, which I think is a genetic treatment that's largely used for leukaemia... And then I attended another talk on how about COVID." P7 FG1</p>  | Self-organization        | Local//Bottom-up    | Scientific research general | Citizens interested in science | Participant | Low    | Yes |
| <p>"I previously worked for a local shopping centre and as part of that we worked with a gentleman who ran an event called IF Oxford. ... they had all kinds of really cool science, scientific displays. I mean, I don't know what the technical terms are, any of them are, but they looked brilliant. They were light globes that children could touch. And, you know, things like that that were really sort of visual and interesting. And it was it went off really well, and we did it following year and again had really good footfall off the back of it. I think with something like that, it needs to be somewhere really central where people are kind of walking through." P16 FG2</p>   | Science Festival         | Local /Bottom-up    | Scientific research general | Citizens interested in science | Participant | Medium | Yes |
| <p>"there's a science museum in Glasgow, and I think there's a museum of Science and industry in Manchester as well. And then in Edinburgh, they have a science festival. ...they used to have just random things like big boards and things, and it was just like a snippet or something on it." P15 FG2</p>  | Science Museum           | National /Bottom-up | Scientific research general | Citizens interested in science | Participant | Medium | Yes |
| <p>"Professor Brian Cox takes a [science] show on tour. I've actually been to one of them and I'm going to his next one. But like XXX said, that's kind of, you know, people who are already interested and that sort of thing getting involved in that." P15 FG2</p>  | Self-organization        | Local//Bottom-up    | Scientific research general | Citizens interested in science | Participant | Medium | Yes |
| <p>"when the Science Museum in Glasgow was mentioned, it reminded me that I was always taken to the Science Museum when I was a child and that fostered my interest." P12 FG2</p>  | Science Museum           | National /Bottom-up | Scientific research general | Citizens interested in science | Participant | Medium | Yes |

|   |                      |                     |                             |                                |             |        |     |
|---|----------------------|---------------------|-----------------------------|--------------------------------|-------------|--------|-----|
| “we've gotten Older People's Forum. So, as part of the Forum, we went into the Natural History Museum to help them reinvent things for older people. So then as part of this, they took us around the exhibition to tell us what everything was all about, and they asked us to go around and find things and change it a little bit.” P11 FG2  | Older People's Forum | Local//Bottom-up    | Scientific research general | Citizens interested in science | Participant | Low    | Yes |
| “It must make a world of difference where you live. I mean, I'm in Oxford and we've got two science museums... And there are lectures all over the place. Wonderful outreach from various labs and things. But if, like my brother in law, you live in the middle of the country, I don't think his children got anything like that because it's just not there. So it's the luck of the draw, really, whether anything is available to you.” P13 FG2           | University           | Local//Bottom-up    | Scientific research general | Citizens interested in science | Participant | Medium | Yes |
| “So you don't need to have big science museums and things. It is trying to find somebody locally who has got an interest in science and who has got the opportunity and any place to go to. Because sometimes ... we used to go [to our churches and places of worship] and meet him [our local scientist]. So it is trying to find somewhere that we can bring people together and talk about things.” P11 FG2   | Self-organization    | Local//Bottom-up    | Scientific research general | Citizens interested in science | Participant | Low    | Yes |
| “If I've come up against that paywall many, many times and I find it really, really frustrating. So in principle, I think the idea of having open access journals is really good. However, like you say, they can be full of jargon” P15 FG2  | Self-organization    | Local//Bottom-up    | Scientific research general | Citizens interested in science | Participant | Medium | Yes |
| “So you think I'll go, I'll go and read this article. Oh, no, you get the first few lines and it's that you need to be a member to to read further. So I do personally find that really frustrating. I think open access is a good thing. Yeah.” P15 FG2  | Self-organization    | Local//Bottom-up    | Scientific research general | Citizens interested in science | Participant | Medium | Yes |
| “I read quite a lot of open access articles on issues that interest me... And also because I have an autistic child, I get from Autism Oxford. I guess a daily feed of synopses, abstracts of journals. The guy who does it, I don't know where he gets them, but they're obviously open access and they at least give you a little abstract.” P13 FG2  | Patient association  | National /Bottom-up | Scientific research general | Citizens interested in science | Participant | Medium | Yes |
| “Somebody mentioned earlier about the kind of summary to these journals. I am quite often being quite difficult to read. And I think that's where public involvement plays a really good part because often you're asked as part of the group, they ask for a couple of volunteers to read over what they've written and make sure it reads well in plain English so that it is more accessible. In fact, I am involved in a project like that myself.” P15 FG2 | Local project        | Local//Bottom-up    | Scientific research general | Citizens interested in science | Participant | Medium | Yes |
| “there are some very good open access journals. I use something called PLOS One... I usually find them accessible.” P13 FG2   | Self-organization    | Local//Bottom-up    | Scientific research         | Citizens interested in         | Participant | Low    | Yes |

|     |   |  |  |         |         |  |  |  |
|-----|---|--|--|---------|---------|--|--|--|
|     |   |  |  | general | science |  |  |  |
| ED* | <p>"I'm just surprised that when you go through your school career and you find out about all the amazing things that British research does and what science does in the UK and all over the world, they never actually teach you how you can get involved. Or just you don't need to have specific groups of scientists come to teach you this at schools, but I do think that I'm surprised it never came up in GCSE. It barely came up in A-levels. Why don't they just mention, you know, this is how people can get involved in these things, even if, let's say, the children are too young to actually do it? But just a general overview of how you can actually get involved in these things later on and why it's important. I do think they should be telling us this." P6 FG1</p> <p>"I've got some very recent first hand experience of this [Open Access] with my father. So I've been reading some papers on some research that I'm interested in. And I was chatting to him just generally, and he went home and opened the paper and then rang me later and said: 'It's all very interesting, but it's way over my head'. So open access, I think, is OK... if you can cut through or the sort of terminology and things like that. But for your layperson, less useful, I would have said." P1 FG1</p> <p>"I would have said one of the bigger problems, I think from citizens becoming aware of the impact, there's just so much and it could become overwhelming... So how do you distil that for citizens to get a grip of?" P1 FG1</p> <p>"I think open access is only really useful if it's to a plain English summary or something as a lead-in, because open access to something very scientific won't suit ninety five percent of the population." P3 FG1</p> <p>"I think open access is great, but I think it has a certain audience and the audience is basically like people who have the ability and some kind of training in social science or science to be able to read it." P10 FG1</p> <p>"the science day coming up at the UCL about various things, but of course, that's more preaching to the converted, and it's going to be people who you know already. And through other PPI work, I do they have various conferences and things to bring people together about research. But again, it's not so much going to be the general public." P12 FG2</p> <p>"I don't think citizens in the community are aware of what's going on. I keep using that phrase, the usual suspects, we are the usual ones, we know what's going and sometimes it's word of mouth. Sometimes I put what I do on my Instagram page on Twitter. I just had a tweet from Cochran looking into something, and I shared, but not everybody in my community is on PPI [patient and public involvement panels]. Nobody would,</p> |  |  |         |         |  |  |  |

for Christ's sake, go and read an academic report.” P5 FG1

“Open Access is excellent, but ... there are very, very few articles, mind you, I haven't seen any, that have been translated into different languages. So how do people whose language is not English, whose first language is not English, can get access to them? ... Also, people who have got other inclusion [needs]. So, people with learning disabilities, for example, people who are blind, how do they access all these things, are they accessible?” P11 FG2

“[In addition to Open Access] there needs to be other ways of communicating some of that information and also making it more plain English. Because everything I've seen has been very academic, and that's great for people who are of a certain level of education. But you know, if you might still be somebody who would benefit from doing more with science but just don't have that level of comprehension, and there isn't anything that I can think of that's readily available in a plain English sort of format.” P16 FG2

\*TD = Transformative Dimension; ED= Exclusion Dimension

ALLINTERACT



## 4.3 Education

### 4.3.1 Methodology

The focus groups conducted by the University of Helsinki followed the guidelines established in the Focus Group protocol of the projects, as well as the individual and collective protection measures based in the country due to the COVID-19 pandemic.

Two focus groups were held with educators/teachers. All the people participated voluntarily throughout the process, and recommendations provided by Deliverable D9.1H (Procedures and Criteria to Identify and Recruit Research Participant) were adopted.

All conversations between the researchers and potential participants about the possibility of participating in the research occurred in a place where the participants felt comfortable and safe to avoid any possible coercion and to ensure that the decision was taken with absolute freedom.

Researchers informed that participants did not receive any type of reward, and the participation did not suppose a cost for the participants. Researchers also explained the possible risks and benefits of participating. The recruitment process was never conducted by someone who may have an undue influence on potential participants. The language employed was English and all comments were fully anonymised and given in confidence.

Control and experimental groups were conducted and covered five sections (which correspond to project objectives): 1) Identification of how societal actors benefit from the social impact of scientific research in gender and education (O1); 2) Exploration of the initiatives to foster societal actors' awareness of the connection between the solutions they appreciate and the scientific research leading to them (O2); 3) Identification of the awareness-raising actions the participants think that are effective to engage them in science (O3); 4) Identification, by the participants, of the actions they know that are successful in the recruitment of new talent for science, including participation in the co-creation of knowledge (O4); 5) Identification of policies that promote awareness-raising actions and citizen engagement in science; and 6) Changes/opportunities for replicability of the actions already identified (only in post-test experimental groups). A lot of introduced evidence is presented in Annex 1.

The focus groups were audio-recorded and transcribed and stored by the University of Helsinki as approved by the university and project ethical boards.

#### *c) Awareness-raising initiatives succeeding at engaging citizens in scientific participation, including the Open Access movement*

- Many medical centers have developed educational outreach programs for students with the hopes of attracting a diverse cohort of talented young individuals to careers in STEM. Stanford University developed an effective 5-week residential program (including classroom instruction, anatomy practicum, hospital field placements, and research projects) for low-income high school students in an attempt to meet this

|   |
|---|
| goal. Cardiac anesthesia is uniquely positioned as a subspecialty to advance the goal of promoting interest in STEM in diverse groups of young students. (Woodward et al., 2018)  |
| - Informal science learning centers (ISLCs; zoos, aquariums, national parks, museums, science centers, and nature centers) in the United States can catalyze public engagement with climate change through greater incorporation of the topic into their curriculum. Importance of using educational interventions to promote increased public engagement with climate change needs to be highlighted. This contrasts with popular suggestions to avoid directly discussing climate change in environmental communication and illustrate that the prevailing social narrative that climate change is a politically unpalatable topic for public discourse is unfounded (Geiger et al., 2017). |
| - Practical activity in the classroom should provide a simplified version of science, making it easier to understand, and be seen as a communication rather than a discovery exercise. Some of these experiences are founding principles on which scientific public engagement activities are built, encouraging social involvement whilst enabling learning more overtly than the more formal classroom setting. However, public engagement allows science to be presented in different ways to the conventional school science laboratory (Refern et al., 2013).  |
| - A learning engagement-promoting model is proposed for developing interactive e-book systems for patient education. An experiment was conducted to explore the effects of the system on the learning outcomes and perceptions of inpatients' family members. Learning with authentic contexts can help learners realize the meanings and values of the learning content, and hence improve their learning engagement and outcomes (Huang & Hwang, 2019)  |
| - Wikipedia is not only the biggest open access encyclopaedia but also an initiative that fosters citizens' participation in science, since any citizen can participate of the creation of new knowledge in Wikipedia. During March 2021, there were several initiatives, called Edit-athons that citizens could join to collaborate in the redaction of translate of Wikipedia contet, for example biographies of women scientists.  |

### 4.3.2 Data analysis

In general terms the data from the University of Helsinki was framed by initial categories set out in the ALLINTERACT Focus Group protocol:

Table 4.5. Definitions of dimensions and categories for Focus Groups

|                   |   |
|-------------------|---|
| <b>Dimensions</b> | <b>Transformative dimension</b> includes those messages that evidence what facilitates the social/political/scientific impact mentioned.                |
|                   | <b>Exclusionary dimension</b> includes those messages that show obstacles hindering the achievement of the targeted social/political/scientific impact. |
| <b>Categories</b> | a) How citizens' <b>benefit</b> from scientific research  |

|  |   |
|--|---|
|  | b) Citizen <b>awareness</b> of the impact of scientific research  |
|  | c) Awareness-raising initiatives succeeding at <b>engaging</b> citizens in scientific participation, including the Open Access movement |
|  | d) Awareness-raising actions that foster the <b>recruitment</b> of new talent in sciences   |
|  | e) <b>Policies</b> that promote awareness-raising actions and citizen engagement in science.  |

However, in practice the discussions did not lend themselves to such an easy categorisation and it was decided to group the findings and analysis around the control and experimental groups.

### 4.3.3 Findings

#### Findings control

| TOPIC c) Awareness-raising initiatives succeeding at engaging citizens in scientific participation, including the Open Access movement |  |                               |                              |                                |                                |                              |   |                      |
|--|--|-------------------------------|------------------------------|--------------------------------|--------------------------------|------------------------------|---|----------------------|
|  | <i>Aim of the enhancing/ participation action</i>  | <i>Promoting organization</i> | <i>Level of intervention</i> | <i>Field of intervention</i>   | <i>Participants</i>            | <i>Type of participation</i> | <i>Level of access to scientific evidence</i> | <i>Social Impact</i> |
|  | We need more action research. Get people involved in more research. This will encourage them to do research.                         | University/school             | National /Bottom-up          | Scientific research in general | Teachers interested in science | Participant                  | High  | Yes                  |
|  | Difficult to include all science in the curriculum. The example of climate change is too broad.                                      | University/school             | National /Bottom-up          | Scientific research in general | Teachers interested in science | Participant                  | High  | Yes                  |
|  | Think about a restaurant. You do not need to understand all the science and processes of a restaurant or food to enjoy what you eat. | University/school             | National /Bottom-up          | Scientific research in general | Teachers interested in science | Participant                  | High  | Yes                  |
|  | However, some people are interested in this too so need to identify and encourage.   | University/school             | National /Bottom-up          | Scientific research in general | Teachers interested in science | Participant                  | High  | Yes                  |
|  | Focus less on research results sometimes and more on the methodology.  | University/school             | National /Bottom-up          | Scientific research in general | Teachers interested in science | Participant                  | High  | Yes                  |

## Findings experimental

## TOPIC c) Awareness-raising initiatives succeeding at engaging citizens in scientific participation, including the Open Access movement

|  | <i>Aim of the enhancing/ participation action</i>   | <i>Promoting organization</i> | <i>Level of intervention</i> | <i>Field of intervention</i>   | <i>Participants</i>            | <i>Type of participation</i> | <i>Level of access to scientific evidence</i> | <i>Social Impact</i> |
|--|---|-------------------------------|------------------------------|--------------------------------|--------------------------------|------------------------------|---|----------------------|
|  | People expect science to find solution. So part of the debate must be about what are the solutions being sort and what problems are we dealing with.            | University/school             | National /Bottom-up          | Scientific research in general | Teachers interested in science | Participant                  | High  | Yes                  |
|  | Climate change is a good example many people are interested but there is a lot of information out there that can be counter-productive. We need to be cautious. | University/school             | National /Bottom-up          | Scientific research in general | Teachers interested in science | Participant                  | High  | Yes                  |
|  | Project-bases learning is the way to go. We need to adopt different ways in working with the public.  | University/school             | National /Bottom-up          | Scientific research in general | Teachers interested in science | Participant                  | High  | Yes                  |
|  | The most important thing is getting the public involved in different activities   | University/school             | National /Bottom-up          | Scientific research in general | Teachers interested in science | Participant                  | High  | Yes                  |
|  | More innovative approaches happen in schools that in universities. These might include taking them to see how a business functions or works in practice.        | University/school             | National /Bottom-up          | Scientific research in general | Teachers interested in science | Participant                  | High  | Yes                  |
|  | Important to bring the reality to the classroom.  | University/school             | National /Bottom-up          | Scientific research in general | Teachers interested in science | Participant                  | High  | Yes                  |

#### 4.4 Summary and conclusions

From the gender data the following conclusions can be drawn:

- Respondents reported a variety of ways through which citizens benefit from scientific research, such as improved medical treatments, improved health information, access to scientific information for educational purposes. Respondents also used scientific information as part of their advocacy efforts on behalf their ethnic community and patient group. The development of Covid-19 vaccines and the improved understanding of gender and ethnic differences in Covid-19 were the most significant example of scientific impact.
- Respondents also provided examples of the barriers that prevent citizens from benefiting from scientific research. These included a language barrier for people whose first language is not English, the level of education, ethnicity for people who belong to ethnic minorities, gender as women were historically excluded or underrepresented in science as participants or researchers, and a lack of funding to take scientific evidence into practice in state schools.
- Many participants described becoming aware of the impact of scientific research via social media. Participants of younger ages appeared to rely on social media more often than participants of older ages. Importantly, the Covid-19 pandemic has led to the use of Zoom and Teams by community activists for connecting communities with scientists internationally.
- Respondents discussed the need to acknowledge that that different generations get their information in different ways and agreed about the importance of social media and other digital information. Respondents acknowledged that for many citizens there could be a barrier to accessing scientific research digitally. Language appeared to be another important barrier. This included both people whose first language wasn't English and people who did not understand scientific language. One respondent suggested that getting rid of the terms "science" could help engage citizens in science. One responded acknowledge a lack of interest in scientific research among the younger generation.
- Based on their personal experience, respondents recollected and discussed a wide range of awareness-raising initiatives succeeding at engaging citizens in scientific participation. These included various university outreach activities, Open Days, Science Festivals, Women in Science Days, Science Museums, popular science shows, Citizen Science websites, online lectures and talks, and numerous individual projects that sought to involve citizens as public contributors.
- Although participants spoke of such initiatives and their experiences rather enthusiastically, there was an agreement that people who participated in them were often the same type of people, or "the usual suspects". Participants acknowledged a

challenge in getting involved those people who are excluded from science or do not show much interest in science. The most salient barrier to widening participation was perceived to be a lack of plain English summary of research.

- The majority of participants believed that Open Access was useful and they gave examples of accessing Open Access journals and articles. However, participants agreed that Open Access alone was not sufficient because the overwhelming majority of citizens would not understand scientific terms and jargon and would find the amount of information overwhelming.
- Although participants acknowledged the importance of awareness-raising actions that foster the recruitment of new talent in the sciences, they were able to provide only a limited number of examples. In particular, these included actions by local authorities, universities, and professional associations. One participant also mentioned the adverse effects of such actions, namely pressure on women to participate in such actions.
- Participants recollected only a few policies that promote awareness-raising actions and citizen engagement in science. These concerned government policies to diversify data science and promote citizen involvement in research in the National Health Service.

From the education the following aspects can be highlighted:

- Simple definitions, supported by examples, of what science can mean helps in communication.
- Outreach can help generate interest in what scientists do and important to take people outside of the classroom.
- Resist the temptation of simply using social media as a tool for communication.
- Interventions may reinforce existing positions rather than change them
- Using KPIs can help strengthen the importance of science and technology in the political sphere.
- Positive action is needed supported by regulation and enforcement.
- Make clear how politics influences decisions on how we fund and use the outcomes of scientific endeavours
- Institutions, such as universities, still tend to pay lip service to the public
- Breaking down scientific disciplines is important and recognise they are viewed differently
- Look at ways at defining value for the public.
- The benefits of doing 'with' rather than doing 'on' needs to be highlighted for the public.
- The competitive nature of science if forcing scientists to work in silos.

## 5. SURVEY

### 5.1 Overview

The data from the survey provide us with valuable information to meet the objective of this report on the use of statistical data. Specifically, O3 “identify the actions through which this awareness is encouraging an active engagement of societal actors in direct participation in science”.

The exploitation of the data was divided into three sections. A first section addressed the sociodemographic questions; a section block focused on actions to foster citizens’ participation in science and a third section about citizens’ awareness of scientific evidence on gender and education.



## 5.2 Section 1 - Sociodemographic questions

The total sample is 7507 cases, whose distribution by gender, as shown in the table below, shows 51.1% of women and 48.9% of men.

### Gender

Table 5.1. Distribution by gender.

|           | Frequency | %     | Valid % | Cumulative % |
|-----------|-----------|-------|---------|--------------|
| Wome<br>n | 3839      | 51,1  | 51,1    | 51,1         |
| Men       | 3668      | 48,9  | 48,9    | 100,0        |
| Total     | 7507      | 100,0 | 100,0   |              |

The highest proportion of cases is found in the 35 to 49 age group, with 31.8%, followed by the 50 to 60 age group with 25.5%. We will pay special attention to young citizens as a group of particular interest, as reflected in objective one. Young people between 16 and 34 account for 24.6%, with the youngest (16 to 24 years) accounting for 7.8%.

### Age

Table 5.2. Distribution by age.

|       | Frequency | %     | Valid % | Cumulative % |
|-------|-----------|-------|---------|--------------|
| 16-24 | 582       | 7,8   | 7,8     | 7,8          |
| 25-34 | 1261      | 16,8  | 16,8    | 24,6         |
| 35-49 | 2385      | 31,8  | 31,8    | 56,3         |
| 50-64 | 1917      | 25,5  | 25,5    | 81,9         |
| +65   | 1362      | 18,1  | 18,1    | 100,0        |
| Total | 7507      | 100,0 | 100,0   |              |

The distribution of the sample by country shows how Germany, Spain and France are the most represented with 13,3% the first two countries and with 13,5% the third one. That means the 40,1% of the total sample.

### Country

Table 5.3. Distribution by country.

|             | Frequency | %    | Valid % | Cumulative % |
|-------------|-----------|------|---------|--------------|
| Germany     | 1000      | 13,3 | 13,3    | 13,3         |
| Cyprus      | 200       | 2,7  | 2,7     | 16,0         |
| Croatia     | 205       | 2,7  | 2,7     | 18,7         |
| Slovakia    | 694       | 9,2  | 9,2     | 28,0         |
| Spain       | 999       | 13,3 | 13,3    | 41,3         |
| Finland     | 703       | 9,4  | 9,4     | 50,6         |
| France      | 1011      | 13,5 | 13,5    | 64,1         |
| Ireland     | 208       | 2,8  | 2,8     | 66,9         |
| Italy       | 203       | 2,7  | 2,7     | 69,6         |
| Luxemburg   | 200       | 2,7  | 2,7     | 72,2         |
| Netherlands | 686       | 9,1  | 9,1     | 81,4         |

|          |      |       |       |       |
|----------|------|-------|-------|-------|
| Portugal | 705  | 9,4   | 9,4   | 90,8  |
| Romania  | 693  | 9,2   | 9,2   | 100,0 |
| Total    | 7507 | 100,0 | 100,0 |       |

The level of education indicates a low percentage of the population with slighter than lower secondary education, 18.6%. This same percentage in the case of the mother's level of studies increases to 51.7%. In turn, the percentage of the population with a master's degree or doctorate is 16.8%. The mother's level of studies is much lower in this case, at 6.1%. The highest percentage is found among those with upper secondary education, at 25.2%.

### Indicate the highest course or educational level you have completed

Table 5.4. Distribution by level of education.

|   | Frequency | %     | Valid % | Cumulated % |
|---|-----------|-------|---------|-------------|
| Educational development during early childhood or preschool education | 100       | 1,3   | 1,3     | 1,3         |
| Basic education   | 303       | 4,0   | 4,0     | 5,4         |
| Lower secondary education   | 1000      | 13,3  | 13,3    | 18,7        |
| Upper secondary education   | 1895      | 25,2  | 25,2    | 43,9        |
| Post-secondary non-tertiary education                                 | 406       | 5,4   | 5,4     | 49,3        |
| Short cycle tertiary education  | 446       | 5,9   | 5,9     | 55,3        |
| Bachelor's degree or equivalent                                       | 1709      | 22,8  | 22,8    | 78,0        |
| Master or equivalent  | 1080      | 14,4  | 14,4    | 92,4        |
| Doctorate or equivalent   | 183       | 2,4   | 2,4     | 94,9        |
| I do not know   | 221       | 2,9   | 2,9     | 97,8        |
| Prefer not to answer  | 164       | 2,2   | 2,2     | 100,0       |
| Total   | 7507      | 100,0 | 100,0   |             |

### What level of education does (or did) your mother have?

Table 5.5. Distribution by mother's level of education.

|   | Frequency | %     | Valid % | Cumulative % |
|---|-----------|-------|---------|--------------|
| Educational development during early childhood or preschool education | 230       | 3,1   | 3,1     | 3,1          |
| Basic education   | 2134      | 28,4  | 28,4    | 31,5         |
| Lower secondary education   | 1518      | 20,2  | 20,2    | 51,7         |
| Upper secondary education   | 1346      | 17,9  | 17,9    | 69,6         |
| Post-secondary non-tertiary education                                 | 321       | 4,3   | 4,3     | 73,9         |
| Short cycle tertiary education  | 325       | 4,3   | 4,3     | 78,2         |
| Bachelor's degree or equivalent                                       | 611       | 8,1   | 8,1     | 86,4         |
| Master or equivalent  | 357       | 4,8   | 4,8     | 91,1         |
| Doctorate or equivalent   | 94        | 1,3   | 1,3     | 92,4         |
| I do not know   | 407       | 5,4   | 5,4     | 97,8         |
| Prefer not to answer  | 164       | 2,2   | 2,2     | 100,0        |
| Total   | 7507      | 100,0 | 100,0   |              |

The percentages for belonging to an ethnic minority group and a religious group are low, at

7% and 8.6%, respectively. Of those surveyed, 14.8% stated that at least one of their parents was born in another country. However, slightly more surprising is the percentage of people who claim to have disabilities or medical condition that limits their daily activities, reaching the 17,1%.

### **Do you consider yourself to belong to an ethnic minority group?**

**Table 5.6. Distribution by ethnic minority group.**

|                      | Frequency | %     | Valid % | Cumulative % |
|----------------------|-----------|-------|---------|--------------|
| Yes                  | 523       | 7,0   | 7,0     | 7,0          |
| No                   | 6439      | 85,8  | 85,8    | 92,7         |
| I do not know        | 443       | 5,9   | 5,9     | 98,6         |
| Prefer not to answer | 102       | 1,4   | 1,4     | 100,0        |
| Total                | 7507      | 100,0 | 100,0   |              |

### **Do you consider yourself to belong to a religious minority group?**

**Table 5.7. Distribution by religious minority group.**

|                      | Frequency | %     | Valid % | Cumulative % |
|----------------------|-----------|-------|---------|--------------|
| Yes                  | 645       | 8,6   | 8,6     | 8,6          |
| No                   | 6442      | 85,8  | 85,8    | 94,4         |
| I do not know        | 328       | 4,4   | 4,4     | 98,8         |
| Prefer not to answer | 92        | 1,2   | 1,2     | 100,0        |
| Total                | 7507      | 100,0 | 100,0   |              |

### **Do you have a disability or medical condition that limits your daily activities?**

**Table 5.8. Distribution by people with disabilities.**

|                      | Frequency | %     | Valid % | Cumulative % |
|----------------------|-----------|-------|---------|--------------|
| Yes                  | 1284      | 17,1  | 17,1    | 17,1         |
| No                   | 5924      | 78,9  | 78,9    | 96,0         |
| I do not know        | 194       | 2,6   | 2,6     | 98,6         |
| Prefer not to answer | 105       | 1,4   | 1,4     | 100,0        |
| Total                | 7507      | 100,0 | 100,0   |              |

### **Was one of his parents born in a foreign country**

**Table 5.9. Distribution by people whose parents were born in a foreign country.**

|                      | Frequency | %     | Valid % | Cumulative % |
|----------------------|-----------|-------|---------|--------------|
| Yes one of them      | 605       | 8,1   | 8,1     | 8,1          |
| Yes, both            | 502       | 6,7   | 6,7     | 14,7         |
| No, none of them     | 6213      | 82,8  | 82,8    | 97,5         |
| I do not know        | 135       | 1,8   | 1,8     | 99,3         |
| Prefer not to answer | 52        | ,7    | ,7      | 100,0        |
| Total                | 7507      | 100,0 | 100,0   |              |

In terms of employment, it is noteworthy that practically 20% of the people surveyed are

retired. The level of unemployment stands at 5.8%. Also noteworthy is the 45.7% percentage of full-time employment among the participants.

### **What is your current employment status?**

**Table 5.10. Distribution by employment status.**

|                        | Frequency | %     | Valid % | Cumulative % |
|------------------------|-----------|-------|---------|--------------|
| Full time employee     | 3427      | 45,7  | 45,7    | 45,7         |
| Part-time employee     | 637       | 8,5   | 8,5     | 54,1         |
| Unemployed             | 438       | 5,8   | 5,8     | 60,0         |
| Voluntarily unemployed | 80        | 1,1   | 1,1     | 61,0         |
| Student                | 302       | 4,0   | 4,0     | 65,1         |
| Student with job       | 102       | 1,4   | 1,4     | 66,4         |
| Retired, disabled      | 1478      | 19,7  | 19,7    | 86,1         |
| Housewife              | 384       | 5,1   | 5,1     | 91,2         |
| I do not know          | 86        | 1,1   | 1,1     | 92,4         |
| Prefer not to answer   | 573       | 7,6   | 7,6     | 100,0        |
| Total                  | 7507      | 100,0 | 100,0   |              |

Regarding employment, both in the present and the past. 21.6% of those surveyed have worked or are working in the education sector related to professions related to the education sector. Therefore, practically one out of every four persons surveyed works in education. This percentage decreases to 8.8% when referring to professions or job positions related to gender issues.

### **Practices (works) or has practiced (has worked in) any profession in the education sector**

**Table 5.11. Distribution by professional practices in the educational sector.**

|                      | Frequency | %     | Valid % | Cumulative % |
|----------------------|-----------|-------|---------|--------------|
| Yes (in the past)    | 1041      | 13,9  | 13,9    | 13,9         |
| Yes (at the present) | 577       | 7,7   | 7,7     | 21,6         |
| No                   | 5666      | 75,5  | 75,5    | 97,0         |
| I do not know        | 145       | 1,9   | 1,9     | 99,0         |
| Prefer not to answer | 78        | 1,0   | 1,0     | 100,0        |
| Total                | 7507      | 100,0 | 100,0   |              |

### **Practices (works) or has practiced (has worked in) any profession or position in gender matters**

**Table 5.12. Distribution by professional practices in gender matters.**

|                      | Frequency | %    | Valid % | Cumulative % |
|----------------------|-----------|------|---------|--------------|
| Yes (in the past)    | 376       | 5,0  | 5,0     | 5,0          |
| Yes (at the present) | 282       | 3,8  | 3,8     | 8,8          |
| No                   | 6618      | 88,2 | 88,2    | 96,9         |
| I do not know        | 160       | 2,1  | 2,1     | 99,1         |
| Prefer not to answer | 71        | ,9   | ,9      | 100,0        |

|       |      |       |       |
|-------|------|-------|-------|
| Total | 7507 | 100,0 | 100,0 |
|-------|------|-------|-------|

30.2% of the people surveyed have a gross annual income of less than €1,043. Approximately one-third of the people surveyed have a net monthly income of at most one thousand euros.

### Gross annual household income in euros

Table 5.13. Distribution by gross annual household income.

|                            | Frequency | %     | Valid % | Cumulative % |
|----------------------------|-----------|-------|---------|--------------|
| Less than 10562€           | 1202      | 16,0  | 16,0    | 16,0         |
| Between 10562€ and 16043€  | 1069      | 14,2  | 14,2    | 30,3         |
| Between 16043€ and 23.295€ | 1180      | 15,7  | 15,7    | 46,0         |
| More than 23.295€          | 2654      | 35,4  | 35,4    | 81,3         |
| I do not know              | 363       | 4,8   | 4,8     | 86,2         |
| Prefer not to answer       | 1039      | 13,8  | 13,8    | 100,0        |
| Total                      | 7507      | 100,0 | 100,0   |              |

## 5.3 Section 2 - Actions to foster citizens participation in science

This section aims to identify those actions that succeed in recruiting new talent in science, especially among vulnerable groups. To do so, we have structured the report in two sections 1) knowledge of actions for the recruitment in science (2 questions) and 2) participation in actions for the recruitment in science.

### 5.3.1 Knowledge of actions to foster citizens participation in science

This section aims to analyse citizens' knowledge about initiatives designed to foster citizen participation in science. This way, the questionnaire includes the following questions:

- Have you heard about any initiative fostering citizen participation in science?
  - If yes, then could you please specify which one(s)?
- Could you tell me about any initiatives that you know to foster citizen participation in science related to gender?

The first question includes “yes”, “no” or “I do not know” as response options, while in the second question a list of initiatives is shared, and respondents are asked to answer as many as they know.

### Question 1

The results to the question “Have you heard of any initiative that encourages citizen participation in science?” are distributed as follows:

Table 5.14. Distribution of respondents' answers to the following sentence “Have you heard of any initiative that encourages citizen participation in science?”

| Have you heard of any initiative that encourages citizen participation in science |           |            |                        |
|---|-----------|------------|------------------------|
|   | Frequency | Percentage | Accumulated percentage |
| Yes   | 1570      | 20,9       | 20,9                   |

|                      |      |       |       |
|----------------------|------|-------|-------|
| No                   | 4868 | 64,8  | 85,8  |
| I do not know        | 1013 | 13,5  | 99,3  |
| Prefer not to answer | 56   | 0,7   | 100,0 |
| Total                | 7507 | 100,0 | 100,0 |

As observed, the proportion of citizens who heard about any initiative to foster citizen participation in science is 20.9%, whereas 64.8% of participants state that they have not heard of any initiative.

### Responses by vulnerable groups

If we look closer at this data across vulnerable groups, we find that, in general, the proportion of people from vulnerable groups who have heard about initiatives to encourage citizen participation in science is higher than the proportion of the total of respondents. The only exception in this line is found in the LGBTI+ community. However, the small size of the sample of LGBTI+ individuals (n = 12), limits the extrapolation of this finding.

Table 5.15. Distribution of respondents' answers to the following sentence "Have you heard of any initiative that encourages citizen participation in science?" across vulnerable groups

| Have you heard of any initiative that encourages citizen participation in science? |        |        |        |                       |                   |                      |        |
|--|--------|--------|--------|-----------------------|-------------------|----------------------|--------|
|  | Woman  | LGBTI+ | Youth  | Low SES <sup>54</sup> | Ethnic minorities | Religious minorities | TOTAL  |
| Yes  | 19,24  | 13,73  | 30,11  | 24,04                 | 41,11             | 40,31                | 20,91  |
| No   | 65,58  | 66,67  | 57,03  | 62,48                 | 48,37             | 48,06                | 64,85  |
| I do not know  | 14,52  | 17,65  | 11,61  | 12,99                 | 9,37              | 11,01                | 13,49  |
| prefer not to answer   | 0,66   | 1,96   | 1,25   | 0,48                  | 1,15              | 0,62                 | 0,75   |
| TOTAL  | 100,00 | 100,00 | 100,00 | 100,00                | 100,00            | 100,00               | 100,00 |

It is remarkable to point that more than 4 out of ten of participants from ethnic and religious minorities (41.11% in the case of ethnic and 40.31% in religious minorities) express that they have heard of initiatives that encourage citizen participation in science, followed by 30.11% of youth and 24.04% of people from low socioeconomic status. In addition, the results show no important differences in women, pointing that the variable "sex" has no effect on the identification of initiatives for the promotion of citizen science. The following figure represents these results.

<sup>54</sup> Low SES is defined as having gross income below 16,043 Euros per year.

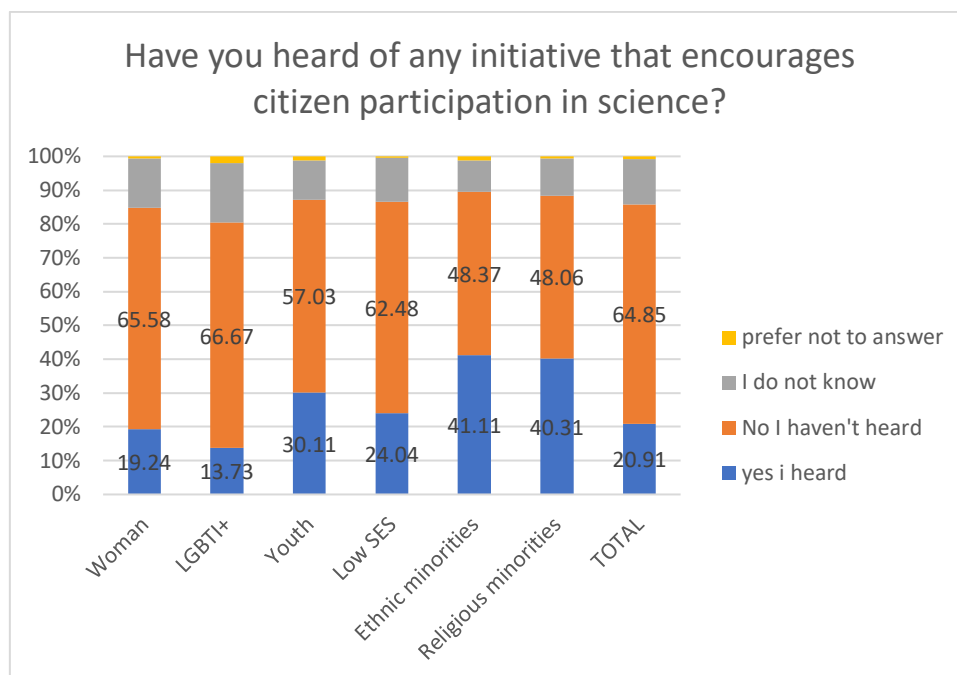


Figure 5.1. Distribution of respondents' answers to the following sentence "Have you heard of any initiative that encourages citizen participation in science?" across vulnerable groups

Therefore, the proportion of people from vulnerable groups who have heard about initiatives to encourage citizen participation in science is higher than the proportion of the total of respondents. This difference is more accentuated in the case of ethnic and religious minorities, with more than 40% in each case (compared with the 20.91% of the total).

### The impact of interactions

This section analyses the impact of two interactions with science in the responses of people from vulnerable groups. The interactions are:

- Has something happened to you or someone in your family that made you change your mind about science or become interested in science?
- Do the scientific people you follow share anecdotes or evidence about science?

In the analysis of the impact of these interactions, we have included the responses of those respondents who had interacted with science; thus, the responses in this section are those from participants who answered "yes" to interaction 1 and "yes, often" and "yes, rarely" in interaction 2.

We can observe that the proportion of participants who have heard of initiatives to encourage citizen participation in science increases as a result of citizens' interactions with science. This result is found across all vulnerable groups and interactions, as well as in the total of participants.

To go through the findings a bit more systematically, the first interaction (changing their mind about science because something happened to them or their families) generally increases the proportion of people from all vulnerable groups, compared with the total of respondents within the vulnerable group. This way, the proportion of people from ethnic and religious minority groups who had interacted with science and have heard of initiatives are 55.47% and 53.36% respectively, compared with the 41.11% and 40.31% of the total. The same happens with youth aged 16-34 and, in this case the proportion increases from 30.11% to 40.46%. It is especially remarkable the increase observed in people from low socioeconomic status, which in this case is of more than 50%, passing from 24.04% to 36.71%. This finding suggests that the impact of interaction 1 in this question affects people from low socioeconomic status to a greater extent. The results from the LGBTI+ community are limited by the small size of the sample (n= 12).

Regarding interaction 2, we can see that the impact of this interaction across vulnerable groups depend on the frequency of publication of scientific content in social networks. Therefore, the more often the scientific content is published, the more people are aware of initiatives that encourage citizen participation in science. In this case, the increases in youth and ethnic minorities are moderate (41.96% and 58.33% respectively), while in women and religious minorities are up to 50% (35.87% and 62.03% in each case). As happened in interaction 1, the more impact is achieved in people from low socioeconomic status, doubling the percentage of the total of people from low SES (49.72% vs 24.04%). Also in this case, the reduced number of responses from LGBTI+ people limits the analysis.

Table 5.16. Distribution of respondents who answered YES to the interaction questions and answers to the question “Have you heard of any initiative that encourages citizen participation in science?”, by vulnerable groups

| Have you heard of any initiative that encourages citizen participation in science? |                      |        |        |        |         |                   |                      |        |
|--|----------------------|--------|--------|--------|---------|-------------------|----------------------|--------|
| INTERACTION 1  |                      | Woman  | LGBTI+ | Youth  | Low SES | Ethnic minorities | Religious minorities | TOTAL  |
|  | Yes                  | 28,31  | 25,00  | 40,46  | 36,71   | 55,47             | 53,36                | 32,41  |
|  | No                   | 60,84  | 41,67  | 51,58  | 54,98   | 37,50             | 39,58                | 58,16  |
|  | I do not know        | 10,65  | 25,00  | 7,46   | 8,01    | 6,25              | 6,71                 | 9,12   |
|  | Prefer not to answer | 0,19   | 8,33   | 0,50   | 0,30    | 0,78              | 0,35                 | 0,32   |
|  | TOTAL                | 100,00 | 100,00 | 100,00 | 100,00  | 100,00            | 100,00               | 100,00 |
| INTERACTION 2:<br>Often  | Yes                  | 35,87  | 28,57  | 41,96  | 49,72   | 58,33             | 62,03                | 39,22  |
|  | No                   | 53,47  | 57,14  | 49,18  | 42,33   | 32,64             | 32,91                | 50,70  |
|  | I do not know        | 10,32  | 14,29  | 8,62   | 7,67    | 8,33              | 4,43                 | 9,91   |
|  | Prefer not to answer | 0,34   | 0,00   | 0,23   | 0,28    | 0,69              | 0,63                 | 0,17   |
|  | TOTAL                | 100,00 | 100,00 | 100,00 | 100,00  | 100,00            | 100,00               | 100,00 |
| INTERACTION 2:<br>Rarely   | Yes                  | 29,27  | 28,57  | 38,68  | 35,94   | 51,55             | 46,32                | 33,24  |
|  | No                   | 59,53  | 71,43  | 52,52  | 55,63   | 39,18             | 43,38                | 57,14  |
|  | I do not know        | 11,00  | 0,00   | 8,18   | 8,13    | 8,25              | 10,29                | 9,33   |
|  | Prefer not to answer | 0,20   | 0,00   | 0,63   | 0,31    | 1,03              | 0,00                 | 0,29   |



| answer |                          |        |               |   |        |        |        |        |
|--------|--------------------------|--------|---------------|---|--------|--------|--------|--------|
| TOTAL  |                          | 100,00 | 100,00        | 100,00  | 100,00 | 100,00 | 100,00 | 100,00 |
|        | Increases                |        | Interaction 1 | Changing their mind about science because something happened                    |        |        |        |        |
|        | Increases more than 50%  |        | Interaction 2 | Following on social media someone who publishes about science... [often/rarely] |        |        |        |        |
|        | Increases more than 100% |        |               |   |        |        |        |        |

The following figure represents the increase (in %) in the responses of people from vulnerable groups who have interacted with science through the abovementioned interactions compared with the total of participants within the vulnerable group. This way, we can observe how the higher impact of interactions is found in people from low socioeconomic status in interaction 1 (changing their mind about science because something happened to them or their families) and interaction 2-often (Following in social media someone who often publishes about science). In addition, we can see that, when people follow in social media a person who rarely publishes scientific content, the impact of this interaction is lower than interaction 1 (changing their mind about science because something happened to them or their families). As abovementioned, the results from the LGBTI+ community are limited due to the reduced number of responses.

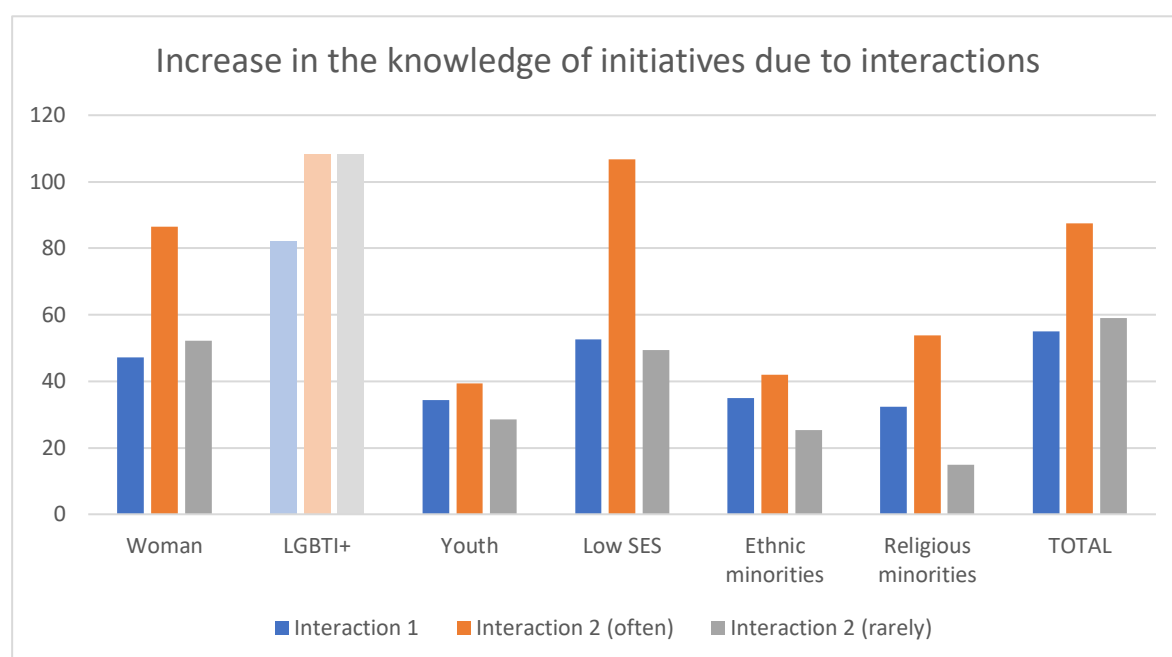


Figure 5.2. Increase in the knowledge of initiatives due to interactions across vulnerable groups

Therefore, interacting with science has an effect in the knowledge of initiatives to foster citizen science. In all vulnerable groups, this impact is higher when participants follow a person on social media who often publishes about science. Regarding vulnerable groups, the impact of interactions is generally more accentuated in people from low socioeconomic status.

## Question 2

When asking about specific initiatives designed specially to foster citizen participation in science related to gender, almost half of the respondents (47-70%) state that they can not identify any initiative.

Table 5.17. Distribution of respondents' answers to the following sentence "Could you tell me about any initiatives that you know to foster citizen participation in science related to gender?"

| Could you tell me about any initiatives that you know to foster citizen participation in science related to gender? |           |            |
|---|-----------|------------|
|   | Frequency | Percentage |
| Others  | 46        | 0,61       |
| Prefer not to answer  | 142       | 1,89       |
| Specific classes  | 622       | 8,29       |
| Talks or briefings at your company (at your workplace)  | 720       | 9,59       |
| Informative sessions in NGOs  | 795       | 10,59      |
| Talks or information sessions in health centers   | 822       | 10,95      |
| Informal chats  | 1141      | 15,20      |
| Conferences   | 1230      | 16,38      |
| Informative sessions in schools   | 1378      | 18,36      |
| Workshops in educational centers (schools, universities and similar)  | 1450      | 19,32      |
| I do not know   | 3581      | 47,70      |

However, if we look at the most identified initiatives, we find that initiatives held in schools are the most known. In this line, 19.32% and 18.36% of participants know of Workshops in educational centers (including schools, universities and similar) and informative session in schools, respectively. Conferences and informal chats are also frequently identified (16.38% and 15.20%).

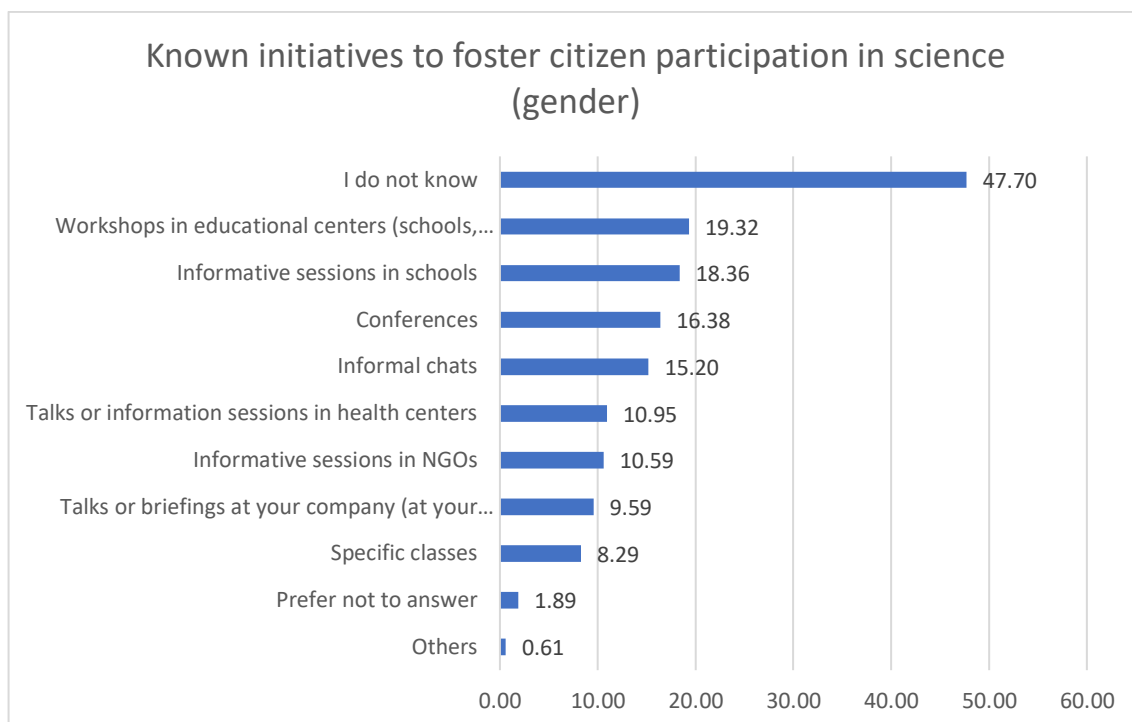


Figure 5.3. Distribution of respondents' answers to the following sentence "Could you tell me about any initiatives that you know to foster citizen participation in science related to gender?"

### Responses by vulnerable groups

This section aims to deepen on possible differences among vulnerable groups in the identification of initiatives to foster citizen participation in science related to gender. The analysis points to the existence of differences across vulnerable groups. In this vein, people from the LGBTI+ community and from low socioeconomic status are less likely to know initiatives to foster citizen participation in science related to gender. However, in the case of the LGBTI+ community, the small sample limits the interpretation of these results. On the contrary, youth aged 16-34 and ethnic and religious minorities tend to know more initiatives. The following figure represents these findings:

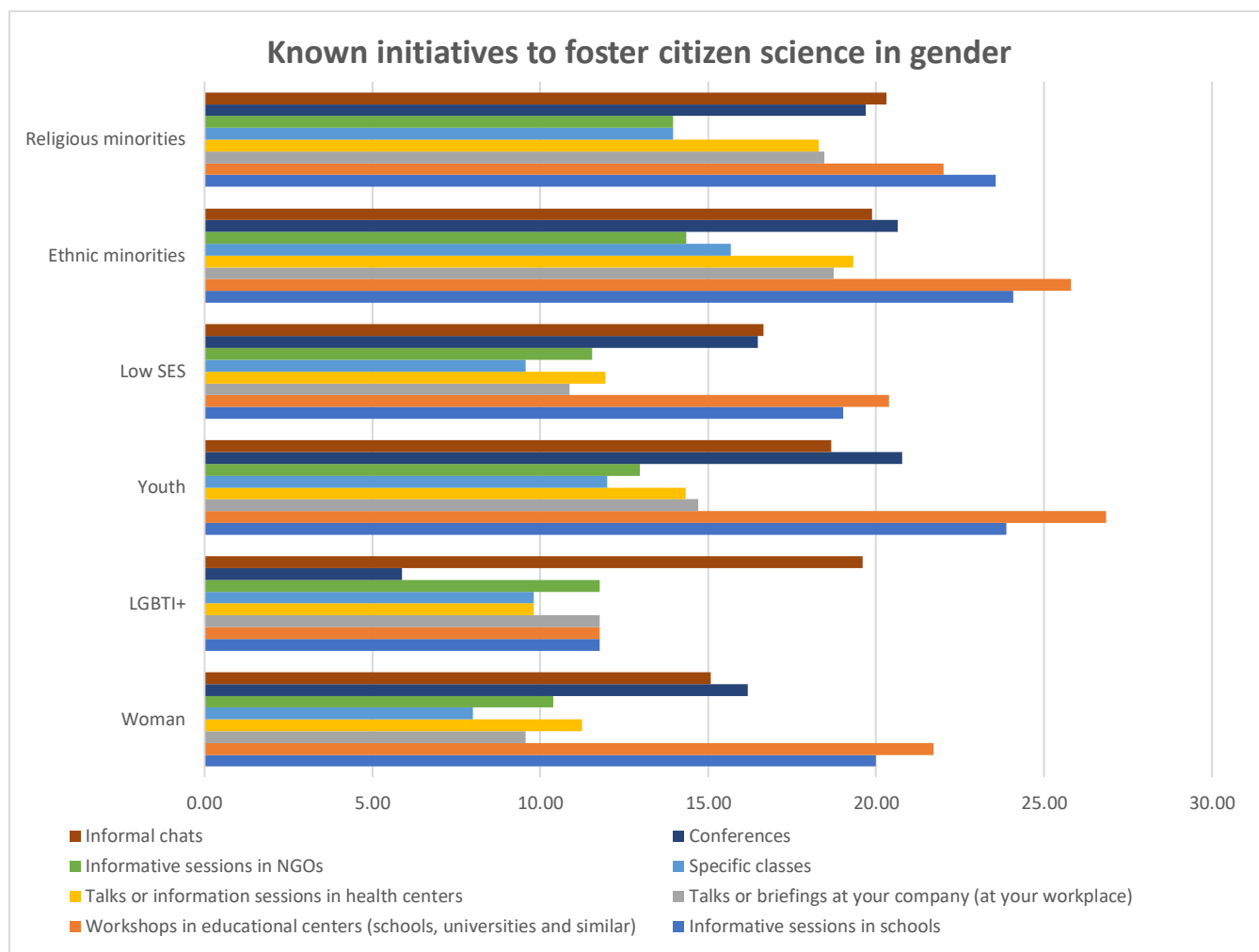


Figure 5.4. Distribution of respondents' answers to the following sentence "Could you tell me about any initiatives that you know to foster citizen participation in science related to gender?" across vulnerable groups

The analysis by gender vulnerable groups indicates that women tend to identify the same initiatives than the total of respondents and in similar percentages. This way, while the most known initiatives globally where those implemented within school settings (workshops and informative sessions in schools) with almost 20% of respondents each one, in the case of women the proportions are slightly higher (20.00% for informative sessions in schools and 21.70% for workshops in educational centres). On the contrary, the least known initiatives are in both cases specific classes and talks or briefings at workplace.

Table 5.18. Distribution of respondents' answers to the following sentence "Could you tell me about any initiatives that you know to foster citizen participation in science related to gender?" by gender vulnerable groups

| Could you tell me about any initiatives that you know to foster citizen participation in science related to gender? |       |        |       |
|---|-------|--------|-------|
|   | Woman | LGBTI+ | TOTAL |
| Informative sessions in schools   | 20,00 | 11,76  | 18,36 |
| Workshops in educational centers (schools, universities and similar)  | 21,70 | 11,76  | 19,32 |
| Talks or briefings at your company (at your workplace)  | 9,57  | 11,76  | 9,59  |
| Talks or information sessions in health centers   | 11,25 | 9,80   | 10,95 |

|                              |       |       |       |
|------------------------------|-------|-------|-------|
| Specific classes             | 7,99  | 9,80  | 8,29  |
| Informative sessions in NGOs | 10,38 | 11,76 | 10,59 |
| Conferences                  | 16,17 | 5,88  | 16,38 |
| Informal chats               | 15,07 | 19,61 | 15,20 |
| Others                       | 0,60  | 3,92  | 0,61  |
| I do not know                | 46,92 | 52,94 | 47,70 |
| Prefer not to answer         | 1,91  | 0,00  | 1,89  |

The results for youth indicate the same patterns of identified initiatives but in higher proportions. This way, youth are more likely than the total of respondents to identify initiatives to foster citizen participation in science, but the most known initiatives are the same (workshops in educational centres with 26.86% of respondents and informative sessions in schools with 23.87%). In the case of young people aged 16-34, the proportion of respondents who know of conferences and informal chats increase considerably (20.78% and 18.67% compared to 16.38% and 15.20%)

Table 5.19. Distribution of respondents' answers to the following sentence "Could you tell me about any initiatives that you know to foster citizen participation in science related to gender?" by youth

| Could you tell me about any initiatives that you know to foster citizen participation in science related to gender? |       |       |
|---|-------|-------|
|   | Youth | TOTAL |
| Informative sessions in schools   | 23,87 | 18,36 |
| Workshops in educational centers (schools, universities and similar)  | 26,86 | 19,32 |
| Talks or briefings at your company (at your workplace)  | 14,70 | 9,59  |
| Talks or information sessions in health centers   | 14,32 | 10,95 |
| Specific classes  | 11,99 | 8,29  |
| Informative sessions in NGOs  | 12,97 | 10,59 |
| Conferences   | 20,78 | 16,38 |
| Informal chats  | 18,67 | 15,20 |
| Others  | 0,54  | 0,61  |
| I do not know   | 32,72 | 47,70 |
| Prefer not to answer  | 2,22  | 1,89  |

On the contrary, people from low socioeconomic status are not more likely to identify initiatives to encourage citizen participation in science than the total of respondents. In this case, the percentages are almost the same than the total of respondents, which imply that is the vulnerable group that is less likely to identify initiatives to foster citizen participation in science (with the exception of the LGBTI+ community which has limited significance due to the limitations with the sample). In this case, the most known initiatives are also those implemented within schools (19.02% for informative sessions and 20.39% for workshops).

Table 5.20. Distribution of respondents' answers to the following sentence "Could you tell me about any initiatives that you know to foster citizen participation in science related to gender?" by low SES<sup>55</sup>

| Could you tell me about any initiatives that you know to foster citizen participation in science related to |  |  |
|---|--|--|
|---|--|--|

<sup>55</sup> Low SES is defined as having gross income below 16,043 Euros per year.

| gender?  |         |       |
|--|---------|-------|
|  | Low SES | TOTAL |
| Informative sessions in schools                                      | 19,02   | 18,36 |
| Workshops in educational centers (schools, universities and similar) | 20,39   | 19,32 |
| Talks or briefings at your company (at your workplace)               | 10,88   | 9,59  |
| Talks or information sessions in health centers                      | 11,93   | 10,95 |
| Specific classes   | 9,56    | 8,29  |
| Informative sessions in NGOs   | 11,54   | 10,59 |
| Conferences  | 16,47   | 16,38 |
| Informal chats   | 16,64   | 15,20 |
| Others   | 0,53    | 0,61  |
| I do not know  | 45,62   | 47,70 |
| Prefer not to answer   | 1,19    | 1,89  |

Finally, in the case of ethnic and religious minorities it is important to remark that the results show a notable increase in the proportion of respondents who have heard of the mentioned initiatives. The most common initiatives are also those implemented in schools or educational settings. In this vein. 25.81% of participants belonging to an ethnic minority group and 22.02% of those belonging to a religious minority group expressed knowing of workshops in educational centres and 24.09% and 23.57% of informative sessions in schools. It is also relevant to point that in this case, the proportion of respondents who do not know any initiative is 24.09% in ethnic minorities and 29.46% in religious minorities, in comparison with the 47.70% of the total of respondents.

Table 5.21. Distribution of respondents' answers to the following sentence "Could you tell me about any initiatives that you know to foster citizen participation in science related to gender?" for belonging to ethnic and religious minorities

| Could you tell me about any initiatives that you know to foster citizen participation in science related to gender? |                   |                      |       |
|---|-------------------|----------------------|-------|
|   | Ethnic minorities | Religious minorities | TOTAL |
| Informative sessions in schools   | 24,09             | 23,57                | 18,36 |
| Workshops in educational centers (schools, universities and similar)  | 25,81             | 22,02                | 19,32 |
| Talks or briefings at your company (at your workplace)  | 18,74             | 18,45                | 9,59  |
| Talks or information sessions in health centers   | 19,31             | 18,29                | 10,95 |
| Specific classes  | 15,68             | 13,95                | 8,29  |
| Informative sessions in NGOs  | 14,34             | 13,95                | 10,59 |
| Conferences   | 20,65             | 19,69                | 16,38 |
| Informal chats  | 19,89             | 20,31                | 15,20 |
| Others  | 0,38              | 0,31                 | 0,61  |
| I do not know   | 24,09             | 29,46                | 47,70 |
| Prefer not to answer  | 0,96              | 2,02                 | 1,89  |

**All vulnerable groups point to initiatives implemented within the school context as those most known in the promotion of citizen science (including informative sessions and**

workshops), with approximately 20% of the responses each one in all cases. Finally in all vulnerable groups except the LGBTI+ community (which has limited significance due to the small size of the sample), respondents tend to know more initiatives than the total of population.




### The impact of interactions

This section analyses the impact of two interactions with science in the responses of people from vulnerable groups. The interactions are:

- Has something happened to you or someone in your family that made you change your mind about science or become interested in science?
- Do the scientific people you follow share anecdotes or evidence about science?

If we look closer at the results by gender vulnerable groups (women and LGBTI+ community), we can observe that in women, there is an increase in the knowledge of all initiatives due to interactions with science. The greatest extent of this increase is found in women who interact with science by following someone on social media who often published about science, with increases of more than 50% and 80% depending on the initiative. A common finding across all interactions is that the most known initiatives are those implemented within educational contexts, including informative sessions in schools and workshops in educational centres.

Table 5.22. Distribution of respondents' answers to the following sentence "Could you tell me about any initiatives that you know to foster citizen participation in science related to gender?" across interactions by gender vulnerable groups

| Could you tell me about any initiatives that you know to foster citizen participation in science related to gender? |      |  |                               |                    |                      |                  |                              |  |                           |        |               |                      |
|---|------|--|-------------------------------|--------------------|----------------------|------------------|------------------------------|--|---------------------------|--------|---------------|----------------------|
|   |      | Informative sessions in schools                                      | Workshops educational centers | Talks at workplace | Talks health centers | Specific classes | Informative sessions in NGOs | Conferences  | Informal chats            | Others | I do not know | Prefer not to answer |
| Women   | I1   | 28,12  | 30,71                         | 14,49              | 16,79                | 10,65            | 14,88                        | 24,76  | 21,31                     | 0,86   | 29,65         | 0,96                 |
|   | I2.O | 32,66  | 38,41                         | 16,24              | 19,63                | 14,89            | 19,63                        | 31,47  | 23,18                     | 1,18   | 24,53         | 1,52                 |
|   | I2.R | 29,08  | 30,26                         | 15,91              | 17,09                | 10,41            | 15,13                        | 21,02  | 23,18                     | 0,79   | 28,49         | 0,39                 |
|   | Tot. | 20,00  | 21,70                         | 9,57               | 11,25                | 7,99             | 10,38                        | 16,17  | 15,07                     | 0,60   | 46,92         | 1,91                 |
| LGBTI+  | I1   | 25,00  | 8,33                          | 8,33               | 25,00                | 16,67            | 25,00                        | 16,67  | 33,33                     | 0,00   | 33,33         | 0,00                 |
|   | I2.O | 0,00   | 0,00                          | 0,00               | 14,29                | 0,00             | 14,29                        | 14,29  | 14,29                     | 14,29  | 57,14         | 0,00                 |
|   | I2.R | 14,29  | 14,29                         | 0,00               | 0,00                 | 14,29            | 14,29                        | 0,00   | 42,86                     | 0,00   | 28,57         | 0,00                 |
|   | Tot. | 11,76  | 11,76                         | 11,76              | 9,80                 | 9,80             | 11,76                        | 5,88   | 19,61                     | 3,92   | 52,94         | 0,00                 |
|   | I1   | Changing their mind about science because something happened         |                               |                    |                      |                  |                              |  | Increase up to 50%        |        |               |                      |
|   | I2.O | Following on social media someone who often publishes about science  |                               |                    |                      |                  |                              |  | Increase of more than 50% |        |               |                      |
|   | I2.R | Following on social media someone who rarely publishes about science |                               |                    |                      |                  |                              |  | Increase of more than 80% |        |               |                      |

The following figures represent these results for women as we can see as a result of citizens' interactions with science the proportion of those who do not know any imitative decreases. The results for the LGBTI+ community are not included because of the limited number of responses (n= 12 in interaction 1 and n=7 in interaction 2):

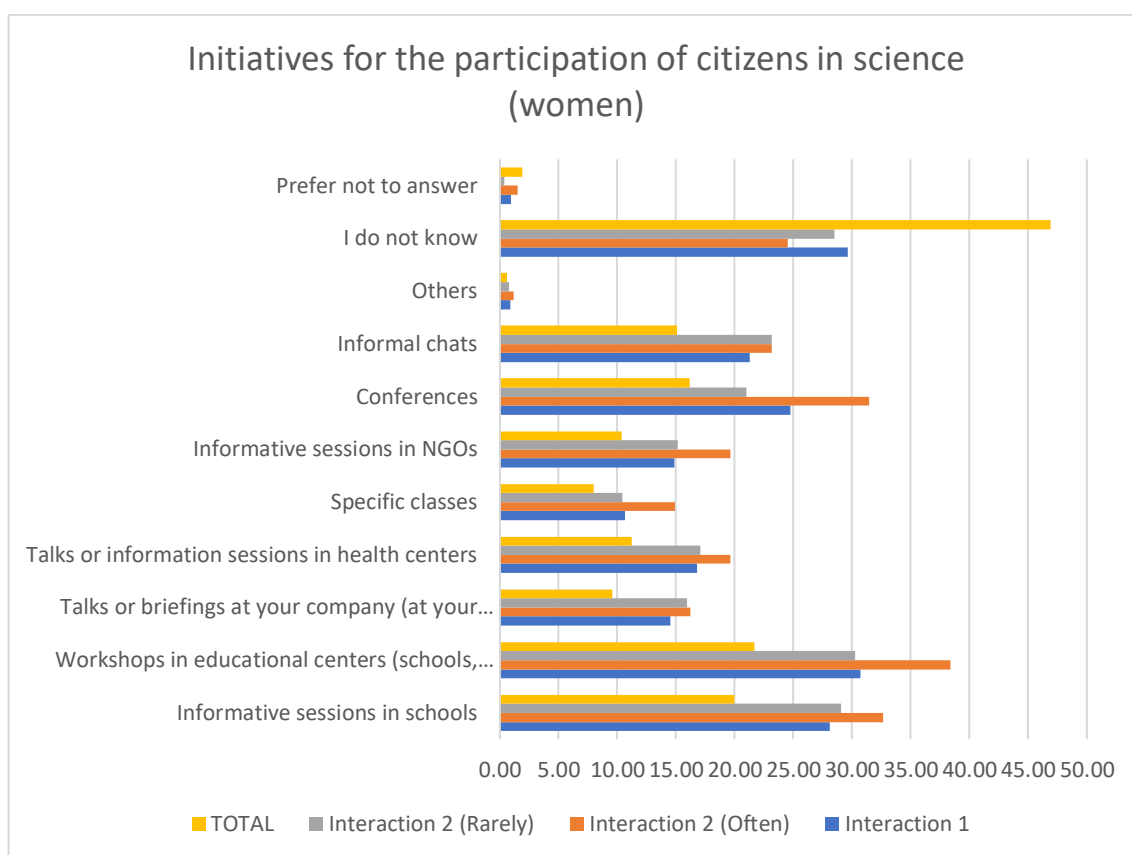


Figure 5.5. Distribution of respondents' answers to the following sentence "Could you tell me about any initiatives that you know to foster citizen participation in science related to gender?" in women across interactions with science

The results for young people aged 16-24 point that although there is an increase in all the identified initiatives, it is proportionally lower in comparison with other vulnerable groups (less than 50% in almost all the cases). In this case, there are not important differences in terms of the impact of each interaction in each initiative. Also in this case, the most identified initiatives correspond to those implemented within the school context (informative sessions and workshops), with approximately 35% each one in all interactions.

Table 5.23. Distribution of respondents' answers to the following sentence "Could you tell me about any initiatives that you know to foster citizen participation in science related to gender?" across interactions by youth

| Could you tell me about any initiatives that you know to foster citizen participation in science related to gender? |      |  |                               |                    |                      |                  |                              |             |                           |        |               |                      |
|---|------|--|-------------------------------|--------------------|----------------------|------------------|------------------------------|-------------|---------------------------|--------|---------------|----------------------|
|   |      | Informative sessions in schools                                      | Workshops educational centers | Talks at workplace | Talks health centers | Specific classes | Informative sessions in NGOs | Conferences | Informal chats            | Others | I do not know | Prefer not to answer |
| Youth   | I1   | 34,33  | 34,33                         | 22,22              | 19,90                | 15,09            | 16,75                        | 26,20       | 23,55                     | 0,50   | 16,42         | 1,16                 |
|   | I2.O | 34,50  | 37,76                         | 19,58              | 20,05                | 15,38            | 17,72                        | 30,77       | 21,68                     | 0,70   | 20,75         | 0,93                 |
|   | I2.R | 33,02  | 35,85                         | 20,75              | 19,50                | 14,78            | 18,24                        | 27,67       | 24,84                     | 0,94   | 17,92         | 0,63                 |
|   | Tot. | 23,87  | 26,86                         | 14,70              | 14,32                | 11,99            | 12,97                        | 20,78       | 18,67                     | 0,54   | 32,72         | 2,22                 |
|   | I1   | Changing their mind about science because something happened         |                               |                    |                      |                  |                              |             | Increase up to 50%        |        |               |                      |
|   | I2.O | Following in social media someone who often publishes about science  |                               |                    |                      |                  |                              |             | Increase of more than 50% |        |               |                      |
|   | I2.R | Following in social media someone who rarely publishes about science |                               |                    |                      |                  |                              |             | Increase of more than 80% |        |               |                      |

The following figure shows the results for young people aged 16-34 and also in this case, the



most notable impact is in the decrease of youth who do not know any initiative. In this case, this decrease is more remarkable in the first interaction than in the second:

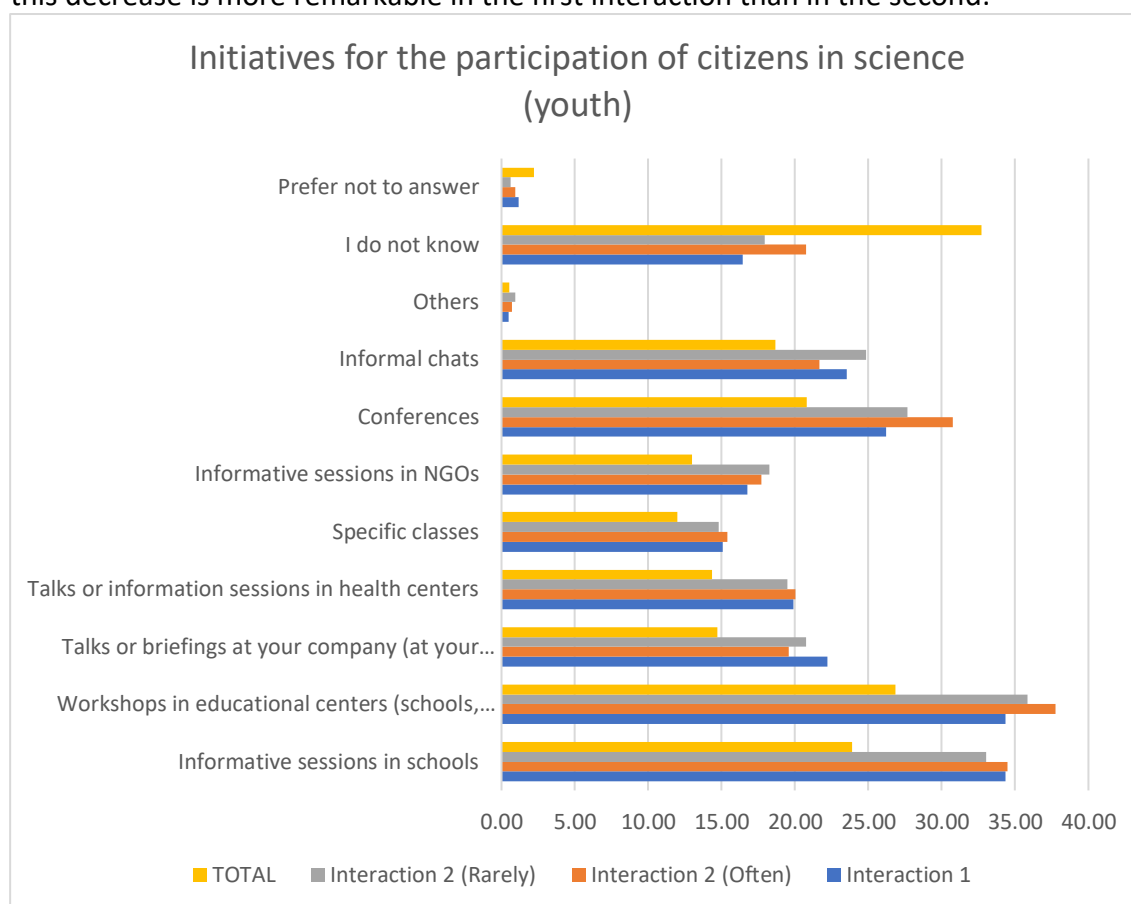


Figure 5.6. Distribution of respondents' answers to the following sentence "Could you tell me about any initiatives that you know to foster citizen participation in science related to gender?" in youth across interactions with science

The results for people from low socioeconomic status indicate that in this case, interactions with science play a greater role in the promotion of initiatives to encourage citizens' participation in science. In this line, in the first interaction (Changing their mind about science because something happened), the percentage of respondents who know of talks at workplace or in health centres increase more than 50% compared with the total, with a final percentage of 18.43% and 18.13%. In the same vein, in the second interaction (Following in social media someone who often publishes about science) the increases are even higher, with more than 80% of increase in three cases (talks in health centres 21.88%, informative sessions in NGOs 21.88% and others 1.14%). In addition, 5 initiatives increase more than 50% compared with the total (workshops in educational centres, talks at workplace, specific classes, conferences and informal chats). However, when this interaction through social media is less frequent (option I2- rarely), the increase is not as notable. In this case, only talks at workplace increase more than 50%. Aligned with other vulnerable groups, in all the interactions, the most known initiatives are those that take place within the school context, including informative sessions and workshops, with almost 30% of respondents each one.

Table 5.24. Distribution of respondents' answers to the following sentence "Could you tell me about any

initiatives that you know to foster citizen participation in science related to gender?" across interactions by low SES

| Could you tell me about any initiatives that you know to foster citizen participation in science related to gender? |      |  |                               |                    |                      |                  |                              |                           |                |        |               |                      |
|---|------|--|-------------------------------|--------------------|----------------------|------------------|------------------------------|---------------------------|----------------|--------|---------------|----------------------|
|   |      | Informative sessions in schools                                      | Workshops educational centers | Talks at workplace | Talks health centers | Specific classes | Informative sessions in NGOs | Conferences               | Informal chats | Others | I do not know | Prefer not to answer |
| Low SES   | I1   | 26,74  | 27,19                         | 18,43              | 18,13                | 13,29            | 17,07                        | 23,41                     | 22,81          | 0,60   | 26,44         | 0,76                 |
|   | I2.O | 27,84  | 34,66                         | 17,90              | 21,88                | 17,05            | 21,88                        | 26,42                     | 25,00          | 1,14   | 22,73         | 0,57                 |
|   | I2.R | 27,50  | 28,75                         | 18,75              | 17,19                | 14,06            | 16,88                        | 23,44                     | 24,69          | 0,63   | 24,06         | 0,31                 |
|   | Tot. | 19,02  | 20,39                         | 10,88              | 11,93                | 9,56             | 11,54                        | 16,47                     | 16,64          | 0,53   | 45,62         | 1,19                 |
|   |      | Changing their mind about science because something happened         |                               |                    |                      |                  |                              | Increase up to 50%        |                |        |               |                      |
|   |      | Following in social media someone who often publishes about science  |                               |                    |                      |                  |                              | Increase of more than 50% |                |        |               |                      |
|   |      | Following in social media someone who rarely publishes about science |                               |                    |                      |                  |                              | Increase of more than 80% |                |        |               |                      |

The following figure describes these findings for people from low socioeconomic status. We can see how due to interactions with science, the proportion of respondents who do not know any initiative is reduced, while increase the percentage of all the initiatives:

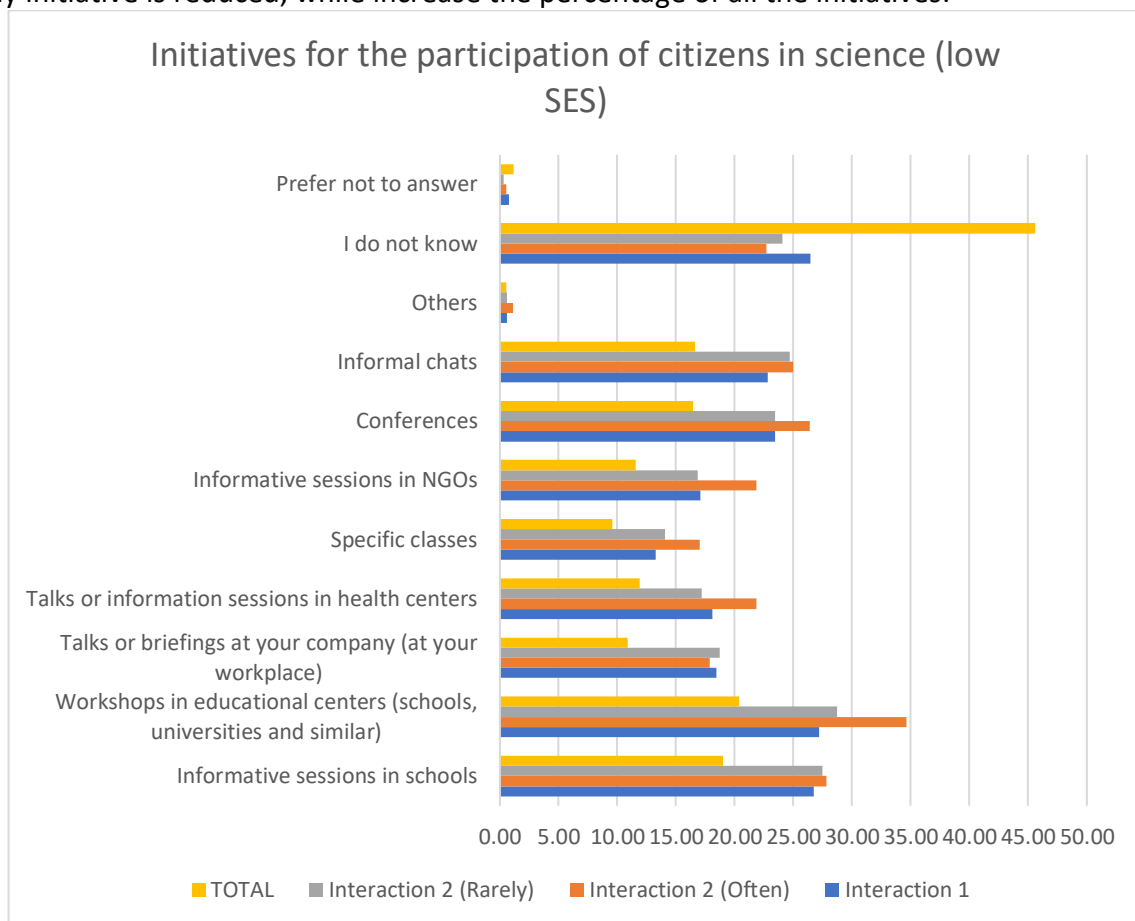


Figure 5.7. Distribution of respondents' answers to the following sentence "Could you tell me about any initiatives that you know to foster citizen participation in science related to gender?" in participants from low SES across interactions with science

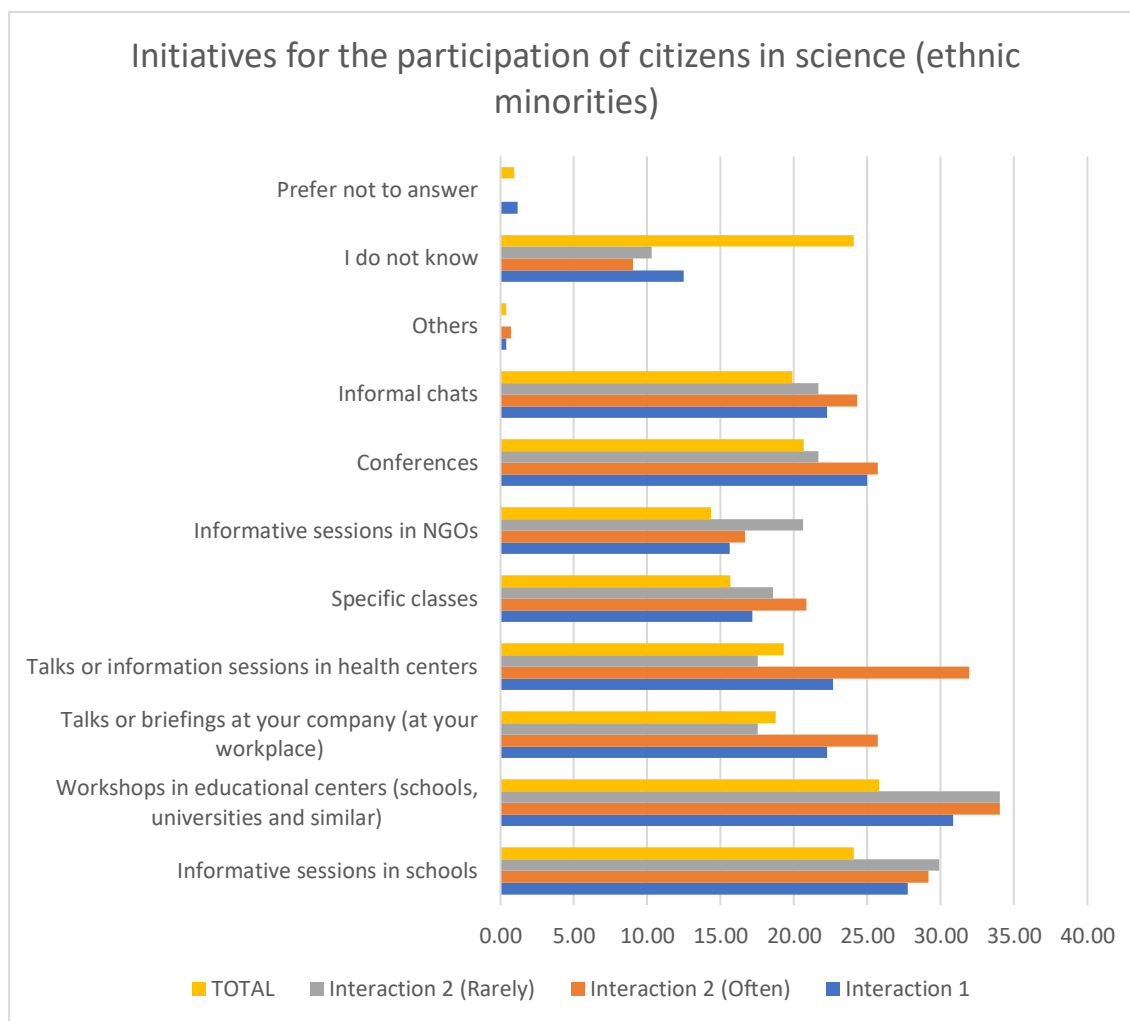
Finally, the results by belonging to ethnic and religious minority groups show similar trends. As happened in all vulnerable groups, those actions that are more commonly known by respondents from ethnic and religious minorities are those implemented in schools (with

approximately 30% each one). In general, the increase in the case of ethnic and religious minorities is not as accentuated as in other vulnerable groups. In this case, the most noticeable increase is found in talks in health centres in those who interact with science through social media with a higher frequency (31.94% in ethnic minorities, which represents an increase of more than 50% and 34.18% in religious minorities, which represents an increase of more than 80%).

Table 5.25. Distribution of respondents' answers to the following sentence "Could you tell me about any initiatives that you know to foster citizen participation in science related to gender?" across interactions for belonging to ethnic and religious minority groups

| Could you tell me about any initiatives that you know to foster citizen participation in science related to gender? |      |  |                               |                    |                      |                  |                              |             |                           |        |               |                      |
|---|------|--|-------------------------------|--------------------|----------------------|------------------|------------------------------|-------------|---------------------------|--------|---------------|----------------------|
|   |      | Informative sessions in schools                                      | Workshops educational centers | Talks at workplace | Talks health centers | Specific classes | Informative sessions in NGOs | Conferences | Informal chats            | Others | I do not know | Prefer not to answer |
| Ethnic  | I1   | 27,73  | 30,86                         | 22,27              | 22,66                | 17,19            | 15,63                        | 25,00       | 22,27                     | 0,39   | 12,50         | 1,17                 |
|   | I2.O | 29,17  | 34,03                         | 25,69              | 31,94                | 20,83            | 16,67                        | 25,69       | 24,31                     | 0,69   | 9,03          | 0,00                 |
|   | I2.R | 29,90  | 34,02                         | 17,53              | 17,53                | 18,56            | 20,62                        | 21,65       | 21,65                     | 0,00   | 10,31         | 0,00                 |
|   | Tot. | 24,09  | 25,81                         | 18,74              | 19,31                | 15,68            | 14,34                        | 20,65       | 19,89                     | 0,38   | 24,09         | 0,96                 |
| Religious   | I1   | 31,10  | 28,27                         | 25,80              | 23,67                | 15,90            | 16,96                        | 24,38       | 21,20                     | 0,00   | 16,96         | 1,77                 |
|   | I2.O | 31,01  | 32,91                         | 30,38              | 34,18                | 19,62            | 17,72                        | 25,32       | 24,05                     | 0,63   | 13,29         | 1,90                 |
|   | I2.R | 27,21  | 27,21                         | 19,12              | 14,71                | 14,71            | 22,79                        | 22,79       | 22,79                     | 0,00   | 17,65         | 2,21                 |
|   | Tot. | 23,57  | 22,02                         | 18,45              | 18,29                | 13,95            | 13,95                        | 19,69       | 20,31                     | 0,31   | 29,46         | 2,02                 |
|   | I1   | Changing their mind about science because something happened         |                               |                    |                      |                  |                              | <div></div> | Increase up to 50%        |        |               |                      |
|   | I2.O | Following in social media someone who often publishes about science  |                               |                    |                      |                  |                              | <div></div> | Increase of more than 50% |        |               |                      |
|   | I2.R | Following in social media someone who rarely publishes about science |                               |                    |                      |                  |                              | <div></div> | Increase of more than 80% |        |               |                      |

The following figures present these findings in ethnic and religious minorities. In these cases, it is also important to remark the decrease in respondents who do not know any initiative.



*Figure 5.8. Distribution of respondents' answers to the following sentence "Could you tell me about any initiatives that you know to foster citizen participation in science related to gender?" in participants from ethnic minorities across interactions with science*

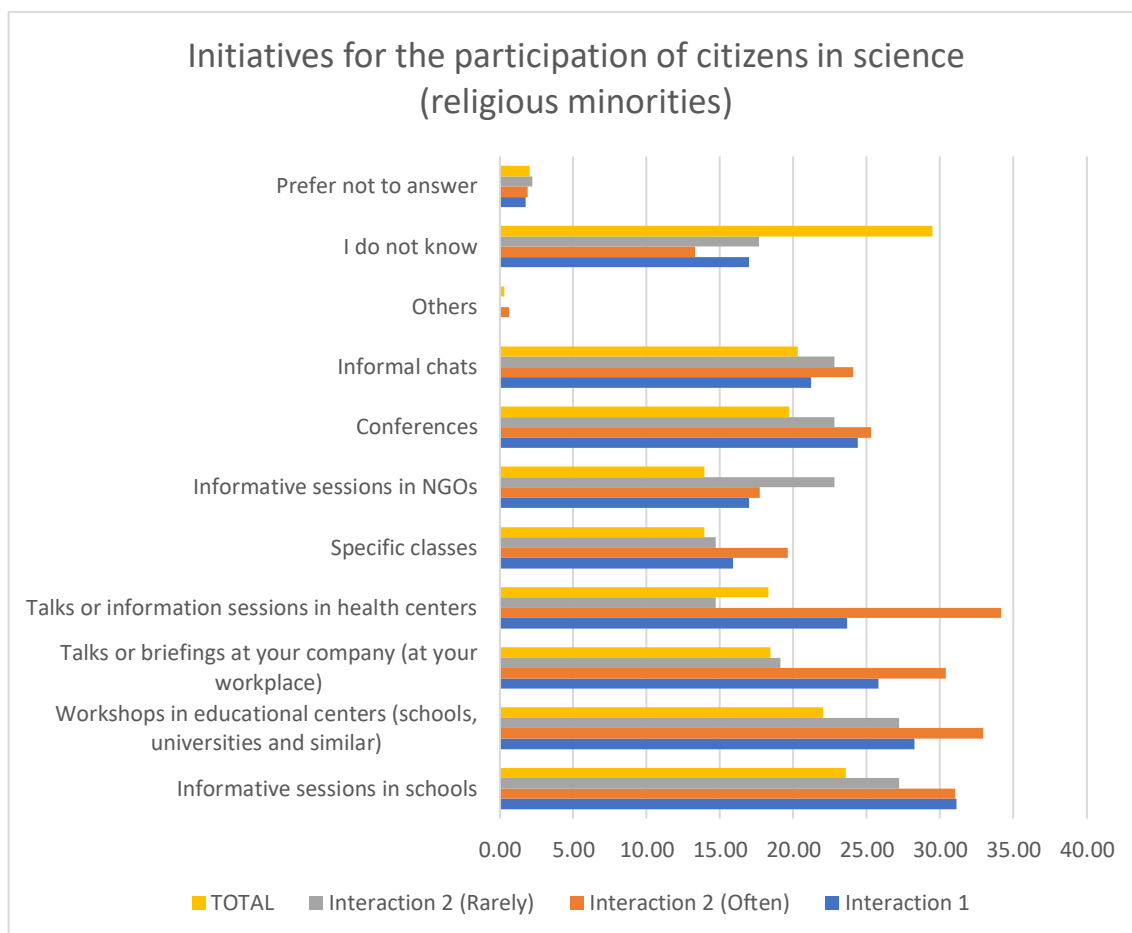


Figure 9. Distribution of respondents' answers to the following sentence "Could you tell me about any initiatives that you know to foster citizen participation in science related to gender?" in participants from religious minorities across interactions with science

Therefore, in all cases the most know initiatives are those implemented within the school context, including informative sessions in schools and workshops. All interactions decrease the proportion of respondents who answer that they do not know any initiative, while increasing the percentage of all response options. The increase is generally more accentuated when citizens interact with science by following someone on social media who often published about science. Finally, the analysed interactions have a greater impact on people from low socioeconomic status, compared to other vulnerable groups.

### 5.3.2 Participation in actions to foster citizens' participation in science

This section aims to deepen on the participation of respondents in actions to encourage citizens' participation in science in education and gender, and includes the following questions:

- Have you participated in any action to discuss scientific discoveries in education, in both face-to-face and online actions?

- Have you participated in any action to discuss scientific breakthroughs in gender issues, in both face-to-face and online actions?

In both cases, respondents are given the following response options: Yes, I have participated in many; Yes, but only some; No, I have not participated; I do not know and Prefer not to answer.

In both cases, almost 8 out of ten of the respondents expressed not having participated in initiatives to discuss scientific evidence on gender or education, while less than 15% state the contrary. The following sections deepen on this analysis.

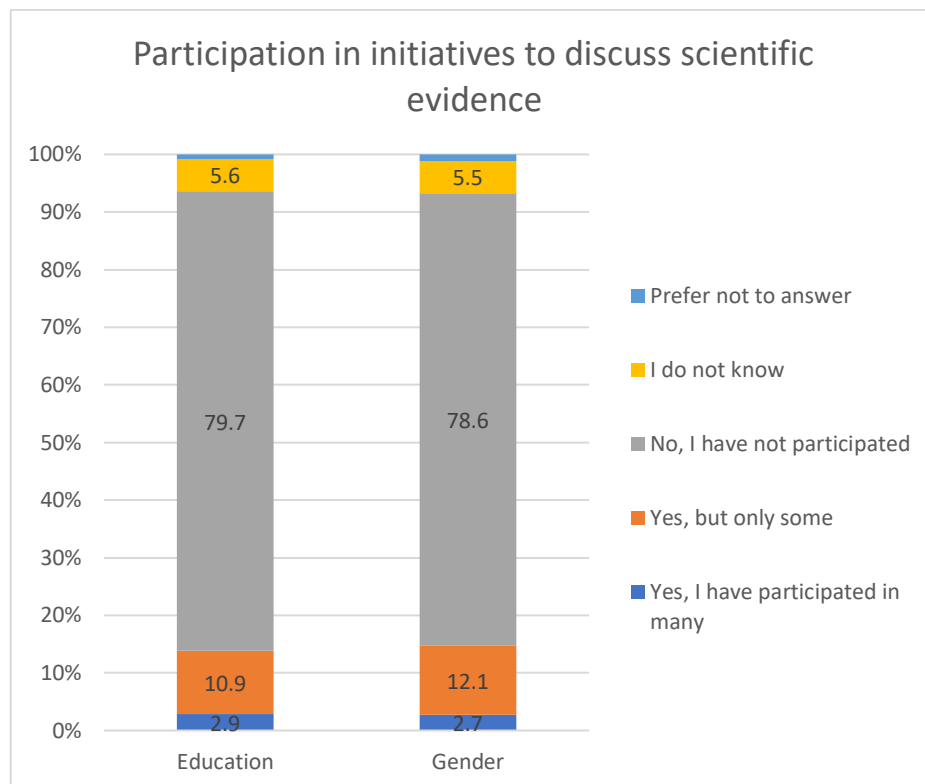


Figure 5.10. Distribution of respondents' answers to the following sentence "Have you participated in any action to discuss scientific discoveries in [education/gender], in both face-to-face and online actions?"

## Question 1

The first question is referred to the participation in actions to discuss scientific discoveries in education and only 13.8% of the respondents expressed having participated in this type of initiatives (including those who have participated in many and those that only in some).

Table 5.26. Distribution of respondents' answers to the following sentence "Have you participated in any action to discuss scientific discoveries in education, in both face-to-face and online actions?"

| Have you participated in any action to discuss scientific discoveries in education, in both face-to-face and online actions? |           |            |                        |
|--|-----------|------------|------------------------|
|  | Frequency | Percentage | Accumulated percentage |

|                                  |      |       |       |
|----------------------------------|------|-------|-------|
| Yes, I have participated in many | 221  | 2,9   | 2,9   |
| Yes, but only some               | 818  | 10,9  | 13,8  |
| No, I have not participated      | 5981 | 79,7  | 93,5  |
| I do not know                    | 424  | 5,6   | 99,2  |
| Prefer not to answer             | 63   | 0,8   | 100,0 |
| Total                            | 7507 | 100,0 | 100,0 |

### Responses by vulnerable groups

If we zoom at the results by vulnerable groups we can observe how, in general, the proportion of respondents from all vulnerable groups that expressed having participated in actions to discuss scientific evidence in education is higher than in the total of respondents. This difference is more accentuated in the case of ethnic and religious minorities. In this case, the total proportion of respondents who have participated in at least some of these initiatives are 36.52% in ethnic minorities and 32.71% in religious minorities, which represents more than the double of the total of participants (13.8%). On the contrary, women and people from low socioeconomic status obtained similar results in comparison with the total population, with 13.05% in the case of women and 16.61% in people from low socioeconomic status.

Table 5.27. Distribution of respondents' answers to the following sentence "Have you participated in any action to discuss scientific discoveries in education, in both face-to-face and online actions?" across vulnerable groups

| Have you participated in any action to discuss scientific discoveries in education, in both face-to-face and online actions? |        |        |        |                       |                   |                      |        |
|--|--------|--------|--------|-----------------------|-------------------|----------------------|--------|
|  | Woman  | LGBTI+ | Youth  | Low SES <sup>56</sup> | Ethnic minorities | Religious minorities | TOTAL  |
| Yes, I have participated in many   | 2,67   | 7,84   | 6,08   | 4,54                  | 15,49             | 13,02                | 2,94   |
| Yes, but only some   | 10,38  | 3,92   | 18,01  | 12,07                 | 21,03             | 19,69                | 10,90  |
| No, I have not participated  | 80,24  | 72,55  | 67,72  | 77,54                 | 57,55             | 61,09                | 79,67  |
| I do not know  | 5,85   | 13,73  | 7,00   | 5,37                  | 5,54              | 5,89                 | 5,65   |
| prefer not to answer   | 0,87   | 1,96   | 1,19   | 0,48                  | 0,38              | 0,31                 | 0,84   |
| TOTAL  | 100,00 | 100,00 | 100,00 | 100,00                | 100,00            | 100,00               | 100,00 |

The following figure represents the distribution of responses from people from vulnerable groups.

<sup>56</sup> Low SES is defined as having gross income below 16,043 Euros per year.

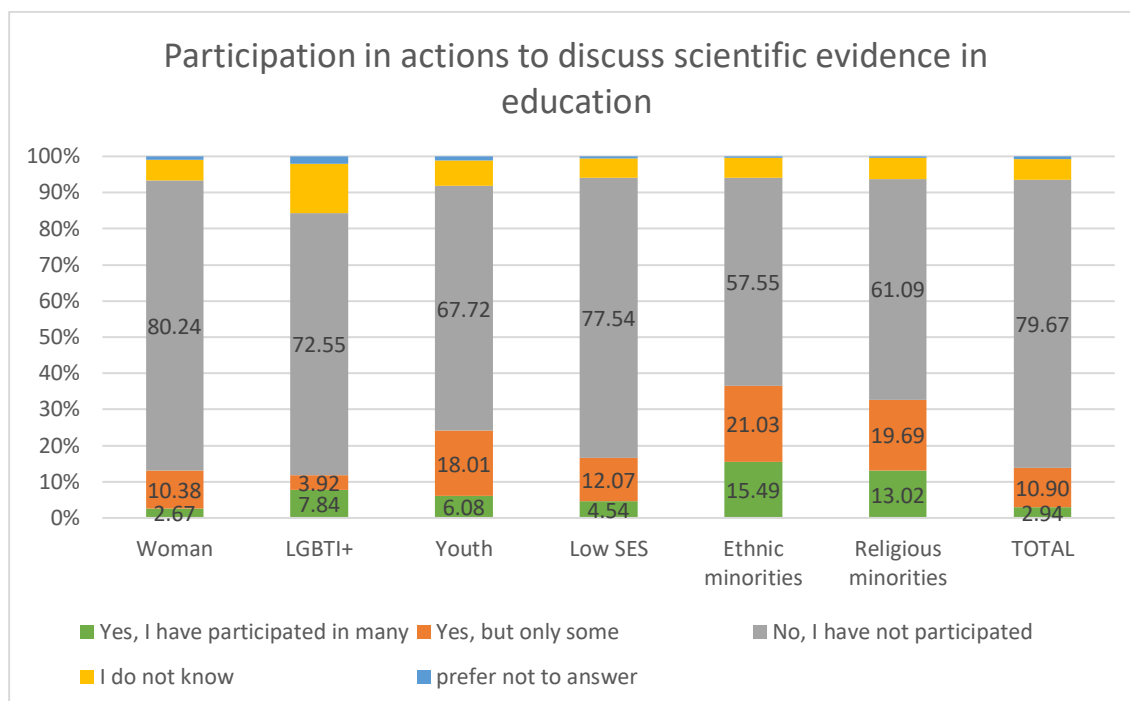


Figure 5.11. Distribution of respondents' answers to the following sentence "Have you participated in any action to discuss scientific discoveries in education, in both face-to-face and online actions?" across vulnerable groups

Generally, the proportion of respondents from vulnerable groups that expressed having participated in actions to discuss scientific evidence is higher than in the total of respondents. This is not the case of women and people from low SES, who get similar results than the total of respondents.

### The impact of interactions

This section analyses the impact of two interactions with science in the responses of people from vulnerable groups. The interactions are:

- Has something happened to you or someone in your family that made you change your mind about science or become interested in science?
- Do the scientific people you follow share anecdotes or evidence about science?

In the analysis of the impact of these interactions, we have included the responses of those respondents who had interacted with science; thus, the responses in this section are those from participants who answered "yes" to interaction 1 and "yes, often" and "yes, rarely" in interaction 2.

The analysis of the impact of interactions in vulnerable groups indicates that interactions with science have an important impact on the participation of participants in initiatives to discuss scientific evidence in education. However, not all interactions are equally effective. This way, if we focus on women, we can see how in all interactions the total percentages of participants who have participated in at least some initiatives are 23.90% (in those who changed their mind



about science due to previous experiences), 28.94% (in those who follow on social media someone who often publishes about science) and 22.20% (in those who follow someone on social media who rarely publishes about science). In this vein, we can conclude that in this case, the most effective interaction is following someone on social media who often publishes about science. It is also remarkable to point that the first two interactions increase the proportion of women who have participated in initiatives in more than 100% (144% of increase in the first, which means to increase from 2.67% to 6.53% and 248% of increase in the second, which implies to increase from 2.67% to 9.31%). In all cases, the proportion of women who have not participated or do not know decrease with interactions with science. Again, the results for the LGBTI+ community have limited implications due to the small size (n = 12, n=7 and n=7 in each interaction).

Table 5.28. Distribution of respondents' answers to the following sentence "Have you participated in any action to discuss scientific discoveries in education, in both face-to-face and online actions?" across interactions by gender vulnerable groups

| Have you participated in any action to discuss scientific discoveries in education, in both face-to-face and online actions? |                                  |             |  |        |        |
|--|----------------------------------|-------------|--|--------|--------|
|  |                                  |             | Women  | LGBTI+ | TOTAL  |
| INTERACTION 1  | Yes, I have participated in many |             | 6,53   | 16,67  | 7,09   |
|  | Yes, but only some               |             | 17,37  | 8,33   | 18,92  |
|  | No, I have not participated      |             | 71,50  | 58,33  | 69,46  |
|  | I do not know                    |             | 4,03   | 8,33   | 3,94   |
|  | Prefer not to answer             |             | 0,58   | 8,33   | 0,59   |
|  | Total                            |             | 100,00   | 100,00 | 100,00 |
| INTERACTION 2 (Often)  | Yes, I have participated in many |             | 9,31   | 14,29  | 9,83   |
|  | Yes, but only some               |             | 19,63  | 14,29  | 19,83  |
|  | No, I have not participated      |             | 68,02  | 57,14  | 67,57  |
|  | I do not know                    |             | 2,37   | 14,29  | 2,17   |
|  | Prefer not to answer             |             | 0,68   | 0,00   | 0,61   |
|  | Total                            |             | 100,00   | 100,00 | 100,00 |
| INTERACTION 2 (Rarely)   | Yes, I have participated in many |             | 1,96   | 0,00   | 3,01   |
|  | Yes, but only some               |             | 20,24  | 14,29  | 21,67  |
|  | No, I have not participated      |             | 73,28  | 85,71  | 72,21  |
|  | I do not know                    |             | 4,13   | 0,00   | 2,82   |
|  | Prefer not to answer             |             | 0,39   | 0,00   | 0,29   |
|  | Total                            |             | 100,00   | 100,00 | 100,00 |
|  | Decreases                        | I1          | Changing their mind about science because something happened         |        |        |
|  | Increases up to 50%              | I2 (Often)  | Following on social media someone who often publishes about science  |        |        |
|  | Increases more than 50%          | I2 (Rarely) | Following on social media someone who rarely publishes about science |        |        |
|  | Increases more than 100%         |             |  |        |        |

This figure shows how, due to interactions with science, increase the proportion of women who have participated in many and in some initiatives to discuss scientific discoveries in education and decrease the proportion of those who have not.

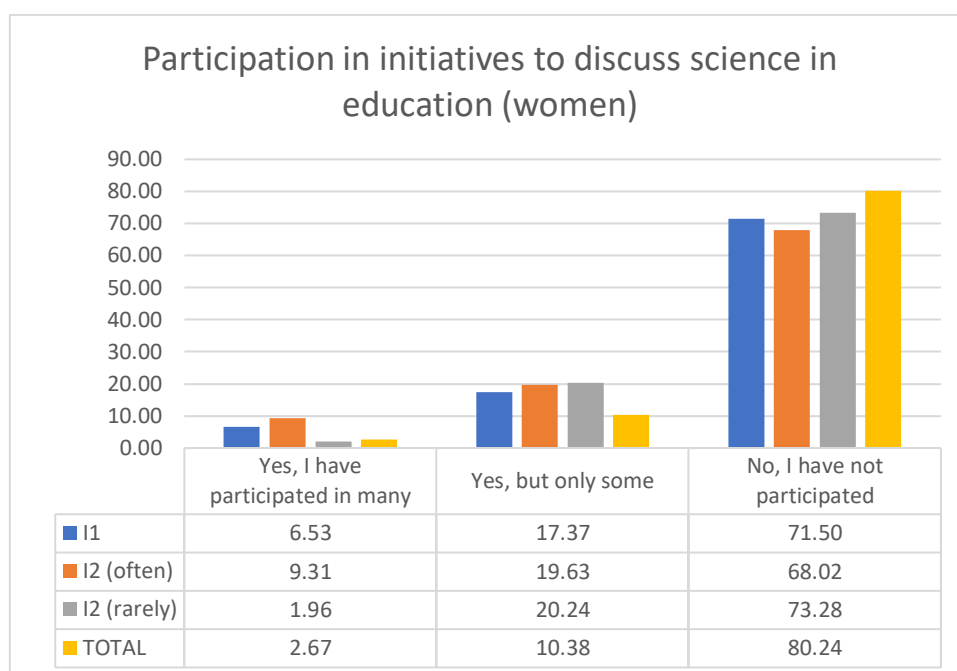


Figure 5.12. Distribution of respondents' answers to the following sentence "Have you participated in any action to discuss scientific discoveries in education, in both face-to-face and online actions?" in women across interactions with science

Regarding young people aged 16-34, the results indicate that all interactions increase the total proportion of those who have participated in initiatives to discuss scientific discoveries in education. This way, while the results for the total of youth were 24.09%, if we add the impact of interactions, the percentages increase up to 37.31% (in youth who changed their mind because something happened to them or their families), 36.37% (in youth who follow on social media someone who often publishes about science) and 34.38% (in those cases in which the person on social media rarely publishes about science). If we consider these results, the most effective interaction with science would be changing their mind about science due to a previous experience. In this case, the proportions of youth who have participated in many initiatives increases by more than 100% in those who changed their mind about science because something happened to them or their families and in those who follow on social networks a person who often publishes about science. The increase of those who have participated in some, in this vulnerable group is not as accentuated as in gender vulnerable groups, with increases of less than 50%.

Table 5.29. Distribution of respondents' answers to the following sentence "Have you participated in any action to discuss scientific discoveries in education, in both face-to-face and online actions?" across interactions by youth groups

| Have you participated in any action to discuss scientific discoveries in education, in both face-to-face and online actions? |                                  |        |
|--|----------------------------------|--------|
|  | Youth                            | TOTAL  |
| INTERACTION<br>1   | Yes, I have participated in many | 12,27  |
|  | Yes, but only some               | 25,04  |
|  | No, I have not participated      | 57,55  |
|  | I do not know                    | 4,64   |
|  | Prefer not to answer             | 0,50   |
|  | Total                            | 100,00 |

|                        |                                  |             |  |
|------------------------|----------------------------------|-------------|--|
| INTERACTION 2 (Often)  | Yes, I have participated in many | 13,99       | 9,83   |
|                        | Yes, but only some               | 22,38       | 19,83  |
|                        | No, I have not participated      | 60,37       | 67,57  |
|                        | I do not know                    | 3,03        | 2,17   |
|                        | Prefer not to answer             | 0,23        | 0,61   |
|                        | Total                            | 100,00      | 100,00   |
| INTERACTION 2 (Rarely) | Yes, I have participated in many | 5,35        | 3,01   |
|                        | Yes, but only some               | 28,93       | 21,67  |
|                        | No, I have not participated      | 61,32       | 72,21  |
|                        | I do not know                    | 4,09        | 2,82   |
|                        | Prefer not to answer             | 0,31        | 0,29   |
|                        | Total                            | 100         | 100,00   |
|                        | Decreases                        | I1          | Changing their mind about science because something happened         |
|                        | Increases up to 50%              | I2 (Often)  | Following on social media someone who often publishes about science  |
|                        | Increases more than 50%          | I2 (Rarely) | Following on social media someone who rarely publishes about science |
|                        | Increases more than 100%         |             |  |

The following figure represent these results:

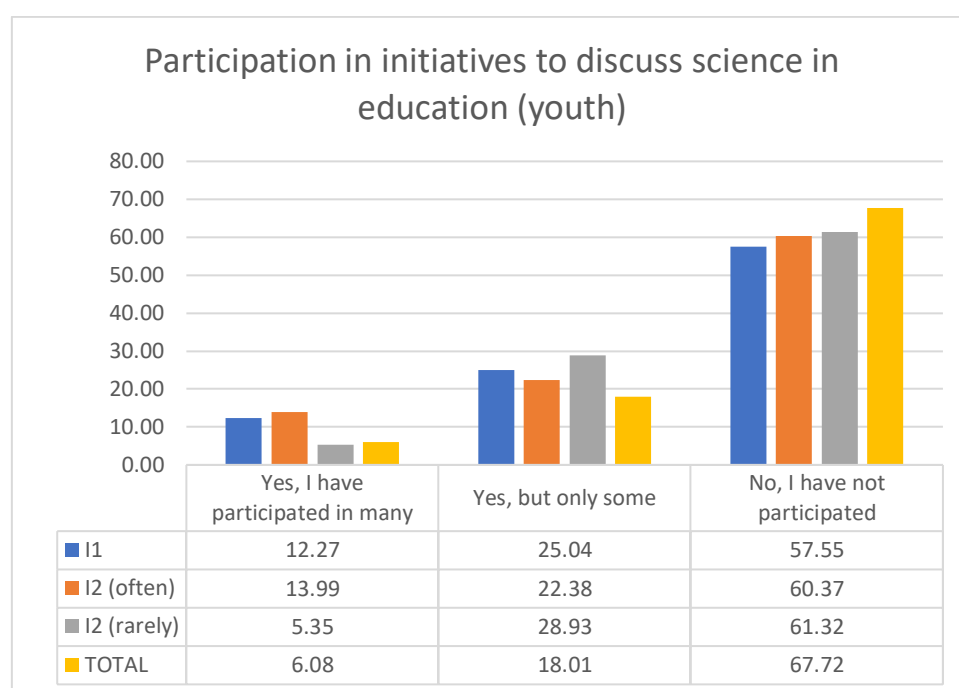


Figure 5.13. Distribution of respondents' answers to the following sentence "Have you participated in any action to discuss scientific discoveries in education, in both face-to-face and online actions?" in youth across interactions with science

As observed in other vulnerable groups, when people from low socioeconomic status have interactions with science, they are more likely to participate in at least some initiatives to discuss scientific evidence in education. In this case, less than two out of ten of people from low SES (16.61%) expressed having participated in at least some initiatives. On the contrary, when we look at those who have interacted with science, the results are 31.87% (for interaction 1), 35.51% (for interaction 2-often) and 31.57% (for interaction 2-rarely).

Therefore, aligned with other vulnerable groups the most effective interaction in this case is following someone on social network who often publishes about science. In addition, the increase in interaction 1 and interaction 2-often follow similar trends than in other vulnerable groups. This way, the higher increase is observed in the percentage of people from low SES who have participated in many initiatives as a result of these interactions (with increases higher than 100%), followed by the percentage of those who have participated in some (with increases higher than 50%).

Table 5.30. Distribution of respondents' answers to the following sentence "Have you participated in any action to discuss scientific discoveries in education, in both face-to-face and online actions?" across interactions by low SES

| Have you participated in any action to discuss scientific discoveries in education, in both face-to-face and online actions? |                                  |             |  |
|--|----------------------------------|-------------|--|
|  |                                  | Low SES     | TOTAL  |
| INTERACTION 1  | Yes, I have participated in many | 11,33       | 7,09   |
|  | Yes, but only some               | 20,54       | 18,92  |
|  | No, I have not participated      | 64,35       | 69,46  |
|  | I do not know                    | 3,17        | 3,94   |
|  | Prefer not to answer             | 0,60        | 0,59   |
|  | Total                            | 100,00      | 100,00   |
| INTERACTION 2 (Often)  | Yes, I have participated in many | 17,33       | 9,83   |
|  | Yes, but only some               | 18,18       | 19,83  |
|  | No, I have not participated      | 62,50       | 67,57  |
|  | I do not know                    | 0,85        | 2,17   |
|  | Prefer not to answer             | 1,14        | 0,61   |
|  | Total                            | 100,00      | 100,00   |
| INTERACTION 2 (Rarely)   | Yes, I have participated in many | 4,38        | 3,01   |
|  | Yes, but only some               | 27,19       | 21,67  |
|  | No, I have not participated      | 64,69       | 72,21  |
|  | I do not know                    | 3,75        | 2,82   |
|  | Prefer not to answer             | 0,00        | 0,29   |
|  | Total                            | 100         | 100,00   |
|  | Decreases                        | I1          | Changing their mind about science because something happened         |
|  | Increases up to 50%              | I2 (Often)  | Following on social media someone who often publishes about science  |
|  | Increases more than 50%          | I2 (Rarely) | Following on social media someone who rarely publishes about science |
|  | Increases more than 100%         |             |  |

This figure reflects how, with interactions with science, the proportion of people from low SES who participate in many or some initiatives to discuss science in education increases, while decreases the proportion of those who do not participate:

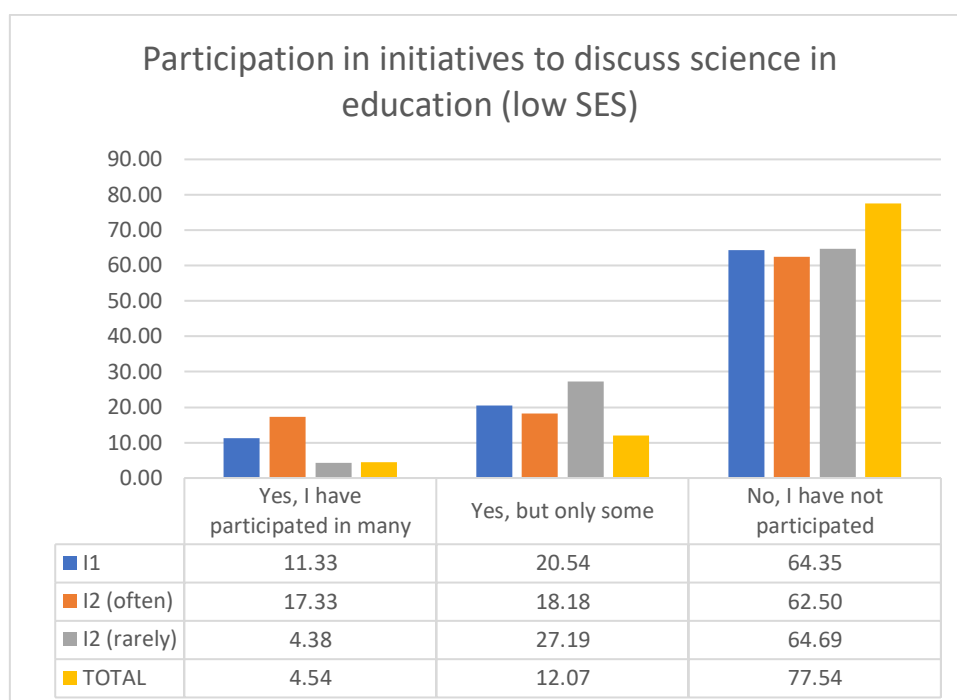


Figure 5.14. Distribution of respondents' answers to the following sentence "Have you participated in any action to discuss scientific discoveries in education, in both face-to-face and online actions?" in people from low SES across interactions with science

Finally, the analysis for respondents who belong to ethnic and religious minority groups who similar results. On the one hand, the total percentage of people from ethnic minorities who have participated in at least some of the initiatives is 36.52% and if we include the impact of interactions the results increase up to 52.73% (interaction 1), 56.95% (interaction 2-often) and 49.49% (interactions 2-rarely). On the other hand, more than three out of ten (32.71%) of people from religious minorities have participated in at least some initiatives, in comparison with the 48.77% obtained in interaction 1, the 56.33% in interaction 2-often and the 41.18% obtained in interaction 2-rarely. It is also noticeable that, in both cases, as happened in other vulnerable groups, the most effective interaction is following someone on social media who often publishes about science and the least effective when this person rarely publishes about science. Finally, both groups follow similar trends: in both groups the proportion of respondents who have participated in many initiatives increase more than 50% in interaction 1 and more than 100% in interaction 2-often. Also in both interactions, the percentages of respondents who participate in some initiatives increase less than 50%.

Table 5.31. Distribution of respondents' answers to the following sentence "Have you participated in any action to discuss scientific discoveries in education, in both face-to-face and online actions?" across interactions for belonging to ethnic and religious minorities

| Have you participated in any action to discuss scientific discoveries in education, in both face-to-face and online actions? |                                  | Ethnic minority | Religious minority | TOTAL |
|--|----------------------------------|-----------------|--------------------|-------|
| INTERACTION 1  | Yes, I have participated in many | 25,78           | 22,97              | 7,09  |
|  | Yes, but only some               | 26,95           | 25,80              | 18,92 |
|  | No, I have not participated      | 42,97           | 46,29              | 69,46 |
|  | I do not know                    | 3,91            | 4,59               | 3,94  |
|  | Prefer not to answer             | 0,39            | 0,35               | 0,59  |

|                           | Total                            | 100,00      | 100,00   | 100,00 |
|---------------------------|----------------------------------|-------------|--|--------|
| INTERACTION 2<br>(Often)  | Yes, I have participated in many | 35,42       | 32,91  | 9,83   |
|                           | Yes, but only some               | 21,53       | 23,42  | 19,83  |
|                           | No, I have not participated      | 38,19       | 40,51  | 67,57  |
|                           | I do not know                    | 4,86        | 3,16   | 2,17   |
|                           | Prefer not to answer             | 0,00        | 0,00   | 0,61   |
|                           | Total                            | 100,00      | 100,00   | 100,00 |
| INTERACTION 2<br>(Rarely) | Yes, I have participated in many | 9,28        | 9,56   | 3,01   |
|                           | Yes, but only some               | 40,21       | 31,62  | 21,67  |
|                           | No, I have not participated      | 46,39       | 51,47  | 72,21  |
|                           | I do not know                    | 3,09        | 6,62   | 2,82   |
|                           | Prefer not to answer             | 1,03        | 0,74   | 0,29   |
|                           | Total                            | 100         | 100  | 100,00 |
|                           | Decreases                        | I1          | Changing their mind about science because something happened         |        |
|                           | Increases up to 50%              | I2          | Following on social media someone who often publishes about science  |        |
|                           | Increases more than 50%          | I2 (Often)  |  |        |
|                           |                                  | I2 (Rarely) | Following on social media someone who rarely publishes about science |        |
|                           | Increases more than 100%         |             |  |        |

The following figures show these results:

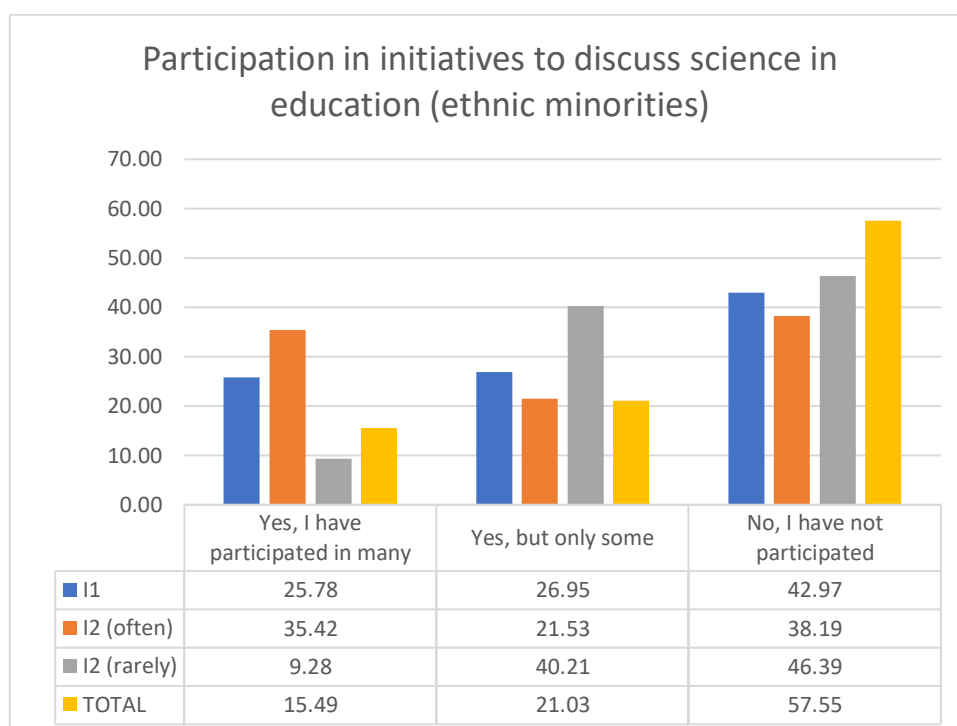


Figure 5.15. Distribution of respondents' answers to the following sentence "Have you participated in any action to discuss scientific discoveries in education, in both face-to-face and online actions?" in people from ethnic minorities across interactions with science

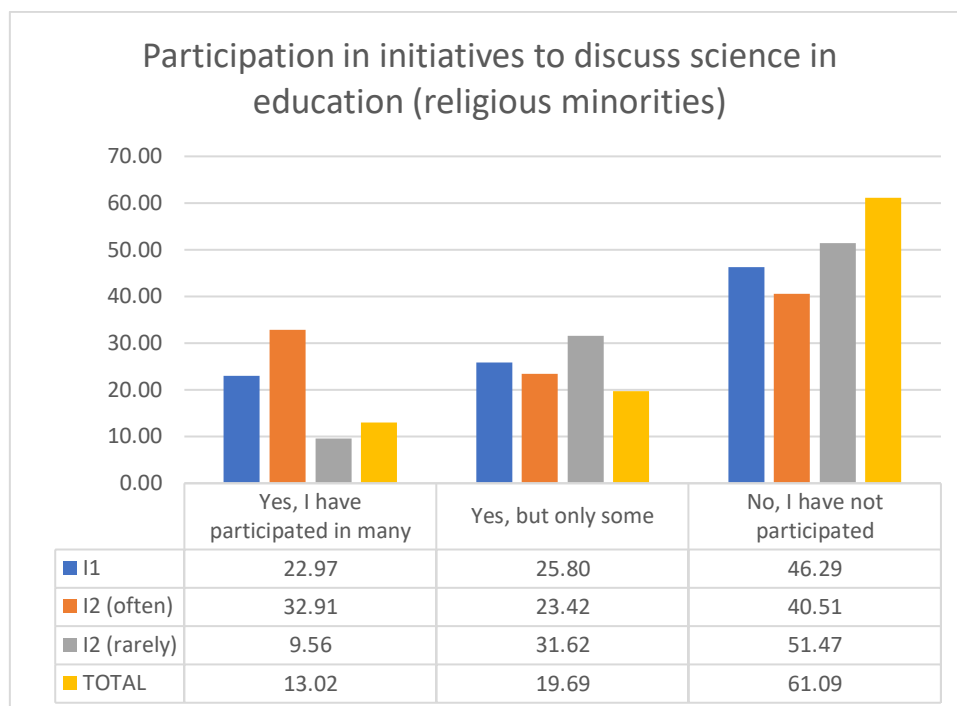


Figure 5.16. Distribution of respondents' answers to the following sentence "Have you participated in any action to discuss scientific discoveries in education, in both face-to-face and online actions?" in people from religious minorities across interactions with science

Therefore, in all vulnerable groups, respondents are more likely to participate in initiatives to discuss scientific discoveries in education when they interact with science through any of the analysed initiatives. In general, the most effective interaction is following someone on social media who often published about science and the least when this person rarely publishes about science. Finally, the results point out that people from low SES and women are the groups that most incremented their participation in initiatives when they interact with science.

## Question 2

The second question is referred to the participation in actions to discuss scientific breakthroughs in gender issues and only 14.8% of the respondents expressed having participated in this type of initiatives (including those who have participated in many and those that only in some).

Table 5.32. Distribution of respondents' answers to the following sentence "Have you participated in any action to discuss scientific breakthroughs in gender, in both face-to-face and online actions?"

| Have you participated in any action to discuss scientific breakthroughs in gender issues, in both face-to-face and online actions? |           |            |                        |
|--|-----------|------------|------------------------|
|  | Frequency | Percentage | Accumulated percentage |
| Yes, I have participated in many   | 204       | 2,7        | 2,7                    |
| Yes, but only some   | 906       | 12,1       | 14,8                   |
| No, I have not participated  | 5899      | 78,6       | 93,4                   |
| I do not know  | 411       | 5,5        | 98,8                   |

|                      |      |       |       |
|----------------------|------|-------|-------|
| Prefer not to answer | 87   | 1,2   | 100,0 |
| Total                | 7507 | 100,0 | 100,0 |

### Responses by vulnerable groups

When we look at the responses of people from vulnerable groups, we can observe that generally, respondents from vulnerable groups are more likely to participate in actions to discuss scientific evidence in gender, compared with the total of respondents. This difference is more accentuated in the case of ethnic and religious minorities (with 41.49% and 35.35% respectively in comparison with the 12.79% of the total). On the contrary, women and people from low socioeconomic status obtained similar results in comparison with the total population, with 14.39% in the case of women and 17.88% in people from low socioeconomic status.

Table 5.33. Distribution of respondents' answers to the following sentence "Have you participated in any action to discuss scientific breakthroughs in gender, in both face-to-face and online actions?" across vulnerable groups

| Have you participated in any action to discuss scientific breakthroughs in gender issues, in both face-to-face and online actions? |        |        |        |                       |                   |                      |        |  |
|--|--------|--------|--------|-----------------------|-------------------|----------------------|--------|--|
|  | Woman  | LGBTI+ | Youth  | Low SES <sup>57</sup> | Ethnic minorities | Religious minorities | TOTAL  |  |
| Yes, I have participated in many   | 2,52   | 7,84   | 5,91   | 4,58                  | 15,49             | 13,80                | 2,72   |  |
| Yes, but only some   | 11,87  | 13,73  | 19,86  | 13,30                 | 26,00             | 21,55                | 12,07  |  |
| No, I have not participated  | 79,32  | 64,71  | 66,09  | 76,31                 | 54,68             | 58,14                | 78,58  |  |
| I do not know  | 5,03   | 13,73  | 6,13   | 4,89                  | 3,44              | 5,58                 | 5,47   |  |
| prefer not to answer   | 1,26   | 0,00   | 2,01   | 0,92                  | 0,38              | 0,93                 | 1,16   |  |
| TOTAL  | 100,00 | 100,00 | 100,00 | 100,00                | 100,00            | 100,00               | 100,00 |  |

This figure presents the distribution of responses from people from vulnerable groups.

<sup>57</sup> Low SES is defined as having gross income below 16,043 Euros per year



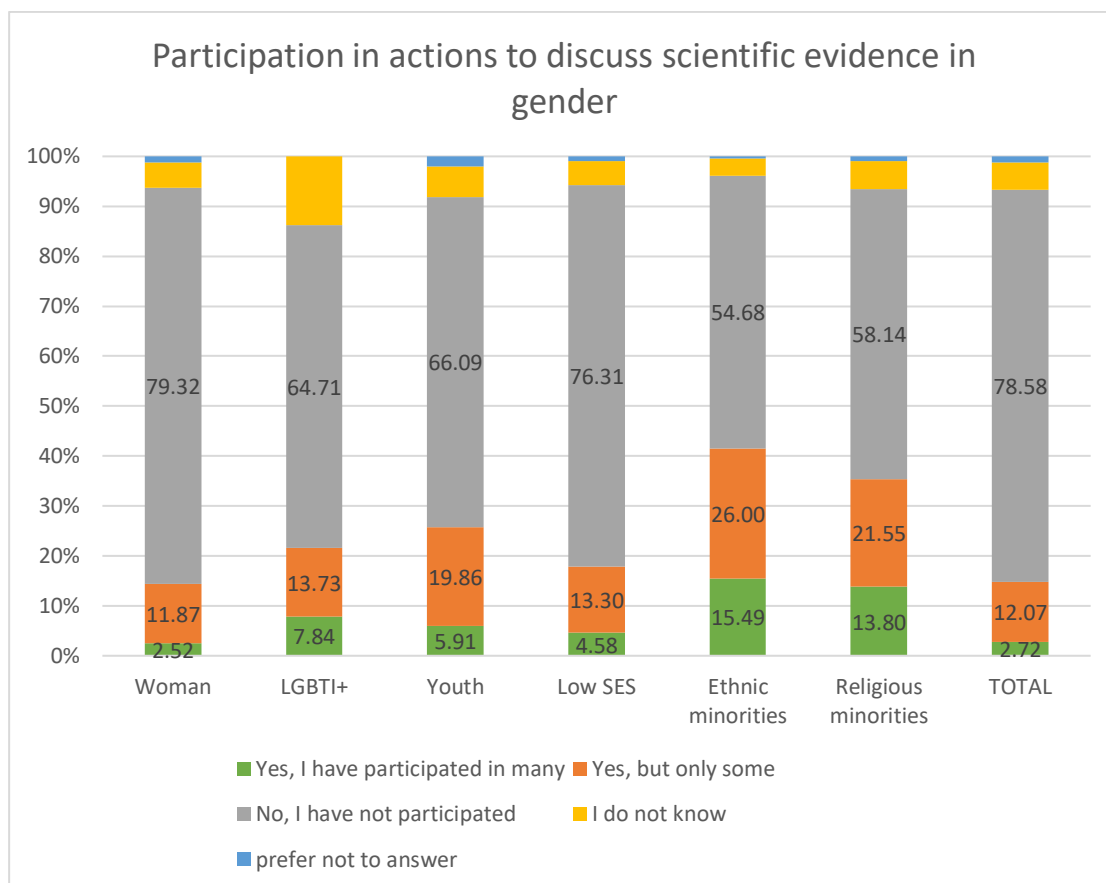


Figure 5.17. Distribution of respondents' answers to the following sentence "Have you participated in any action to discuss scientific breakthroughs in gender, in both face-to-face and online actions?" across vulnerable groups

**Generally, the proportion of respondents from vulnerable groups that expressed having participated in actions to discuss scientific evidence is higher than in the total of respondents. The difference is more noticeable in ethnic and religious minorities. This is not the case of women and people from low SES, who get similar results than the total of respondents.**

### The impact of interactions

This section analyses the impact of two interactions with science in the responses of people from vulnerable groups. The interactions are:

- Has something happened to you or someone in your family that made you change your mind about science or become interested in science?
- Do the scientific people you follow share anecdotes or evidence about science?

In the analysis of the impact of these interactions, we have included the responses of those respondents who had interacted with science; thus, the responses in this section are those from participants who answered "yes" to interaction 1 and "yes, often" and "yes, rarely" in interaction 2.

When we look at data by gender vulnerable groups, we can see an increment in the proportion of women who have participated in at least some initiatives to discuss gender science. Thus, 14.59% of the total of women expressed having participated in these initiatives, compared with the 25.82% among those who changed their mind due to previous experiences with science, 31.30% among those who follow on social media someone who often publishes about science and 24.16% when this person on social media rarely publishes about science. Regarding the impact of each interaction, the most effective interaction in the promotion of women participation is following someone on social media who often publishes about science, with increases of more than 50% (participation in some initiatives) and more than 100% (participation in many initiatives). Interaction 1 also promotes notable increases in the participation of women, but this is not the case of the interaction of following someone on social media who rarely publishes about science. Also in this case, the analysis by LGBTI+ individuals has limitations caused by the small size of the sample (n=12, n=7 and n=7).

Table 5.34. Distribution of respondents' answers to the following sentence "Have you participated in any action to discuss scientific breakthroughs in gender, in both face-to-face and online actions?" across interactions by gender vulnerable groups

| Have you participated in any action to discuss scientific breakthroughs in gender issues, in both face-to-face and online actions? |                                  |             |  |        |
|--|----------------------------------|-------------|--|--------|
|  |                                  | Women       | LGBTI+   | TOTAL  |
| INTERACTION 1  | Yes, I have participated in many | 6,43        | 25,00  | 6,93   |
|  | Yes, but only some               | 19,39       | 41,67  | 21,06  |
|  | No, I have not participated      | 70,25       | 25,00  | 67,86  |
|  | I do not know                    | 2,88        | 8,33   | 3,25   |
|  | Prefer not to answer             | 1,06        | 0,00   | 0,91   |
|  | Total                            | 100,00      | 100,00   | 100,00 |
| INTERACTION 2 (Often)  | Yes, I have participated in many | 8,46        | 42,86  | 8,87   |
|  | Yes, but only some               | 22,84       | 0,00   | 22,26  |
|  | No, I have not participated      | 65,31       | 42,86  | 65,65  |
|  | I do not know                    | 2,20        | 14,29  | 2,52   |
|  | Prefer not to answer             | 1,18        | 0,00   | 0,70   |
|  | Total                            | 100,00      | 100,00   | 100,00 |
| INTERACTION 2 (Rarely)   | Yes, I have participated in many | 1,96        | 0,00   | 2,92   |
|  | Yes, but only some               | 22,20       | 14,29  | 22,55  |
|  | No, I have not participated      | 72,69       | 85,71  | 71,62  |
|  | I do not know                    | 2,36        | 0,00   | 2,53   |
|  | Prefer not to answer             | 0,79        | 0,00   | 0,39   |
|  | Total                            | 100         | 100  | 100    |
|  | Decreases                        | I1          | Changing their mind about science because something happened         |        |
|  | Increases up to 50%              | I2 (Often)  | Following on social media someone who often publishes about science  |        |
|  | Increases more than 50%          | I2 (Rarely) | Following on social media someone who rarely publishes about science |        |
|  | Increases more than 100%         |             |  |        |

This figure shows that, when we add the impact of interactions with science, the proportion of women who have not participated decreases, while increases the percentage of those who participate in some and in many initiatives. In this case, the most effective interaction in

fostering women participation in gender science is following someone on social media who often publishes about science.

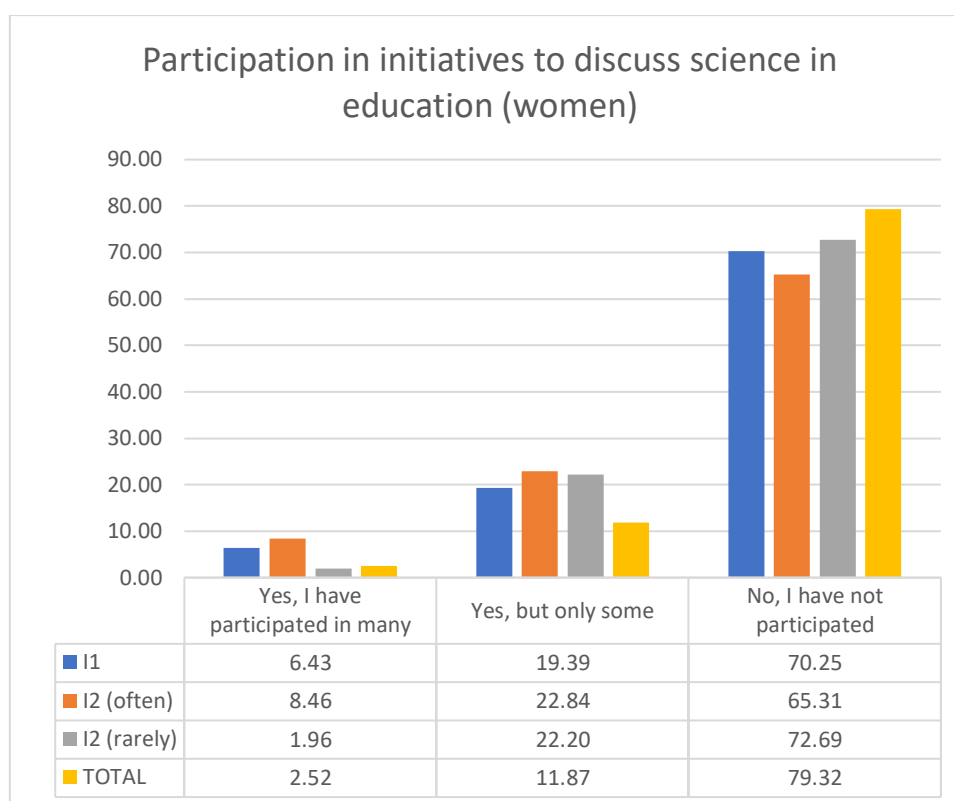


Figure 5.18. Distribution of respondents' answers to the following sentence "Have you participated in any action to discuss scientific breakthroughs in gender, in both face-to-face and online actions?" in women across interactions with science

The analysis for young people aged 16-34 points to an increment in the participation in at least some initiatives to discuss gender breakthroughs due to interactions with science. In this line, while the total percentage of participation among youth is 25.77%, with interactions the proportions rise to 41.29% (changing their mind about science because something happened to them or their families), 37.30% (following someone on social media who often publishes about science) and 37.42% (when this person rarely publishes about science). Therefore, based on these results we can state that the most effective interaction in this case is changing their mind about science due to previous experiences. In addition, interaction 1 and 2- often, increase the proportion of youth who have participated in many initiatives by more than 100%

Table 5.35. Distribution of respondents' answers to the following sentence "Have you participated in any action to discuss scientific breakthroughs in gender, in both face-to-face and online actions?" across interactions by youth groups

| Have you participated in any action to discuss scientific breakthroughs in gender issues, in both face-to-face and online actions? |                                  | Youth | TOTAL |
|--|----------------------------------|-------|-------|
| INTERACTION 1  | Yes, I have participated in many | 12,60 | 6,93  |
|  | Yes, but only some               | 28,69 | 21,06 |
|  | No, I have not participated      | 54,06 | 67,86 |
|  | I do not know                    | 3,32  | 3,25  |

|                           |                                  |          |  |
|---------------------------|----------------------------------|----------|--|
|                           | Prefer not to answer             | 1,33     | 0,91   |
|                           | Total                            | 100,00   | 100,00   |
| INTERACTION 2<br>(Often)  | Yes, I have participated in many | 12,59    | 8,87   |
|                           | Yes, but only some               | 24,71    | 22,26  |
|                           | No, I have not participated      | 58,74    | 65,65  |
|                           | I do not know                    | 3,03     | 2,52   |
|                           | Prefer not to answer             | 0,93     | 0,70   |
|                           | Total                            | 100,00   | 100,00   |
| INTERACTION 2<br>(Rarely) | Yes, I have participated in many | 6,60     | 2,92   |
|                           | Yes, but only some               | 30,82    | 22,55  |
|                           | No, I have not participated      | 61,64    | 71,62  |
|                           | I do not know                    | 0,63     | 2,53   |
|                           | Prefer not to answer             | 0,31     | 0,39   |
|                           | Total                            | 100      | 100,00   |
|                           | Decreases                        | I1       | Changing their mind about science because something happened         |
|                           | Increases up to 50%              | I2       | Following on social media someone who often publishes about science  |
|                           |                                  | (Often)  |  |
|                           | Increases more than 50%          | I2       | Following on social media someone who rarely publishes about science |
|                           |                                  | (Rarely) |  |
|                           | Increases more than 100%         |          |  |

This figure presents the abovementioned results, including a decrease in the proportion of youth who have never participated in initiatives to discuss gender scientific advances.

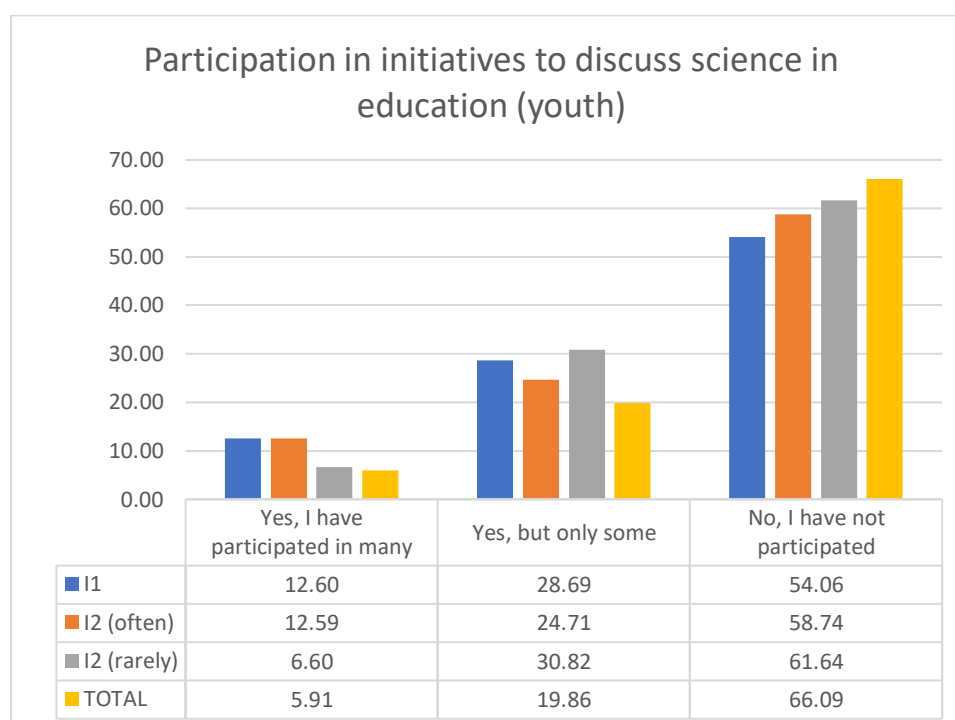


Figure 5.19. Distribution of respondents' answers to the following sentence "Have you participated in any action to discuss scientific breakthroughs in gender, in both face-to-face and online actions?" in youth across interactions with science

The analysis for household income indicates that interactions with science boost the participation of people from low SES in initiatives to discuss scientific advances in gender. Thus, when people from low SES interact with science, the percentage of participation in at

least some initiatives is 33.08% (interaction 1), 41.16% (interaction 2-often) and 31.26% (interaction 2-rarely), compared with the 17.88% of the total of people from low SES. This analysis also points that the most effective interaction for people from low SES (with an increment of more than 130%) is following someone on social media who often publishes about science. Finally, the first two interactions follow similar increase patterns with increments of more than 100% in the option “Yes, I have participated in many” and more than 50% in the “Yes, but only some”.

Table 5.36. Distribution of respondents' answers to the following sentence “Have you participated in any action to discuss scientific breakthroughs in gender, in both face-to-face and online actions?” across interactions by low SES

| Have you participated in any action to discuss scientific breakthroughs in gender issues, in both face-to-face and online actions? |                                  |             |  |
|--|----------------------------------|-------------|--|
|  |                                  | Low SES     | TOTAL  |
| INTERACTION 1  | Yes, I have participated in many | 11,18       | 6,93   |
|  | Yes, but only some               | 21,90       | 21,06  |
|  | No, I have not participated      | 63,14       | 67,86  |
|  | I do not know                    | 2,87        | 3,25   |
|  | Prefer not to answer             | 0,91        | 0,91   |
|  | Total                            | 100,00      | 100,00   |
| INTERACTION 2 (Often)  | Yes, I have participated in many | 17,33       | 8,87   |
|  | Yes, but only some               | 23,86       | 22,26  |
|  | No, I have not participated      | 56,25       | 65,65  |
|  | I do not know                    | 1,99        | 2,52   |
|  | Prefer not to answer             | 0,57        | 0,70   |
|  | Total                            | 100,00      | 100,00   |
| INTERACTION 2 (Rarely)   | Yes, I have participated in many | 4,38        | 2,92   |
|  | Yes, but only some               | 26,88       | 22,55  |
|  | No, I have not participated      | 65,94       | 71,62  |
|  | I do not know                    | 2,19        | 2,53   |
|  | Prefer not to answer             | 0,63        | 0,39   |
|  | Total                            | 100,00      | 100  |
|  | Decreases                        | I1          | Changing their mind about science because something happened         |
|  | Increases up to 50%              | I2 (Often)  | Following on social media someone who often publishes about science  |
|  | Increases more than 50%          | I2 (Rarely) | Following on social media someone who rarely publishes about science |
|  | Increases more than 100%         |             |  |

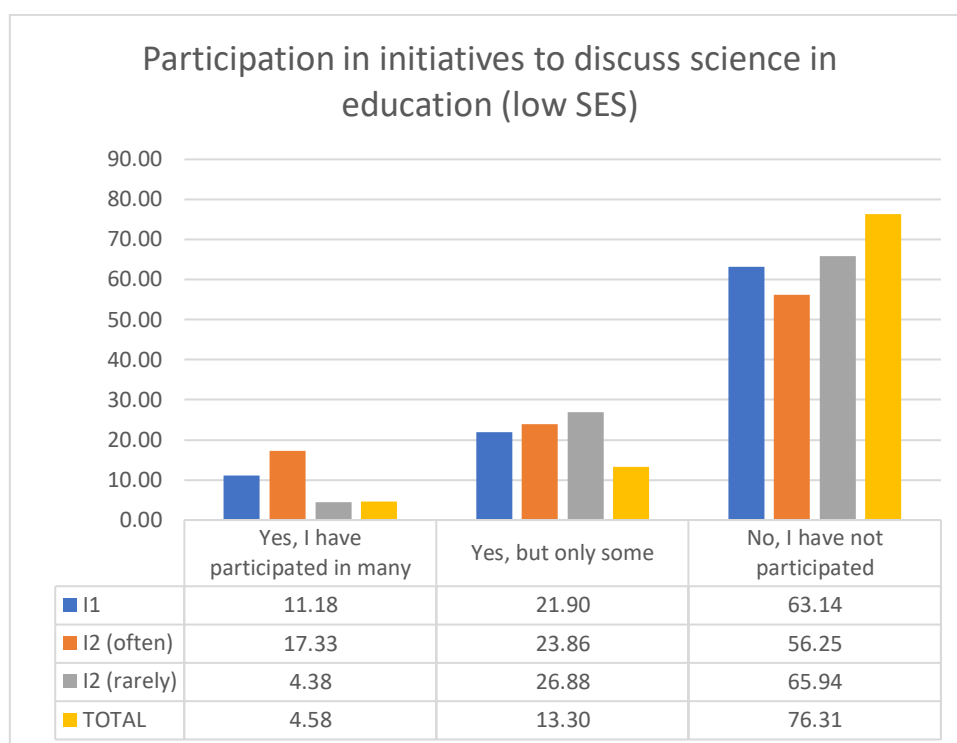


Figure 5.20. Distribution of respondents' answers to the following sentence "Have you participated in any action to discuss scientific breakthroughs in gender, in both face-to-face and online actions?" in people from low SES across interactions with science

Finally, in ethnic and religious minorities interactions with science also play an undeniable role in the promotion of participation in scientific discussions in gender. On the one hand, the proportion of participation among ethnic minorities who have interacted with science is 59.37% (interaction 1), 62.50 (interaction 2-often) and 54.64% (interaction 2-rarely), compared with the 41.49% of the total of ethnic minorities. On the other hand, the participation among religious minorities with interactions with science is 54.07% (interaction 1), 60.76% (interaction 2-often) and 45.59% (interaction 2-rarely), compared with the 35.35% of the total of religious minorities. In both cases, it is relevant how the proportion of those who have participated in many discussions about scientific advances in gender increases approximately 150% as a result of following someone on social media who often publishes about science.

Table 5.37. Distribution of respondents' answers to the following sentence "Have you participated in any action to discuss scientific breakthroughs in gender, in both face-to-face and online actions?" across interactions for belonging to ethnic and religious minorities

| Have you participated in any action to discuss scientific breakthroughs in gender issues, in both face-to-face and online actions? |                                  |                 |                    |        |
|--|----------------------------------|-----------------|--------------------|--------|
|  |                                  | Ethnic minority | Religious minority | TOTAL  |
| INTERACTION<br>1   | Yes, I have participated in many | 25,39           | 24,03              | 6,93   |
|  | Yes, but only some               | 33,98           | 30,04              | 21,06  |
|  | No, I have not participated      | 37,89           | 42,05              | 67,86  |
|  | I do not know                    | 2,34            | 2,83               | 3,25   |
|  | Prefer not to answer             | 0,39            | 1,06               | 0,91   |
|  | Total                            | 100,00          | 100,00             | 100,00 |

|                           |                                  |             |  |        |
|---------------------------|----------------------------------|-------------|--|--------|
| INTERACTION 2<br>(Often)  | Yes, I have participated in many | 38,89       | 34,18  | 8,87   |
|                           | Yes, but only some               | 23,61       | 26,58  | 22,26  |
|                           | No, I have not participated      | 36,11       | 36,71  | 65,65  |
|                           | I do not know                    | 0,69        | 2,53   | 2,52   |
|                           | Prefer not to answer             | 0,69        | 0,00   | 0,70   |
|                           | Total                            | 100,00      | 100,00   | 100,00 |
| INTERACTION 2<br>(Rarely) | Yes, I have participated in many | 9,28        | 11,03  | 2,92   |
|                           | Yes, but only some               | 45,36       | 34,56  | 22,55  |
|                           | No, I have not participated      | 44,33       | 50,00  | 71,62  |
|                           | I do not know                    | 1,03        | 3,68   | 2,53   |
|                           | Prefer not to answer             | 0,00        | 0,74   | 0,39   |
|                           | Total                            | 100,00      | 100,00   | 100,00 |
|                           | Decreases                        | I1          | Changing their mind about science because something happened         |        |
|                           | Increases up to 50%              | I2 (Often)  | Following on social media someone who often publishes about science  |        |
|                           | Increases more than 50%          | I2 (Rarely) | Following on social media someone who rarely publishes about science |        |
|                           | Increases more than 100%         |             |  |        |

The following figures represent these results in ethnic and religious minorities:

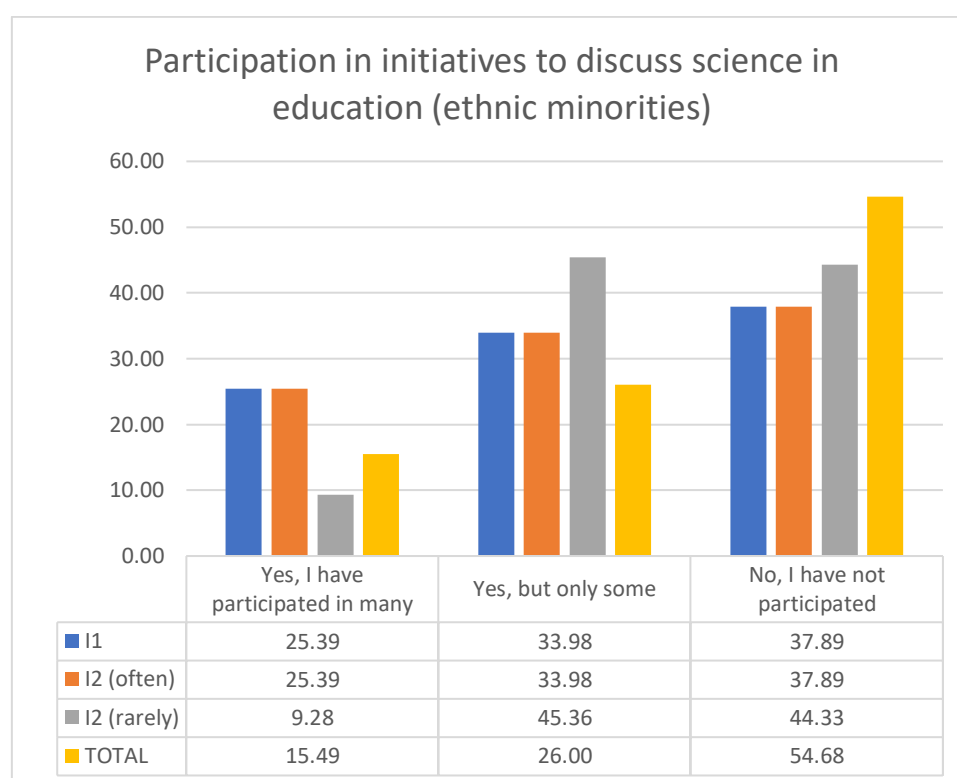
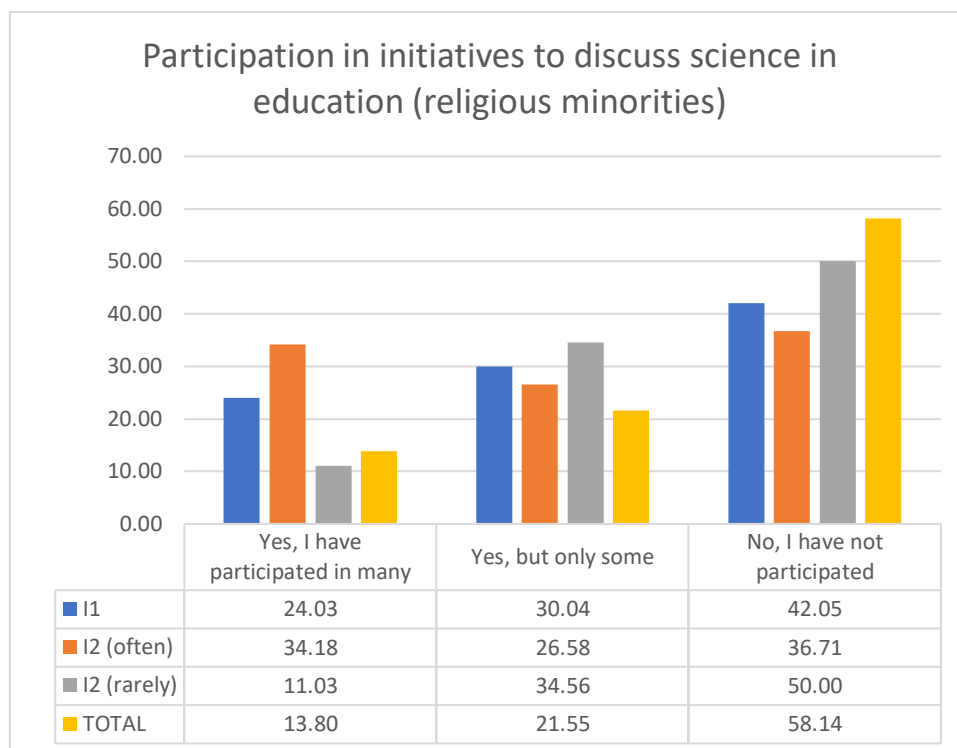


Figure 5.21. Distribution of respondents' answers to the following sentence "Have you participated in any action to discuss scientific breakthroughs in gender, in both face-to-face and online actions?" in people from ethnic minorities across interactions with science



*Figure 5.22. Distribution of respondents' answers to the following sentence "Have you participated in any action to discuss scientific breakthroughs in gender, in both face-to-face and online actions?" in people from religious minorities across interactions with science*

**We can conclude that all interactions have impact in the promotion of participation of people from vulnerable groups in discussion about scientific advances in gender. However, the most effective interaction in almost all the cases is following a scientific person on social media when this person often publishes about science (including scientific anecdotes and evidence). Finally, the group that is most benefitted from these interactions with science are people from low socioeconomic status, with increments in participation of approximately 150%, compared with the total of participants within their vulnerable group.**



## 5.4 Section 3- Awareness of scientific evidence on education or gender

This section aims to identify through what sources citizens become aware of scientific evidence on gender and education. It is structured in three sub-sections: sources of information on scientific evidence, conversations about scientific evidence and source of awareness of scientific evidence.

### 5.4.1 Sources of information on scientific evidence

This first subsection includes the responses to the following question:

- Have you become aware of some scientific evidence on education or gender through sources of information such as newspapers, magazines, scientific journals, television, YouTube, social media,....?

The results are summarized in the following table and indicate that almost 3 out of ten of the respondents use sources of information to learn about scientific evidence on education and gender. On the contrary, 54.0% do not use these sources.

Table 5.38. Distribution of respondents' answers to the following sentence "Have you become aware of some scientific evidence on education or gender through sources of information such as newspapers, magazines, scientific journals, television, youtube, social media...?"

| <b>Have you become aware of some scientific evidence on education or gender through sources of information such as newspapers, magazines, scientific journals, television, youtube, social media...?</b> |           |            |                        |
|--|-----------|------------|------------------------|
|  | Frequency | Percentage | Accumulated percentage |
| Yes, I have  | 2231      | 29,7       | 29,7                   |
| No, I have not   | 4054      | 54,0       | 83,7                   |
| I do not know  | 1120      | 14,9       | 98,6                   |
| Prefer not to answer   | 102       | 1,4        | 100,0                  |
| Total  | 7507      | 100,0      | 100,0                  |

### Responses by vulnerable groups

The analysis across vulnerable groups point to the existence of differences in comparison with the total of respondents. Ethnic and religious minorities as well as young people tend to use information sources more than the total population, while people from low SES and women get similar percentages and LGBTI+ community slightly lower percentages.

Table 5.39. Distribution of respondents' answers to the following sentence "Have you become aware of some scientific evidence on education or gender through sources of information such as newspapers, magazines, scientific journals, television, youtube, social media...?" across vulnerable groups

| <b>Have you learned of any scientific evidence on education or gender through information sources such as newspapers, magazines, scientific publications, television, YouTube, social networks, etc</b> |        |             |             |                       |                   |                      |       |
|---|--------|-------------|-------------|-----------------------|-------------------|----------------------|-------|
| Women   | LGBTI+ | Youth 16-24 | Youth 25-34 | Low SES <sup>58</sup> | Ethnic minorities | Religious minorities | TOTAL |

<sup>58</sup> Low SES is defined as having gross income below 16,043 Euros per year

|                      |        |        |        |        |        |        |        |        |
|----------------------|--------|--------|--------|--------|--------|--------|--------|--------|
| Yes                  | 29,93  | 23,53  | 46,91  | 37,43  | 32,10  | 48,37  | 44,50  | 29,72  |
| No                   | 53,05  | 49,02  | 36,08  | 45,60  | 52,31  | 37,67  | 42,02  | 54,00  |
| I do not know        | 15,52  | 27,45  | 14,09  | 15,23  | 14,44  | 13,38  | 12,56  | 14,92  |
| Prefer not to answer | 1,49   | 0,00   | 2,92   | 1,74   | 1,14   | 0,57   | 0,93   | 1,36   |
| TOTAL                | 100,00 | 100,00 | 100,00 | 100,00 | 100,00 | 100,00 | 100,00 | 100,00 |

The following figure represents these results across vulnerable groups.

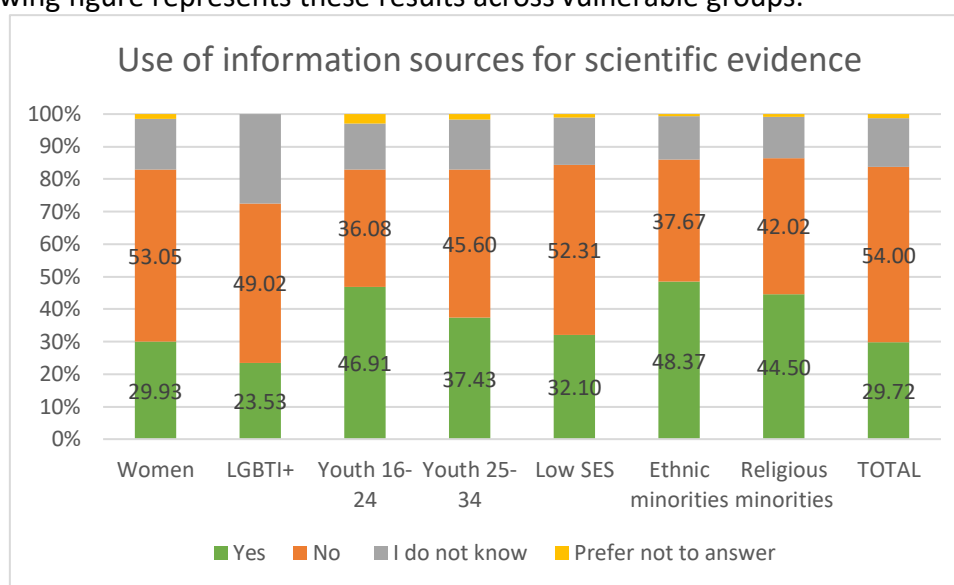


Figure 5.23. Distribution of respondents' answers to the following sentence "Have you become aware of some scientific evidence on education or gender through sources of information such as newspapers, magazines, scientific journals, television, youtube, social media...?" across vulnerable groups

Therefore, differences in the use of information sources to exist across vulnerable groups. On the one hand, youth and ethnic and religious minorities express using these sources more than the total of respondents. On the other hand, there are not relevant differences between the responses from women and people from low SES, and the total of respondents.

### The impact of interactions

This section analyses the impact of two interactions with science in the responses of people from vulnerable groups. The interactions are:

- Has something happened to you or someone in your family that made you change your mind about science or become interested in science?
- Do the scientific people you follow share anecdotes or evidence about science?

In the analysis of the impact of these interactions, we have included the responses of those respondents who had interacted with science; thus, the responses in this section are those from participants who answered "yes" to interaction 1 and "yes, often" and "yes, rarely" in interaction 2.

Interactions with science increase the use of information sources to learn about scientific evidence on education and gender in all vulnerable groups, although not all interactions are equally effective. First, the analysis related to interaction 1 (changing own's mind about science due to previous experience with science) indicates that in all vulnerable groups, approximately or more than half of the respondents use newspapers, magazines, scientific publications, television, YouTube, social networks, etc. to learn about scientific evidence. In addition, when women and people from low SES interact with science through this interaction, they are more than 50% more likely to use information sources to learn about scientific evidence. In youth and ethnic and religious minorities, the increase is lower than 50%. Second, the analysis for interaction 2-often (following someone on social media who often publishes about science) indicates that the percentages of people who use the abovementioned sources to learn about scientific evidence on education and gender are even higher, ranging from 56.51% (women) to 74.31% (ethnic minorities). In this case, almost in all vulnerable groups we can observe an increment of more than 50%. Third, the results for interaction 2-rarely (following someone on social media who rarely publishes about science) indicate that following a scientist on social networks is not enough if these scientists do not provide users the opportunity to interact with scientific content by sharing anecdotes or evidence about science. In this case, the proportion of respondents that express using information sources ranges from 42.86% (LGBTI+) to 58.76% (ethnic minorities). Finally, due to the reduced number of responses from the LGBTI+ community (n=12, n=7 and n=7), their results have limited implications

Table 5.40. Distribution of respondents' answers to the following sentence "Have you become aware of some scientific evidence on education or gender through sources of information such as newspapers, magazines, scientific journals, television, youtube, social media..." across interactions and vulnerable groups

| Have you learned of any scientific evidence on education or gender through information sources such as newspapers, magazines, scientific publications, television, YouTube, social networks, etc |                      |        |        |                |                |         |                      |                         |        |
|--|----------------------|--------|--------|----------------|----------------|---------|----------------------|-------------------------|--------|
|  |                      | Women  | LGBTI+ | Youth<br>16-24 | Youth<br>25-34 | Low SES | Ethnic<br>minorities | Religious<br>minorities | TOTAL  |
| I1   | Yes                  | 45,59  | 58,33  | 58,88          | 55,17          | 49,70   | 62,50                | 60,42                   | 46,64  |
|  | No                   | 40,60  | 16,67  | 28,93          | 33,00          | 36,40   | 27,34                | 29,33                   | 39,66  |
|  | I do not know        | 12,86  | 25,00  | 11,17          | 10,84          | 12,69   | 9,77                 | 9,19                    | 12,69  |
|  | Prefer not to answer | 0,96   | 0,00   | 1,02           | 0,99           | 1,21    | 0,39                 | 1,06                    | 1,01   |
|  | TOTAL                | 100,00 | 100,00 | 100,00         | 100,00         | 100,00  | 100,00               | 100,00                  | 100,00 |
| I2.Often   | Yes                  | 56,51  | 57,14  | 66,90          | 61,32          | 63,35   | 74,31                | 71,52                   | 56,35  |
|  | No                   | 33,67  | 14,29  | 26,06          | 27,53          | 25,00   | 15,28                | 18,99                   | 33,30  |
|  | I do not know        | 8,97   | 28,57  | 6,34           | 10,10          | 10,80   | 9,72                 | 8,23                    | 9,65   |
|  | Prefer not to answer | 0,85   | 0,00   | 0,70           | 1,05           | 0,85    | 0,69                 | 1,27                    | 0,70   |
|  | TOTAL                | 100,00 | 100,00 | 100,00         | 100,00         | 100,00  | 100,00               | 100,00                  | 100,00 |
| I2.Rarely  | Yes                  | 44,79  | 42,86  | 57,39          | 53,20          | 52,19   | 58,76                | 55,88                   | 48,10  |
|  | No                   | 41,06  | 44,79  | 32,17          | 37,44          | 37,50   | 31,96                | 35,29                   | 40,52  |
|  | I do not know        | 13,36  | 0,00   | 9,57           | 9,36           | 9,38    | 9,28                 | 8,82                    | 10,79  |

|                         |           |  |        |        |        |        |        |        |
|-------------------------|-----------|--|--------|--------|--------|--------|--------|--------|
| Prefer not to answer    | 0,79      | 0,00   | 0,87   | 0,00   | 0,94   | 0,00   | 0,00   | 0,58   |
| TOTAL                   | 100,00    | 100,00   | 100,00 | 100,00 | 100,00 | 100,00 | 100,00 | 100,00 |
| Decrease                | I1        | Changing their mind about science because something happened         |        |        |        |        |        |        |
| Increase up to 50%      | I2.Often  | Following on social media someone who often publishes about science  |        |        |        |        |        |        |
| Increase up to 100%     | I2.Rarely | Following on social media someone who rarely publishes about science |        |        |        |        |        |        |
| Increase more than 100% |           |  |        |        |        |        |        |        |

In the following figure we can see that, based on the increase achieved due to each interaction with science, the impact of all interactions is more accentuated in people from low SES and in women than in other vulnerable groups.

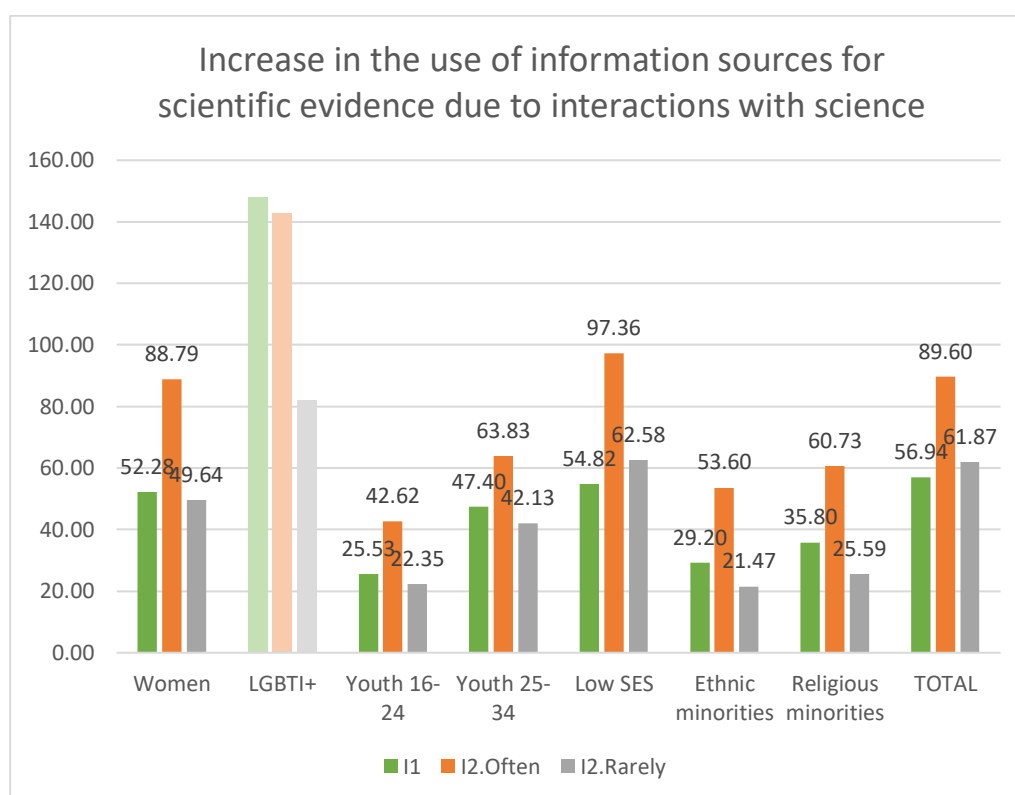


Figure 5.24. Increase in respondents' answers to the following sentence "Have you become aware of some scientific evidence on education or gender through sources of information such as newspapers, magazines, scientific journals, television, youtube, social media..." across interactions with science and vulnerable groups

Finally, all interactions increase the proportion of people from all vulnerable groups who use information sources to learn about scientific evidence on education and gender. However, not all interactions are equally effective. This analysis points to following someone on social media who often publishes about science as the interaction with more impact across vulnerable groups. Finally, the analysed interactions have a greater impact on people from low socioeconomic status, compared to other vulnerable groups.

#### 5.4.2 Conversations about scientific evidence

This section aims to analyse the use of conversations to learn about scientific evidence on gender and education and includes the following questions:

- Have you ever talked about scientific evidence on education with other people?
- Have you ever talked about scientific evidence on gender with other people?

Both of them include four response options: yes, no, I do not know and prefer not to answer. The following table summarize the results obtained and show how more than one third of the respondents (37.7% in education and 33.4% in gender) share conversations about scientific evidence with other people.

Table 5.41. Distribution of respondents' answers to the following sentence "Have you ever talked about scientific evidence on education with other people?"

| <b>Have you ever talked about scientific evidence on education with other people?</b> |           |            |                        |
|---|-----------|------------|------------------------|
|   | Frequency | Percentage | Accumulated percentage |
| Yes, I have   | 2831      | 37,7       | 37,7                   |
| No, I have not  | 3888      | 51,8       | 89,5                   |
| I do not know   | 686       | 9,1        | 98,6                   |
| Prefer not to answer  | 102       | 1,4        | 100,0                  |
| Total   | 7507      | 100,0      | 100,0                  |

Table 5.42. Distribution of respondents' answers to the following sentence "Have you ever talked about scientific evidence on gender with other people?"

| <b>Have you ever talked about scientific evidence on gender with other people?</b> |           |            |                        |
|--|-----------|------------|------------------------|
|  | Frequency | Percentage | Accumulated percentage |
| Yes, I have  | 2505      | 33,4       | 33,4                   |
| No, I have not   | 4326      | 57,6       | 91,0                   |
| I do not know  | 581       | 7,7        | 98,7                   |
| Prefer not to answer   | 95        | 1,3        | 100,0                  |
| Total  | 7507      | 100,0      | 100,0                  |

The following figure also represents this trend:

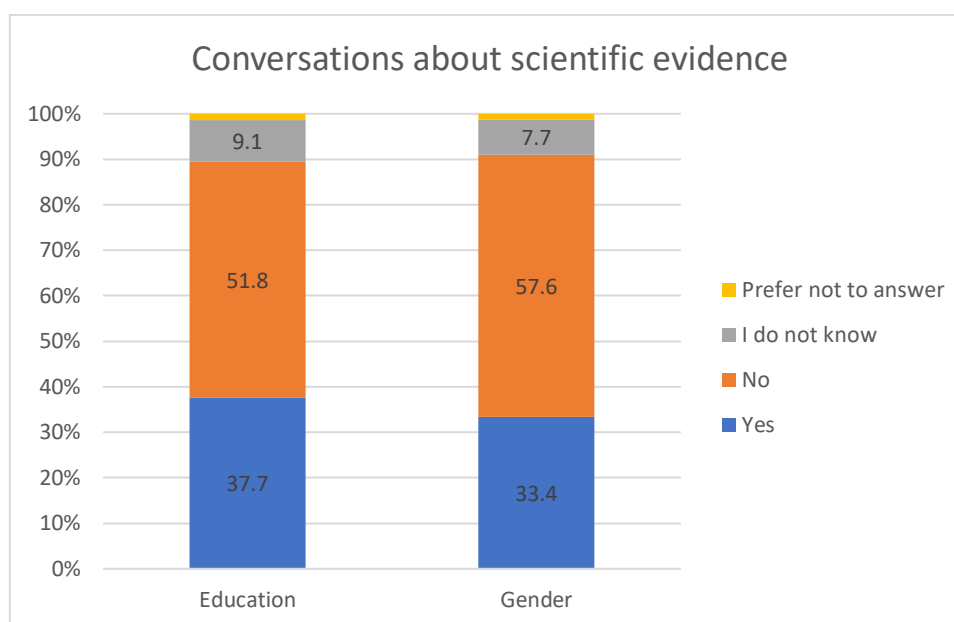


Figure 5.25. Distribution of respondents' answers to the following sentence "Have you ever talked about scientific evidence on [education/gender] with other people?"

## Responses by vulnerable groups

This section aims to look closer at the results across vulnerable groups. On the one hand, regarding conversations on education, the results range from 29.41% (in the LGBTI+ community) to 52.58% (in ethnic minorities). When comparing vulnerable groups with the total of population, we can observe that youth as well as ethnic and religious minorities are more likely to share conversations about scientific evidence on education than the total population: 45.19% in youth 16-24, 41.55% in youth 25-34, 52.58% in ethnic minorities and 50.70% in religious minorities, compared to 37.71% in the total. On the contrary, LGBTI+ community express sharing less conversations than the total of respondents (29.41%) and in women (37.20%) and people from low SES (39.75%) there are not relevant differences compared with the total.

Table 5.43. Distribution of respondents' answers to the following sentence "Have you ever talked about scientific evidence on education with other people?" across vulnerable groups

| Have you ever talked to other people about scientific evidence related to education? |       |        |             |             |                       |                   |                      |       |
|--|-------|--------|-------------|-------------|-----------------------|-------------------|----------------------|-------|
|  | Women | LGBTI+ | Youth 16-24 | Youth 25-34 | Low SES <sup>59</sup> | Ethnic minorities | Religious minorities | TOTAL |
| Yes  | 37,20 | 29,41  | 45,19       | 41,55       | 38,75                 | 52,58             | 50,70                | 37,71 |
| No   | 52,06 | 50,98  | 38,14       | 46,47       | 51,87                 | 36,52             | 39,84                | 51,79 |
| I do not know  | 9,23  | 17,65  | 14,26       | 10,15       | 8,54                  | 10,13             | 8,37                 | 9,14  |
| Prefer not to answer   | 1,52  | 1,96   | 2,41        | 1,82        | 0,84                  | 0,76              | 1,09                 | 1,36  |

<sup>59</sup> Low SES is defined as having gross income below 16,043 Euros per year

|       |        |        |        |        |        |        |        |        |
|-------|--------|--------|--------|--------|--------|--------|--------|--------|
| TOTAL | 100,00 | 100,00 | 100,00 | 100,00 | 100,00 | 100,00 | 100,00 | 100,00 |
|-------|--------|--------|--------|--------|--------|--------|--------|--------|

The following figure shows the distribution of responses across vulnerable groups, compared with the total of respondents:

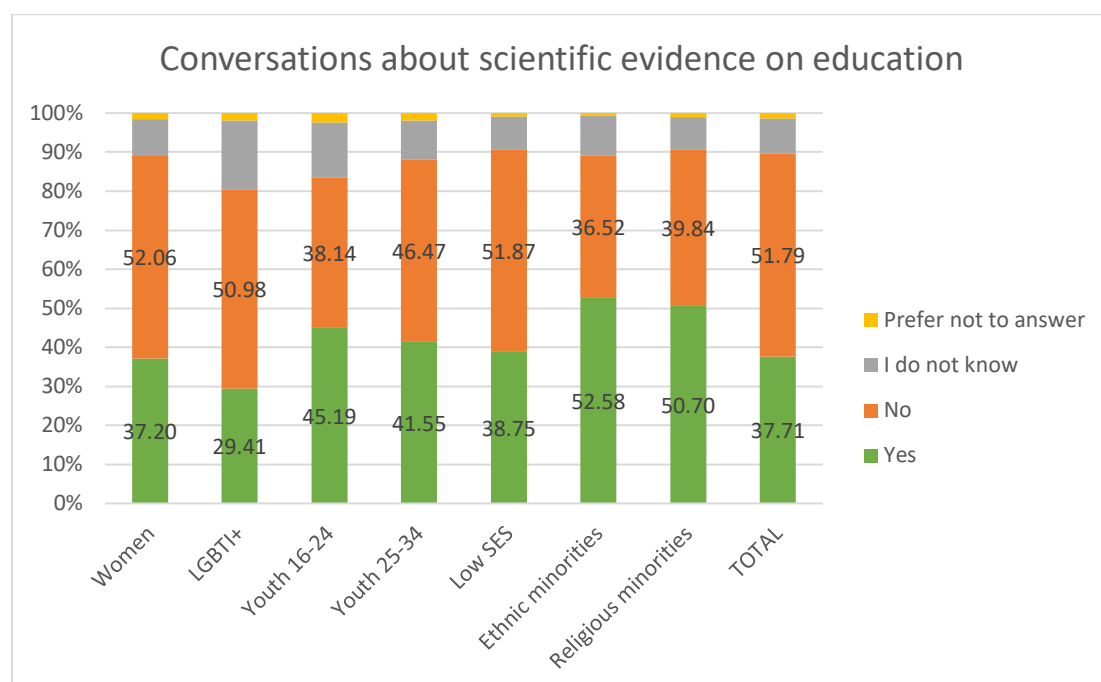


Figure 5.26. Distribution of respondents' answers to the following sentence "Have you ever talked about scientific evidence on education with other people?" across vulnerable groups

On the other hand, results about conversations on gender, the results range from 27.45% (in the LGBTI+ community) to 50.67% (in ethnic minorities). When comparing vulnerable groups with the total of population, we can observe that youth as well as ethnic and religious minorities are more likely to share conversations about scientific evidence on gender than the total population: 44.67% in youth 16-24, 39.81% in youth 25-34, 50.67% in ethnic minorities and 47.44% in religious minorities, compared to 33.37% in the total. On the contrary, LGBTI+ community express sharing less conversations than the total of respondents (27.45%) and in women (34.05%) and people from low SES (35.36%) there are not relevant differences compared with the total.

Table 5.44. Distribution of respondents' answers to the following sentence "Have you ever talked about scientific evidence on gender with other people?" across vulnerable groups

| Have you ever talked to other people about scientific evidence related to gender? |        |        |             |             |         |                   |                      |        |
|---|--------|--------|-------------|-------------|---------|-------------------|----------------------|--------|
|   | Women  | LGBTI+ | Youth 16-24 | Youth 25-34 | Low SES | Ethnic minorities | Religious minorities | TOTAL  |
| Yes   | 34,05  | 27,45  | 44,67       | 39,81       | 35,36   | 50,67             | 47,44                | 33,37  |
| No  | 57,06  | 49,02  | 41,07       | 48,69       | 56,41   | 42,45             | 44,96                | 57,63  |
| I do not know   | 7,47   | 23,53  | 10,82       | 9,75        | 7,31    | 5,74              | 6,82                 | 7,74   |
| Prefer not to answer  | 1,42   | 0,00   | 3,44        | 1,74        | 0,92    | 1,15              | 0,78                 | 1,27   |
| TOTAL   | 100,00 | 100,00 | 100         | 100,00      | 100,00  | 100,00            | 100,00               | 100,00 |

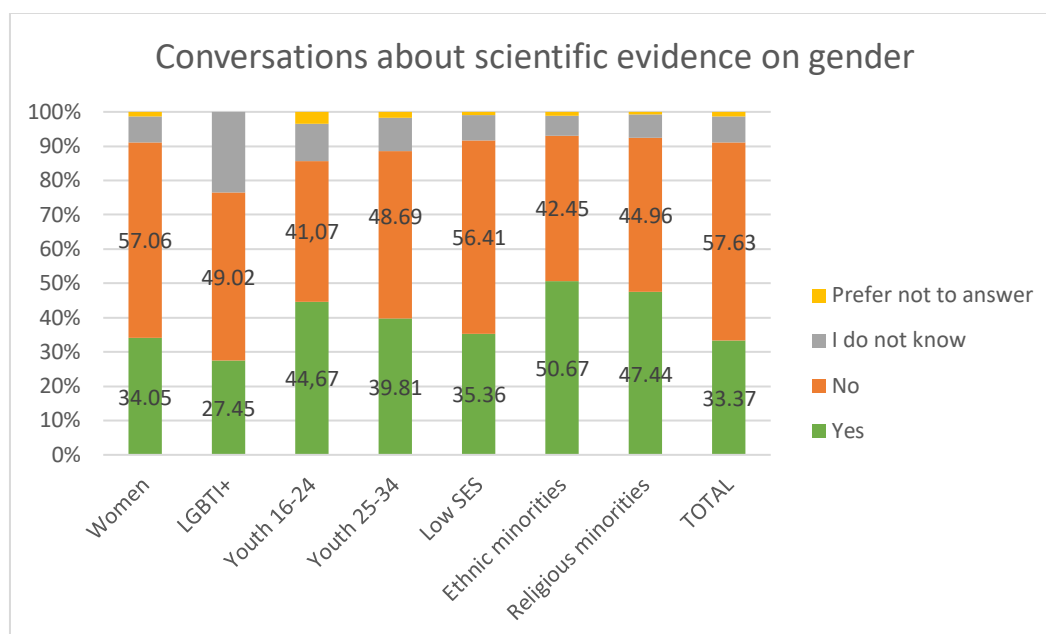


Figure 5.27. Distribution of respondents' answers to the following sentence "Have you ever talked about scientific evidence on gender with other people?" across vulnerable groups

## The impact of interactions

This section analyses the impact of two interactions with science in the responses of people from vulnerable groups. The interactions are:

- Has something happened to you or someone in your family that made you change your mind about science or become interested in science?
- Do the scientific people you follow share anecdotes or evidence about science?

In the analysis of the impact of these interactions, we have included the responses of those respondents who had interacted with science; thus, the responses in this section are those from participants who answered "yes" to interaction 1 and "yes, often" and "yes, rarely" in interaction 2.

Interactions with science increase the use of information sources to learn about scientific evidence on education in all vulnerable groups, although not all interactions are equally effective. First, the analysis related to interaction 1 (changing own's mind about science due to previous experience with science) indicates that in all vulnerable groups, approximately or more than half of the respondents have talked to other people about scientific evidence related to education. In addition, in ethnic minorities and religious minorities groups exist an increase up to 50%, but in the case of women and youth (16-24) the increase is up to 100%. Second, the analysis for interaction 2-often indicates that the percentages of people who have talked to other people about scientific evidence on education are even higher, ranging from 62.94% (women) to 75.95% (religious minorities). In this case, almost in all vulnerable groups we can observe an increment of more than 50%. Third, the results for interaction 2-rarely indicate that following a scientist on social networks is not enough if these scientists do not



provide users the opportunity to interact with scientific content by sharing anecdotes or evidence about science. In this case, the proportion of respondents that express using information sources ranges from 42.86% (LGBTI+) to 61.86% (ethnic minorities). Finally, due to the reduced number of responses from the LGBTI+ community (n=12, n=7 and n=7), their results have limited implications.

Table 5.45. Distribution of respondents' answers to the following sentence "Have you ever talked about scientific evidence on education with other people?" across vulnerable groups and interactions

| Have you ever talked to other people about scientific evidence related to education? |                         |        |           |  |             |         |                   |                      |        |
|--|-------------------------|--------|-----------|--|-------------|---------|-------------------|----------------------|--------|
|  |                         | Women  | LGBTI+    | Youth 16-24  | Youth 25-34 | Low SES | Ethnic minorities | Religious minorities | TOTAL  |
| I1   | Yes                     | 53,36  | 58,33     | 56,35  | 58,87       | 57,25   | 66,02             | 62,54                | 55,33  |
|  | No                      | 38,39  | 33,33     | 31,47  | 34,48       | 35,35   | 24,22             | 29,33                | 36,57  |
|  | I do not know           | 7,20   | 8,33      | 10,66  | 5,91        | 6,50    | 9,38              | 7,42                 | 7,09   |
|  | Prefer not to answer    | 1,06   | 0,00      | 1,52   | 0,74        | 0,91    | 0,39              | 0,71                 | 1,01   |
|  | TOTAL                   | 100,00 | 100,00    | 100,00   | 100,00      | 100,00  | 100,00            | 100,00               | 100,00 |
|  |                         |        |           |  |             |         |                   |                      |        |
| I2.Often   | Yes                     | 62,94  | 71,43     | 66,20  | 65,16       | 67,90   | 73,61             | 75,95                | 63,83  |
|  | No                      | 31,47  | 14,29     | 25,35  | 30,31       | 28,13   | 19,44             | 17,72                | 30,70  |
|  | I do not know           | 4,91   | 14,29     | 7,75   | 4,18        | 3,98    | 6,25              | 5,70                 | 5,04   |
|  | Prefer not to answer    | 0,68   | 0,00      | 0,70   | 0,35        | 0,00    | 0,69              | 0,63                 | 0,43   |
|  | TOTAL                   | 100,00 | 100,00    | 100,00   | 100,00      | 100,00  | 100,00            | 100,00               | 100,00 |
|  |                         |        |           |  |             |         |                   |                      |        |
| I2.Rarely  | Yes                     | 57,76  | 42,86     | 51,30  | 53,69       | 60,94   | 61,86             | 61,03                | 59,28  |
|  | No                      | 34,18  | 42,86     | 33,04  | 39,90       | 32,81   | 29,90             | 29,41                | 33,82  |
|  | I do not know           | 7,86   | 14,29     | 15,65  | 5,42        | 5,63    | 8,25              | 9,56                 | 6,71   |
|  | Prefer not to answer    | 0,20   | 0,00      | 0,00   | 0,99        | 0,63    | 0,00              | 0,00                 | 0,19   |
|  | TOTAL                   | 100,00 | 100,00    | 100,00   | 100,00      | 100,00  | 100,00            | 100,00               | 100,00 |
|  |                         |        |           |  |             |         |                   |                      |        |
|  | Decrease                |        | I1        | Changing their mind about science because something happened         |             |         |                   |                      |        |
|  | Increase up to 50%      |        | I2.Often  | Following on social media someone who often publishes about science  |             |         |                   |                      |        |
|  | Increase up to 100%     |        | I2.Rarely | Following on social media someone who rarely publishes about science |             |         |                   |                      |        |
|  | Increase more than 100% |        |           |  |             |         |                   |                      |        |

In the following figure we can see that, based on the increase achieved due to each interaction with science, the impact of all interactions is more accentuated in people from low SES and in women than in other vulnerable groups.

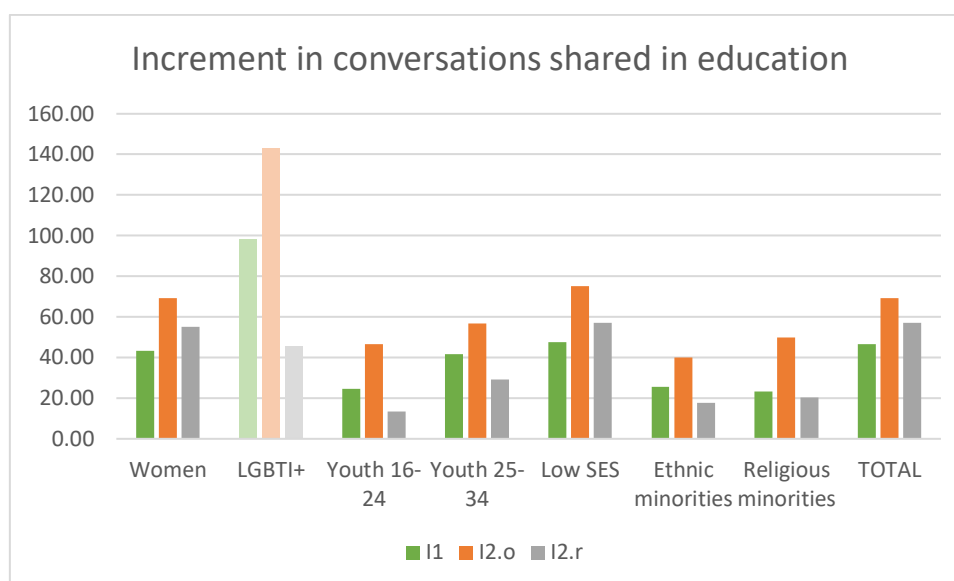


Figure 5.28. Increment of respondents' answers to the following sentence "Have you ever talked about scientific evidence on education with other people?" across vulnerable groups and interactions

Interactions with science increase the use of information sources to learn about scientific evidence on gender in all vulnerable groups, although not all interactions are equally effective. First, the analysis related to interaction 1 (changing own's mind about science due to previous experience with science) indicates that in all vulnerable groups, approximately or more than half of the respondents have talked to other people about scientific evidence related to gender. In addition, in women and youth (16-24) the increase is up to 100%. Ethnic and religious minorities, as well as youth (16-24) increase up to 50%. Second, the analysis for interaction 2-often indicates that the percentages of people who have talked to other people about scientific evidence on gender are even higher, ranging from 61.08% (women) to 73.42% (religious minorities). In this case, almost in all vulnerable groups we can observe an increment of more than 50%. Third, the results for interaction 2-rarely indicate that following a scientist on social networks is not enough if these scientists do not provide users the opportunity to interact with scientific content by sharing anecdotes or evidence about science. In this case, the proportion of respondents that express using information sources ranges from 42.86% (LGBTI+) to 63.92% (ethnic minorities). Finally, due to the reduced number of responses from the LGBTI+ community (n=12, n=7 and n=7), their results have limited implications.

Table 5.46. Distribution of respondents' answers to the following sentence "Have you ever talked about scientific evidence on gender with other people?" across vulnerable groups and interactions

| Have you ever talked to other people about scientific evidence related to gender? |        |       |       |         |        |           |       |
|---|--------|-------|-------|---------|--------|-----------|-------|
| Women   | LGBTI+ | Youth | Youth | Low SES | Ethnic | Religious | TOTAL |

|           |                         |           | 16-24  | 25-34  |        |        | minorities | minorities |        |
|-----------|-------------------------|-----------|--|--------|--------|--------|------------|------------|--------|
| I1        | Yes                     | 52,40     | 66,67  | 62,44  | 58,87  | 55,14  | 64,45      | 62,90      | 53,14  |
|           | No                      | 42,51     | 16,67  | 27,92  | 34,24  | 39,43  | 29,30      | 31,10      | 41,20  |
|           | I do not know           | 4,41      | 16,67  | 7,61   | 5,91   | 4,38   | 5,86       | 5,30       | 4,80   |
|           | Prefer not to answer    | 0,67      | 0,00   | 2,03   | 0,99   | 1,06   | 0,39       | 0,71       | 0,85   |
|           | TOTAL                   | 100,00    | 100,00   | 100,00 | 100,00 | 100,00 | 100,00     | 100,00     | 100,00 |
| I2.Often  | Yes                     | 61,08     | 57,14  | 64,79  | 62,72  | 64,49  | 72,92      | 73,42      | 60,52  |
|           | No                      | 34,52     | 28,57  | 27,46  | 31,71  | 30,97  | 25,00      | 25,32      | 34,78  |
|           | I do not know           | 3,72      | 14,29  | 6,34   | 4,88   | 4,26   | 2,08       | 1,27       | 4,26   |
|           | Prefer not to answer    | 0,68      | 0,00   | 1,41   | 0,70   | 0,28   | 0,00       | 0,00       | 0,43   |
|           | TOTAL                   | 100,00    | 100,00   | 100,00 | 100,00 | 100,00 | 100,00     | 100,00     | 100,00 |
| I2.Rarely | Yes                     | 53,63     | 42,86  | 52,17  | 61,08  | 56,88  | 63,92      | 59,56      | 52,87  |
|           | No                      | 40,08     | 57,14  | 41,74  | 34,48  | 36,56  | 31,96      | 36,03      | 41,79  |
|           | I do not know           | 6,09      | 0,00   | 5,22   | 3,94   | 5,94   | 4,12       | 4,41       | 5,05   |
|           | Prefer not to answer    | 0,20      | 0,00   | 0,87   | 0,49   | 0,63   | 0,00       | 0,00       | 0,29   |
|           | TOTAL                   | 100,00    | 100,00   | 100,00 | 100,00 | 100,00 | 100,00     | 100,00     | 100,00 |
|           | Decrease                | I1        | Changing their mind about science because something happened         |        |        |        |            |            |        |
|           | Increase up to 50%      | I2.Often  | Following on social media someone who often publishes about science  |        |        |        |            |            |        |
|           | Increase up to 100%     | I2.Rarely | Following on social media someone who rarely publishes about science |        |        |        |            |            |        |
|           | Increase more than 100% |           |  |        |        |        |            |            |        |

In the following figure we can see that, based on the increase achieved due to each interaction with science, the impact of all interactions is more accentuated in people from low SES and in women than in other vulnerable groups.

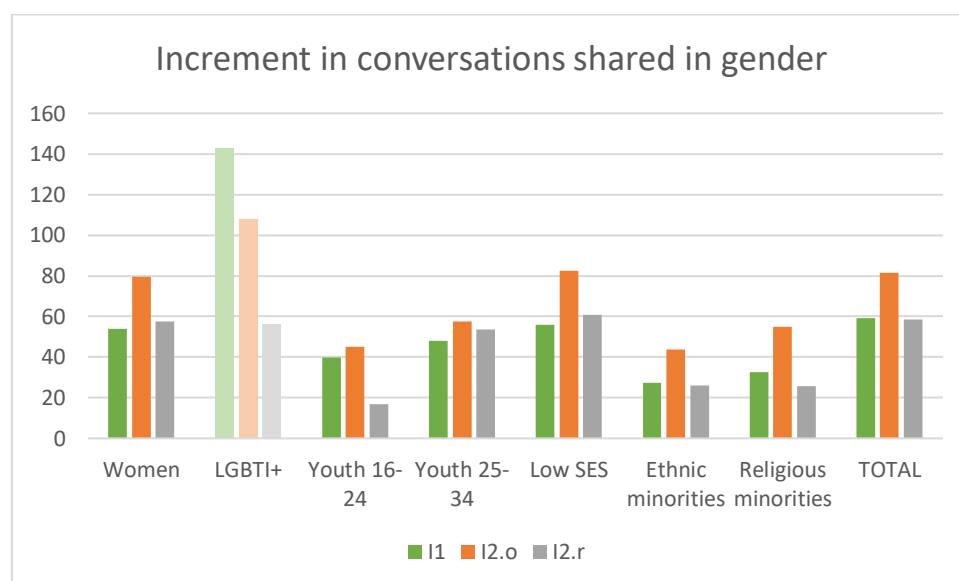


Figure 29. Increment of respondents' answers to the following sentence "Have you ever talked about scientific evidence on gender with other people?" across vulnerable groups and interactions

### 5.4.3 Source of awareness of scientific evidence

The final section aims to analyse to what extent citizens learn from scientific evidence on education and gender through information sources or conversations and includes the following two questions:

- To what extent have you become aware of scientific evidence on education through information sources or from face to face or digital conversations with other persons?
- To what extent have you become aware of scientific evidence on gender through information sources or from face to face or digital conversations with other persons?

Both questions include the following response options: especially sources of information, especially conversations, I do not know and prefer not to answer.

The results show that in education, the responses are distributed equitably, with approximately one third of the answer (31.01%) in sources of information, another third (30.69%) in conversations and the final third (35.95%) do not know.

Table 5.47. Distribution of respondents' answers to the following sentence "To what extent have you become aware of scientific evidence on education through information sources or from face to face or digital conversations with other persons?"

| <b>To what extent have you become aware of scientific evidence on education through information sources or from face to face or digital conversations with other persons?</b> |           |            |                        |
|---|-----------|------------|------------------------|
|   | Frequency | Percentage | Accumulated percentage |
| Especially sources of information   | 2328      | 31,01      | 31,01                  |
| Especially conversations  | 2304      | 30,69      | 61,70                  |
| I do not know   | 2699      | 35,95      | 97,66                  |
| Prefer not to answer  | 176       | 2,34       | 100,00                 |
| Total   | 7507      | 100,00     | 100,00                 |

The same question referred to learning about scientific evidence on gender show similar results, although in this case, the percentage of people that do not know (40,5%) is higher than the other response options (26.9% and 30.0%).

Table 5.48. Distribution of respondents' answers to the following sentence "To what extent have you become aware of scientific evidence on gender through information sources or from face to face or digital conversations with other persons?"

| <b>To what extent have you become aware of scientific evidence on gender through information sources or from face to face or digital conversations with other persons?</b> |           |            |                        |
|--|-----------|------------|------------------------|
|  | Frequency | Percentage | Accumulated percentage |
| Especially sources of information  | 2021      | 26,9       | 26,9                   |
| Especially conversations   | 2255      | 30,0       | 57,0                   |
| I do not know  | 3041      | 40,5       | 97,5                   |
| Prefer not to answer   | 190       | 2,5        | 100,0                  |
| Total  | 7507      | 100,0      | 100,0                  |

## Responses by vulnerable groups

If we look at the responses across vulnerable groups, we can observe that ethnic and religious minorities are more likely to learn about scientific evidence on education through information sources than other vulnerable groups (46.08% and 43.72% respectively). On the contrary, less than 30% of LGBTI+, women and people from low SES express using these sources to learn about scientific evidence on education. Regarding the use of conversations and discussions to learn about scientific evidence on education, the use of these conversations is more widespread among youth (36.94% for youth aged 16-24 and 33.4% for youth aged 25-34) and less in the LGBTI+ community (21.57%).

Table 5.49. Distribution of respondents' answers to the following sentence "To what extent have you become aware of scientific evidence on education through information sources or from face to face or digital conversations with other persons?" across vulnerable groups

| <b>To what extent have you learned about scientific evidence related to education through information sources or from face-to-face or digital conversations with other people</b> |        |        |             |             |                       |                   |                      |        |
|---|--------|--------|-------------|-------------|-----------------------|-------------------|----------------------|--------|
|   | Women  | LGBTI+ | Youth 16-24 | Youth 25-34 | Low SES <sup>60</sup> | Ethnic minorities | Religious minorities | TOTAL  |
| Especially information sources  | 29,57  | 27,45  | 36,43       | 35,61       | 29,99                 | 46,08             | 43,72                | 31,01  |
| Especially conversations  | 30,75  | 21,57  | 36,94       | 33,47       | 32,01                 | 32,50             | 32,25                | 30,69  |
| I do not know   | 37,14  | 50,98  | 22,51       | 28,31       | 35,98                 | 19,89             | 22,95                | 35,95  |
| Prefer not to answer  | 2,54   | 0,00   | 4,12        | 2,62        | 2,03                  | 1,53              | 1,09                 | 2,34   |
| TOTAL   | 100,00 | 100,00 | 100,00      | 100,00      | 100,00                | 100,00            | 100,00               | 100,00 |

In the following figure we can also see this trend:

<sup>60</sup> Low SES is defined as having gross income below 16,043 Euros per year

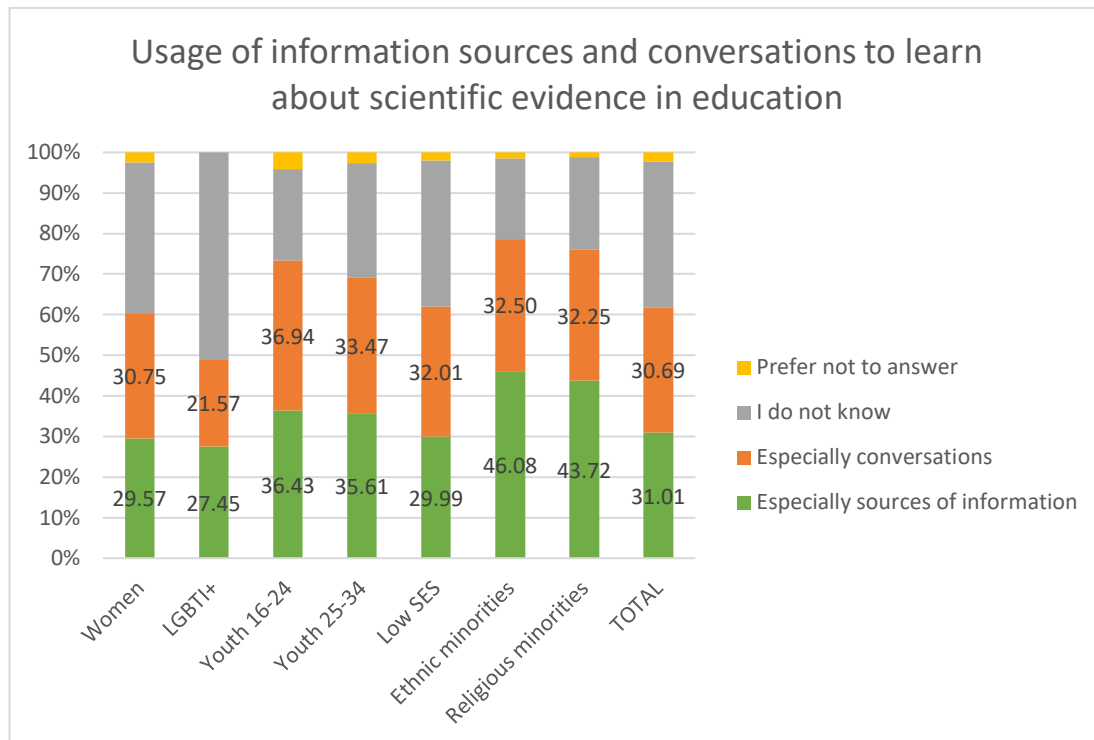


Figure 5.30. Distribution of respondents' answers to the following sentence "To what extent have you become aware of scientific evidence on education through information sources or from face to face or digital conversations with other persons?" across vulnerable groups

The results regarding gender point to similar trends with slightly lower results. On the one hand, those groups who express the most learning about scientific evidence on gender through information sources are ethnic and religious minorities with (37.28% and 35.97%) and those who are less likely to use them are women, LGBTI+ and people from low SES with approximately one quarter of the respondents within the vulnerable group. On the other hand, the use of conversations is more frequent among ethnic and religious minorities with 39.01% and 35.81% respectively and less in the LGBTI+ community (25.49%)

Table 5.50. Distribution of respondents' answers to the following sentence "To what extent have you become aware of scientific evidence on gender through information sources or from face to face or digital conversations with other persons?" across vulnerable groups

| To what extent have you learned about scientific evidence related to gender through information sources or from face-to-face or digital conversations with other people |        |        |             |             |         |                   |                      |        |
|---|--------|--------|-------------|-------------|---------|-------------------|----------------------|--------|
|   | Women  | LGBTI+ | Youth 16-24 | Youth 25-34 | Low SES | Ethnic minorities | Religious minorities | TOTAL  |
| Especially information sources  | 25,53  | 25,49  | 32,82       | 29,82       | 26,07   | 37,28             | 35,97                | 26,92  |
| Especially conversations  | 30,69  | 25,49  | 33,85       | 34,02       | 31,84   | 39,01             | 35,81                | 30,04  |
| I do not know   | 41,18  | 49,02  | 29,38       | 32,99       | 40,03   | 22,37             | 27,13                | 40,51  |
| Prefer not to answer  | 2,60   | 0,00   | 3,95        | 3,17        | 2,07    | 1,34              | 1,09                 | 2,53   |
| TOTAL   | 100,00 | 100,00 | 100,00      | 100,00      | 100,00  | 100,00            | 100,00               | 100,00 |

The following figure describes these findings:

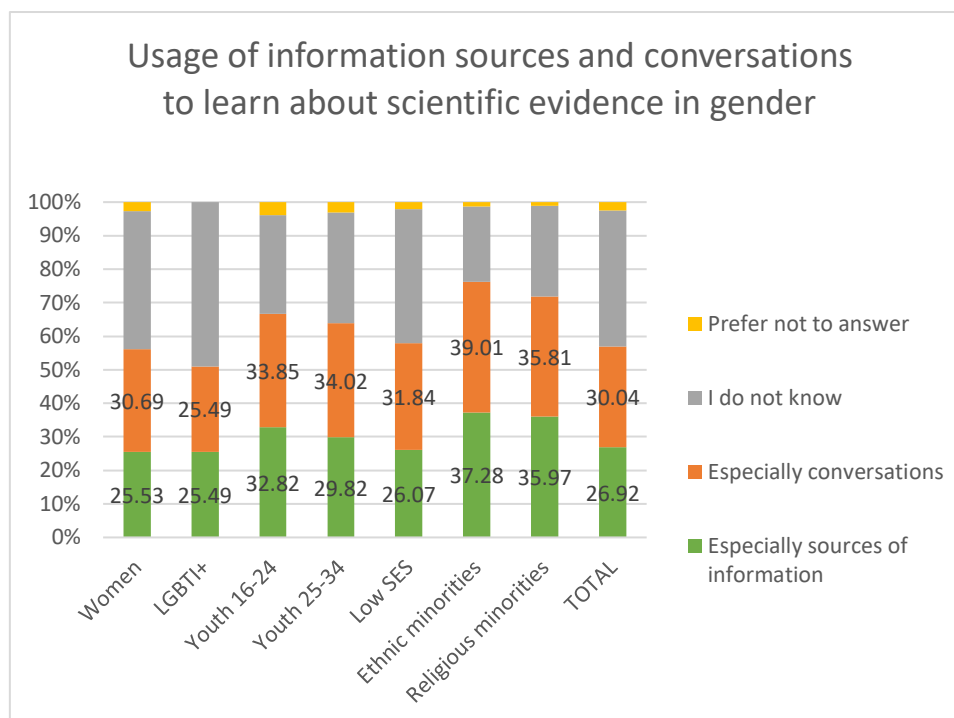


Figure 5.31. Distribution of respondents' answers to the following sentence "To what extent have you become aware of scientific evidence on gender through information sources or from face to face or digital conversations with other persons?" across vulnerable groups

Therefore, people from ethnic and religious minorities tend to use information sources more than other vulnerable groups and women and people from low SES less.

### The impact of interactions

This section analyses the impact of two interactions with science in the responses of people from vulnerable groups. The interactions are:

- Has something happened to you or someone in your family that made you change your mind about science or become interested in science?
- Do the scientific people you follow share anecdotes or evidence about science?

In the analysis of the impact of these interactions, we have included the responses of those respondents who had interacted with science; thus, the responses in this section are those from participants who answered "yes" to interaction 1 and "yes, often" and "yes, rarely" in interaction 2.

In this case, we can observe that in general, interactions with science tend to foster the use of information sources to a greater extent than conversations and discussions. This finding is especially accentuated in those who interact with science by following on social networks a scientific person who often published about science. This way, in almost all vulnerable groups within this interaction, we find increments of more than 50% in those participants who

express that they especially use sources of information to learn about scientific evidence on education (with percentages ranking from 42.86% to 72.22%, compared with the 27.45% to 46.08% of the total). On the contrary, those who learn through conversations and discussions decrease in almost all vulnerable groups, compared with the total of respondents (14.29% to 35.21% vs 21,57% to 36,94%). However, when participants follow on social media someone who rarely publishes about science, the results show that this interaction with science increases not only the percentage of participants who learn about scientific evidence on education through information sources but also through conversations, but both increments are less accentuated than those found when the person on social media often publishes about science. In general, the vulnerable group that uses information sources the most are ethnic minorities and the least the LGBTI+. Regarding conversations, women and people from low SES are those that are most likely to use conversations and discussions to learn about scientific evidence on education and LGBTI+ and ethnic minorities are the least likely to use conversations to learn about science.

Table 5.51. Distribution of respondents' answers to the following sentence "To what extent have you become aware of scientific evidence on education through information sources or from face to face or digital conversations with other persons?" across vulnerable groups and interactions

| To what extent have you learned about scientific evidence related to education through information sources or from face-to-face or digital conversations with other people |                                   |           |  |             |         |                   |                      |        |        |
|--|-----------------------------------|-----------|--|-------------|---------|-------------------|----------------------|--------|--------|
|  | Women                             | LGBTI+    | Youth 16-24  | Youth 25-34 | Low SES | Ethnic minorities | Religious minorities | TOTAL  |        |
| I1   | Especially sources of information | 37,24     | 33,33  | 44,67       | 44,83   | 38,67             | 57,03                | 56,54  | 39,77  |
|  | Especially conversations          | 38,29     | 25,00  | 35,53       | 36,70   | 38,07             | 29,69                | 30,04  | 37,63  |
|  | I do not know                     | 22,74     | 41,67  | 16,75       | 16,50   | 21,30             | 11,33                | 12,01  | 20,84  |
|  | Prefer not to answer              | 1,73      | 0,00   | 3,05        | 1,97    | 1,96              | 1,95                 | 1,41   | 1,76   |
|  | TOTAL                             | 100,00    | 100,00   | 100,00      | 100,00  | 100,00            | 100,00               | 100,00 | 100,00 |
| I2.Often   | Especially sources of information | 48,56     | 42,86  | 48,59       | 54,36   | 51,42             | 72,22                | 67,09  | 49,65  |
|  | Especially conversations          | 33,50     | 14,29  | 35,21       | 29,62   | 33,52             | 18,75                | 24,05  | 32,43  |
|  | I do not know                     | 16,58     | 42,86  | 14,08       | 13,94   | 13,35             | 8,33                 | 7,59   | 16,61  |
|  | Prefer not to answer              | 1,35      | 0,00   | 2,11        | 2,09    | 1,70              | 0,69                 | 1,27   | 1,30   |
|  | TOTAL                             | 100,00    | 100,00   | 100,00      | 100,00  | 100,00            | 100,00               | 100,00 | 100,00 |
| I2.Rarely  | Especially sources of information | 39,49     | 42,86  | 43,48       | 45,32   | 41,25             | 39,18                | 44,85  | 42,47  |
|  | Especially conversations          | 44,99     | 28,57  | 44,35       | 42,36   | 43,75             | 45,36                | 41,91  | 42,27  |
|  | I do not know                     | 15,13     | 28,57  | 12,17       | 11,33   | 14,06             | 14,43                | 13,24  | 14,58  |
|  | Prefer not to answer              | 0,39      | 0,00   | 0,00        | 0,99    | 0,94              | 1,03                 | 0,00   | 0,68   |
|  | TOTAL                             | 100,00    | 100,00   | 100,00      | 100,00  | 100,00            | 100,00               | 100,00 | 100,00 |
|  | Decrease                          | I1        | Changing their mind about science because something happened         |             |         |                   |                      |        |        |
|  | Increase up to 50%                | I2.Often  | Following on social media someone who often publishes about science  |             |         |                   |                      |        |        |
|  | Increase up to 100%               | I2.Rarely | Following on social media someone who rarely publishes about science |             |         |                   |                      |        |        |
|  | Increase more than 100%           |           |  |             |         |                   |                      |        |        |

In the following figure, we can observe how the use of information sources to learn about scientific evidence on education (those bars in blue colours) increase as a consequence of all



the analyses interactions with science. In addition, this increment is more accentuated in people from low SES and in interaction 2-often (following someone on social media who often publishes about science). On the contrary, the use of conversations decreases in several cases when adding the impact of interactions with science (see bars in orange). This is the case, for example of ethnic and religious minorities. Globally, the group that benefits the most of interactions with science in the use of both sources (information sources and conversations) are people from low socioeconomic status:

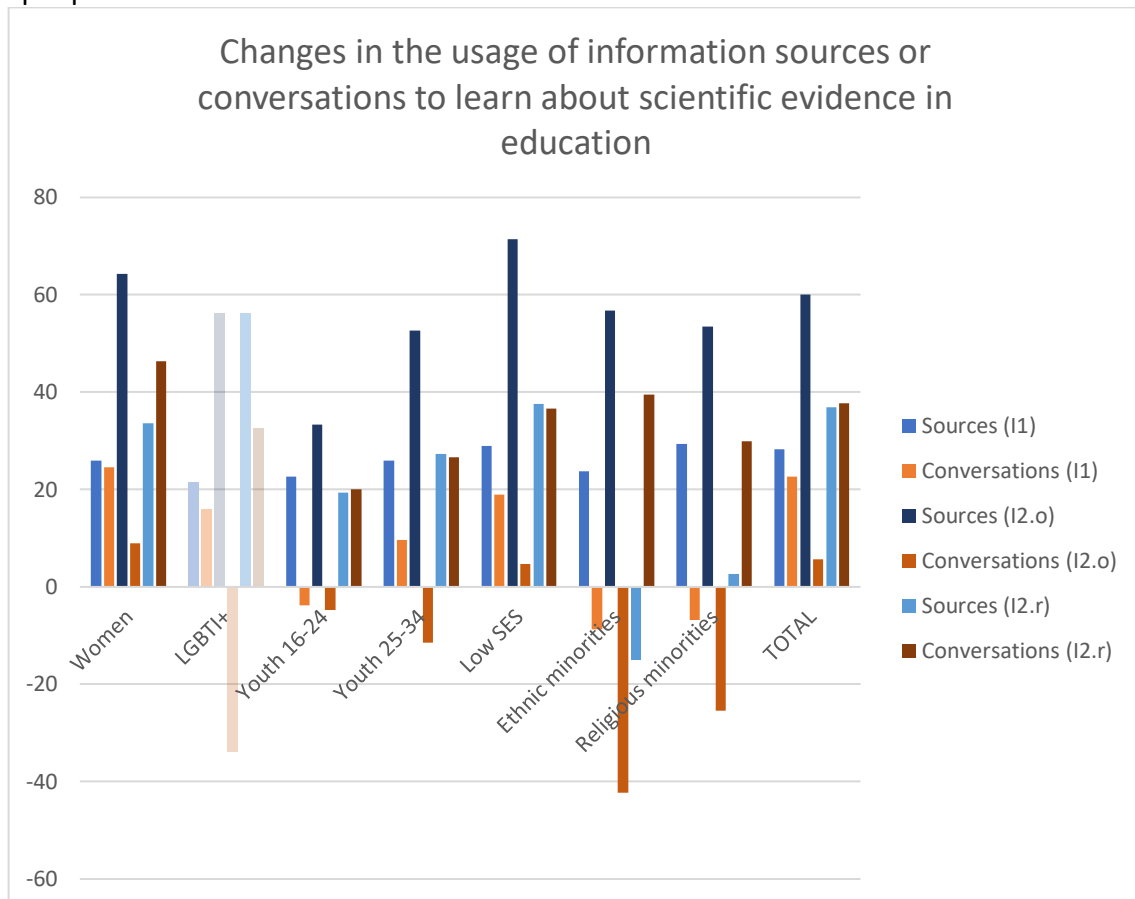


Figure 5.32. Changes in the distribution of respondents' answers to the following sentence "To what extent have you become aware of scientific evidence on education through information sources or from face to face or digital conversations with other persons?" across vulnerable groups and interactions

The analysis of the impact of interactions in respondents' answers to the question "To what extent have you become aware of scientific evidence on gender through information sources or from face to face or digital conversations with other persons?" indicates that interactions with science generally increase the proportion of respondents who learn about scientific evidence on gender through both sources (information sources and conversations). In this vein, changing mind about science due to previous experiences with science is associated with an increase up to 50% on the usage of information sources in all vulnerable group and the percentages range from 31.36% (women) to 45.94% (religious minorities). A similar trend is observed among those respondents who interact with science by following on social media someone who often publishes about science. However, in this case, the proportional increase in most cases is higher than 50%, which implies that the use of information sources on gender among respondents who follow on social media someone who often publishes about science

range from 46.48% (youth 16-24) to 58.33% (ethnic minorities). In addition, following a scientist on social media is not enough to increase the use of information sources on gender if this person does not publish about science frequently. This is the case of interaction 2-rarely, which in general achieve lower impacts than previous interactions, ranging from 28.57% (LGBTI+) to 37.44% (youth aged 25-34). In this case, it is especially relevant the decrease observed in ethnic and religious minorities (from 37,28% to 31.96% and from 35,97% to 33.09% respectively). Regarding the use of conversations, we can observe that, while following someone on social media who rarely publishes about science increases the use of conversations in all vulnerable groups (ranging from 42.86% in the LGBTI+ community to 49.48% in ethnic minorities), this is not the case of the other interactions. This way, for women and people from low SES, having changed their mind about science because something happened to them or their families is associated with a higher use of conversations to learn about scientific evidence on gender than in the other vulnerable groups. In the case of following someone on social media who often publishes about science, the groups with higher increments in the use of conversations are women and youth aged 16-24.

Table 5.52. Distribution of respondents' answers to the following sentence "To what extent have you become aware of scientific evidence on gender through information sources or from face to face or digital conversations with other persons?" across vulnerable groups and interactions

| To what extent have you learned about scientific evidence related to gender through information sources or from face-to-face or digital conversations with other people |                                   |           |        |  |             |         |                   |                      |        |
|---|-----------------------------------|-----------|--------|--|-------------|---------|-------------------|----------------------|--------|
|   |                                   | Women     | LGBTI+ | Youth 16-24  | Youth 25-34 | Low SES | Ethnic minorities | Religious minorities | TOTAL  |
| I1  | Especially sources of information | 31,86     | 33,33  | 43,15  | 38,92       | 32,93   | 44,92             | 45,94                | 34,81  |
|   | Especially conversations          | 38,77     | 16,67  | 33,50  | 36,95       | 38,97   | 40,23             | 36,75                | 38,06  |
|   | I do not know                     | 27,54     | 50,00  | 20,81  | 22,66       | 27,04   | 13,67             | 16,96                | 25,69  |
|   | Prefer not to answer              | 1,82      | 0,00   | 2,54   | 1,48        | 1,06    | 1,17              | 0,35                 | 1,44   |
|   | TOTAL                             | 100,00    | 100,00 | 100,00   | 100,00      | 100,00  | 100,00            | 100,00               | 100,00 |
| I2.Often  | Especially sources of information | 43,15     | 57,14  | 46,48  | 47,04       | 48,01   | 58,33             | 56,96                | 44,43  |
|   | Especially conversations          | 34,52     | 0,00   | 37,32  | 33,10       | 33,52   | 31,94             | 33,54                | 33,04  |
|   | I do not know                     | 21,15     | 42,86  | 14,79  | 17,42       | 17,61   | 9,03              | 9,49                 | 21,39  |
|   | Prefer not to answer              | 1,18      | 0,00   | 1,41   | 2,44        | 0,85    | 0,69              | 0,00                 | 1,13   |
|   | TOTAL                             | 100,00    | 100,00 | 100,00   | 100,00      | 100,00  | 100,00            | 100,00               | 100,00 |
| I2.Rarely   | Especially sources of information | 33,60     | 28,57  | 33,04  | 37,44       | 33,13   | 31,96             | 33,09                | 35,28  |
|   | Especially conversations          | 45,19     | 42,86  | 48,70  | 44,33       | 47,19   | 49,48             | 49,26                | 42,95  |
|   | I do not know                     | 20,24     | 28,57  | 16,52  | 16,75       | 18,44   | 17,53             | 15,44                | 20,51  |
|   | Prefer not to answer              | 0,98      | 0,00   | 1,74   | 1,48        | 1,25    | 1,03              | 2,21                 | 1,26   |
|   | TOTAL                             | 100,00    | 100,00 | 100,00   | 100,00      | 100,00  | 100,00            | 100,00               | 100,00 |
|   | Decrease                          | I1        |        | Changing their mind about science because something happened         |             |         |                   |                      |        |
|   | Increase up to 50%                | I2.Often  |        | Following on social media someone who often publishes about science  |             |         |                   |                      |        |
|   | Increase up to 100%               | I2.Rarely |        | Following on social media someone who rarely publishes about science |             |         |                   |                      |        |
|   | Increase more than 100%           |           |        |  |             |         |                   |                      |        |

Finally in this figure we can observe how, globally, women and people from low socioeconomic status are the two groups that are more benefitted by interactions with science, both in the use of information sources and conversations to learn about scientific evidence on gender. In addition, in general we can see that the use of information sources (bars in blue colours) increases more than the use of conversations (bars in orange colours).

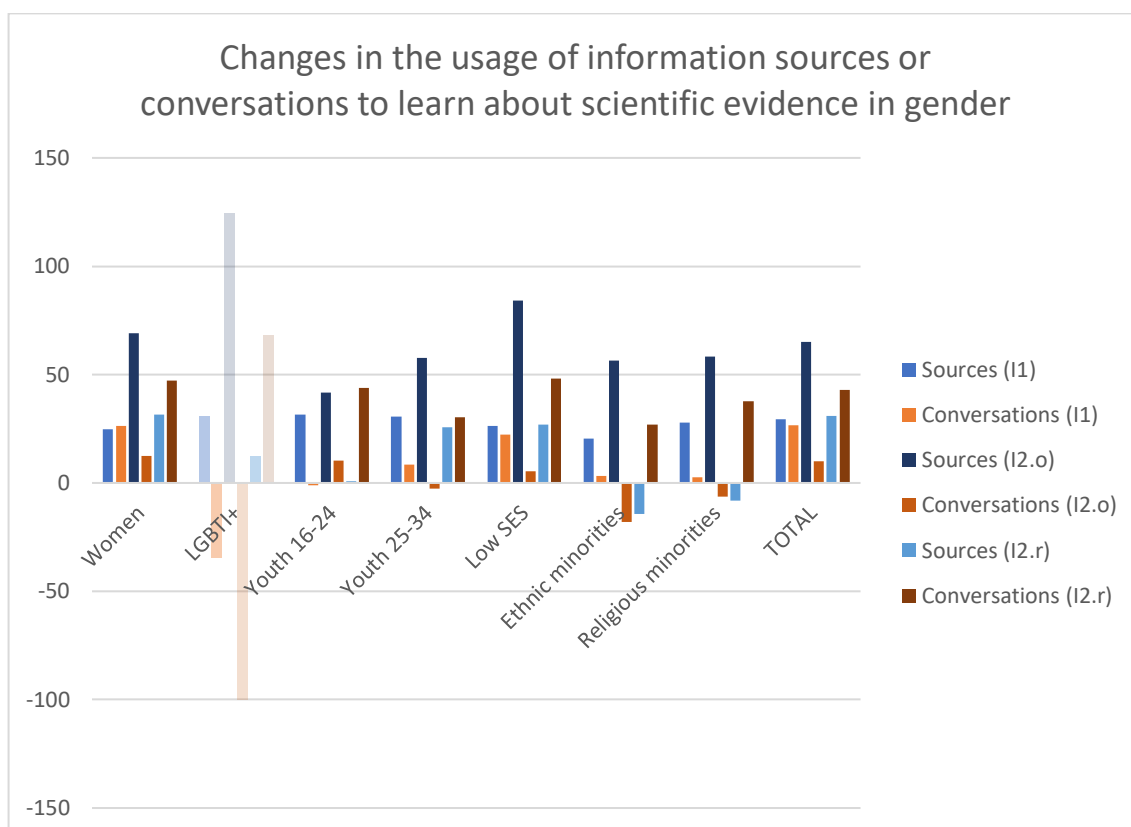


Figure 5.33. Changes in the distribution of respondents' answers to the following sentence "To what extent have you become aware of scientific evidence on gender through information sources or from face to face or digital conversations with other persons?" across vulnerable groups and interactions

Therefore, interactions have an impact in the increase of the use of both information sources and conversations to learn about scientific evidence and this impact depends on the type and frequency of the interaction. In education as well as in gender, following someone on social media who often publishes about science is the interaction with the highest impact and it increases the use of information sources in all vulnerable groups. In general, people from low SES and women are the two groups that benefit the most from interactions with science.

## 5.5 Conclusions for Sections 1-3

|  |
|--|
| <p><b><i>Knowledge of actions to encourage citizen science</i></b></p> <ul style="list-style-type: none"> <li>- 20.9% of citizens heard about initiatives to foster citizen participation in science</li> <li>- Initiatives held in schools are the most known by participants: 19.32% know of workshops in educational centres (including schools, universities and similar) and 18.36% know about informative sessions in schools.</li> </ul>  |
| <p><b><i>Participation in actions to foster citizens' participation in science</i></b></p> <ul style="list-style-type: none"> <li>- Only 13.8% of the respondents expressed having participated in initiatives to foster citizens' participation in science in education and 14.8% in gender (including those who have participated in many and those that only in some).</li> </ul>   |
| <p><b><i>Sources of information of scientific evidence</i></b></p> <ul style="list-style-type: none"> <li>- Almost 3 out of ten of the respondents (29.7%) use sources of information to learn about scientific evidence on education and gender.</li> </ul>   |
| <p><b><i>Conversations about scientific evidence</i></b></p> <ul style="list-style-type: none"> <li>- More than one third of the respondents (37.7% in education and 33.4% in gender) share conversations about scientific evidence with other people.</li> </ul>  |
| <p><b><i>Source of awareness of scientific evidence on gender and education</i></b></p> <ul style="list-style-type: none"> <li>- In education, the responses are distributed equitably, with approximately one third of the answer (31.01%) in sources of information and another third (30.69%) in conversations</li> <li>- In gender, 26.9% use sources of information and 30.0% conversations.</li> </ul>   |
| <p><b><i>Vulnerable groups</i></b></p> <ul style="list-style-type: none"> <li>- People from vulnerable groups are more likely to have heard about initiatives to encourage citizen participation in science. This difference is more accentuated in the case of ethnic and religious minorities, with more than 40% in each case (compared with the 20.91% of the total).</li> <li>- Vulnerable groups tend to know more initiatives than the total of population and point to initiatives implemented within the school context as those most known in the promotion of citizen science (including informative sessions and workshops), with approximately 20% of the responses each one in all cases.</li> <li>- In general, respondents from vulnerable groups are more likely to express having participated in actions to discuss scientific evidence in gender and education compared with the total of respondents. This is not the case of women and people from low SES, who get similar results than the total of respondents.</li> <li>- Youth and ethnic and religious minorities express using information sources to learn about scientific evidence more than the total of respondents. Women and people from low SES obtain similar results than the total of respondents.</li> <li>- Ethnic and religious minorities express talking about scientific evidence related to education and gender to other people more than the total of respondents. Women and people from low SES obtain similar results than the total of respondents.</li> </ul> |
| <p><b><i>The role of interactions</i></b></p> <ul style="list-style-type: none"> <li>- Interacting with science has an effect in the knowledge of initiatives to foster citizen science. In all vulnerable groups, this impact is higher when participants follow a person on social</li> </ul>  |

media who often publishes about science. Regarding vulnerable groups, the impact of interactions is generally more accentuated in people from low socioeconomic status.

- Interactions with science decrease the proportion of respondents who answer that they do not know any initiative, while increasing the percentage of all response options, being those implemented within the school context the most known. The increase is generally more accentuated when citizens interact with science by following someone on social media who often published about science and interactions have a greater impact on people from low socioeconomic status, compared to other vulnerable groups.
- In all vulnerable groups, respondents are more likely to participate in initiatives to discuss scientific discoveries in education and gender when they interact with science. In general, the most effective interaction is followings someone on social media who often published about science and the least when this person rarely publishes about science. People from low SES and women are the groups that most incremented their participation in initiatives when they interact with science.
- All interactions increase the proportion of people from all vulnerable groups who use information sources to learn about scientific evidence on education and gender. Following someone on social media who often publishes about science is the interaction with more impact across vulnerable groups and people from low socioeconomic status, the group that benefit the most from interactions with science.
- All interactions increase the proportion of people from all vulnerable groups who talk to other people about scientific evidence related to education and gender. Women and people from low socioeconomic status increase their percentages up to 100% with interactions intervene.

## 5.6 Analysis of the associations between items in terms of interactions

Regarding the items included in block 3, focusing on the attitudes and behaviours towards science and scientific evidence from the participants in the survey, we introduce here the results of the analysis regarding the impact of the interactions with their relatives (family members) and/or with people sharing scientific evidence through the social networks on their own engagement with science and scientific evidence.

Next, we analyse each item, one-by-one.

On the question "have you heard of any initiative that encourages citizen participation in science", the data suggest that having someone in the family who has changed their mind about science or become interested in science does not have a noticeable impact on having or not having heard of any initiative that encourages citizen participation in science. Symmetric measures reveal a rather low degree of association between the two variables (Phi of 0.375). The significance level (0.0000) suggests that this statement is significant and that, therefore, we can say that interaction (in the family) with someone interested in science does not imply that the respondent knows about initiatives encouraging citizens to participate in science.

Table 5.53. **Symmetrical measurements:** Have you heard of any initiative that encourages citizen participation in science \* Has something happened to you or someone in your family that made you change your mind about science or become interested in science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,375  | ,000                     |
|                    | V for Cramer      | ,217  | ,000                     |
|                    | Contingency ratio | ,351  | ,000                     |
| N of valid cases   |                   | 7507  |                          |

When we ask what happens when the respondent knows (or does not know) someone who shares anecdotes or evidence about science on the networks, we see that the relationship is even smaller. The Phi value is 0.65 (with a significance of 0.0000), which indicates that knowing (or not) initiatives that encourage citizens to participate in science is not related to interactions (or not) with people who share anecdotes or evidence about science.

Table 5.54: **Symmetrical measurements:** Have you heard of any initiative that encourages citizen participation in science \* Do the scientific people you follow share anecdotes or evidence about science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,165  | ,000                     |
|                    | V for Cramer      | ,095  | ,000                     |
|                    | Contingency ratio | ,163  | ,000                     |
| N of valid cases   |                   | 2506  |                          |

On the other hand, participating (or not) in talks about scientific discoveries in education (either face-to-phase or online) seems to be more related to having some kind of interaction with someone (in the family) who is interested in science. In this case, the data (Phi of 0.473) suggest that there is a slight relationship between the two variables, and the relationship is significant (0.000).

Table 5.55: **Symmetrical measurements:** Have you participated in any action to talk about scientific discoveries in education, face to face or online \* Has something happened to you or someone in your family that made you change your mind about science or become interested in science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,473  | ,000                     |
|                    | V for Cramer      | ,273  | ,000                     |
|                    | Contingency ratio | ,427  | ,000                     |
| N of valid cases   |                   | 7507  |                          |

Having someone in the family interested in science has much more impact than following people who share anecdotes or evidence about science. The data in the latter case suggest that following people who share scientific evidence does not seem to be related to participating (or not) in actions to talk about scientific discoveries in education.

Table 5.56: **Symmetrical measurements:** Have you participated in any action to talk about scientific discoveries in education, face to face or online \* Do the scientific people you follow share anecdotes or evidence about science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,186  | ,000                     |
|                    | V for Cramer      | ,093  | ,000                     |
|                    | Contingency ratio | ,183  | ,000                     |
| N of valid cases   |                   | 2506  |                          |

In the case of having participated in an action to talk about science discoveries in education, if that action was an informative session in schools, the data reveal that this type of activity has no relationship with having someone in the family who is interested in science. The data are conclusive: a Phi of 0.135 suggests that there is no relationship (and that is significant, as the significance level shows).

Table 5.57: **Symmetrical measurements:** Informative sessions in schools \* Has something happened to you or someone in your family that made you change your mind about science or become interested in science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,135  | ,000                     |
|                    | V for Cramer      | ,135  | ,000                     |
|                    | Contingency ratio | ,134  | ,000                     |
| N of valid cases   |                   | 7507  |                          |

Nor does it appear that interactions with other people, sharing anecdotes or evidence about science, have anything to do with participating in informative sessions in schools. Nor do the data reveal a relationship between these two variables.

Table 5.58: **Symmetrical measurements:** Informative sessions in schools \* Do the scientific people you follow share anecdotes or evidence about science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,098  | ,000                     |
|                    | V for Cramer      | ,098  | ,000                     |
|                    | Contingency ratio | ,097  | ,000                     |
| N of valid cases   |                   | 2506  |                          |

Similarly, something similar happens with participation in workshops in educational centres: the data suggest that participating (or not) in such activities is not related to having someone in the family who is interested in science, or that something happened to you or someone in your family that made you change your mind about science or become interested in science.

Table 5.59: **Symmetrical measurements:** Workshops in educational centers \* Has something happened to you or someone in your family that made you change your mind about science or become interested in science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,141  | ,000                     |
|                    | V for Cramer      | ,141  | ,000                     |
|                    | Contingency ratio | ,139  | ,000                     |

|                  |      |  |
|------------------|------|--|
| N of valid cases | 7507 |  |
|------------------|------|--|

Following someone who shares anecdotes or evidence about science has even less to do with whether something happened to you or someone in your family that made you change your mind about science or become interested in science.

Table 5.60: **Symmetrical measurements:** Workshops in educational centers \* Do the scientific people you follow share anecdotes or evidence about science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,080  | ,003                     |
|                    | V for Cramer      | ,080  | ,003                     |
|                    | Contingency ratio | ,079  | ,003                     |
| N of valid cases   |                   | 2506  |                          |

In the case of briefings in your company, something similar happens: neither having someone in the family interested in science topics, nor following people who share anecdotes or evidence about science, seems to have any impact on going (or not) to briefings.

Table 5.61: **Symmetrical measurements:** Talks or informative sessions in your company \* Has something happened to you or someone in your family that made you change your mind about science or become interested in science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,120  | ,000                     |
|                    | V for Cramer      | ,120  | ,000                     |
|                    | Contingency ratio | ,120  | ,000                     |
| N of valid cases   |                   | 7507  |                          |

Table 5.62: **Symmetrical measurements:** Talks or informative sessions in your company \* Do the scientific people you follow share anecdotes or evidence about science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,070  | ,014                     |
|                    | V for Cramer      | ,070  | ,014                     |
|                    | Contingency ratio | ,070  | ,014                     |
| N of valid cases   |                   | 2506  |                          |

Similarly, the same is true for talks or information sessions in health centres.

Table 5.63: **Symmetrical measurements:** Talks or information sessions in health centres \* Has something happened to you or someone in your family that made you change your mind about science or become interested in science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,110  | ,000                     |
|                    | V for Cramer      | ,110  | ,000                     |
|                    | Contingency ratio | ,109  | ,000                     |
| N of valid cases   |                   | 7507  |                          |



Table 5.64: **Symmetrical measurements:** Talks or information sessions in health centres \* Do the scientific people you follow share anecdotes or evidence about science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,065  | ,031                     |
|                    | V for Cramer      | ,065  | ,031                     |
|                    | Contingency ratio | ,065  | ,031                     |
| N of valid cases   |                   | 2506  |                          |

We also found no significant relationship between attending specific classes and the two interaction variables mentioned: having someone in the family who is interested in science, or following someone who shares anecdotes or evidence about science.

Table 5.65: **Symmetrical measurements:** Specific classes \* Has something happened to you or someone in your family that made you change your mind about science or become interested in science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,076  | ,000                     |
|                    | V for Cramer      | ,076  | ,000                     |
|                    | Contingency ratio | ,076  | ,000                     |
| N of valid cases   |                   | 7507  |                          |

Table 5.66: **Symmetrical measurements:** Specific classes \* Do the scientific people you follow share anecdotes or evidence about science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,075  | ,007                     |
|                    | V for Cramer      | ,075  | ,007                     |
|                    | Contingency ratio | ,075  | ,007                     |
| N of valid cases   |                   | 2506  |                          |

The same applies to attending (or not) informative sessions in NGOs.

Table 5.67: **Symmetrical measurements:** Informative sessions in NGOs \* Has something happened to you or someone in your family that made you change your mind about science or become interested in science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,106  | ,000                     |
|                    | V for Cramer      | ,106  | ,000                     |
|                    | Contingency ratio | ,105  | ,000                     |
| N of valid cases   |                   | 7507  |                          |

Table 5.68: **Symmetrical measurements:** Informative sessions in NGOs \* Do the scientific people you follow share anecdotes or evidence about science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,094  | ,000                     |
|                    | V for Cramer      | ,094  | ,000                     |
|                    | Contingency ratio | ,094  | ,000                     |
| N of valid cases   |                   | 2506  |                          |

The same applies to attending (or not attending) conferences.

Table 5.69: **Symmetrical measurements:** Conferences \* Has something happened to you or someone in your family that made you change your mind about science or become interested in science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,120  | ,000                     |
|                    | V for Cramer      | ,120  | ,000                     |
|                    | Contingency ratio | ,120  | ,000                     |
| N of valid cases   |                   | 7507  |                          |

Table 5.70: **Symmetrical measurements:** Conferences \* Do the scientific people you follow share anecdotes or evidence about science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,112  | ,000                     |
|                    | V for Cramer      | ,112  | ,000                     |
|                    | Contingency ratio | ,111  | ,000                     |
| N of valid cases   |                   | 2506  |                          |

In terms of participating in informal chats, the data suggest that interactions with other people who show an interest in science (whether from one's own family, or people who share anecdotes or evidence about science), are also unrelated.

Table 5.71: **Symmetrical measurements:** informal chats \* Has something happened to you or someone in your family that made you change your mind about science or become interested in science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,103  | ,000                     |
|                    | V for Cramer      | ,103  | ,000                     |
|                    | Contingency ratio | ,102  | ,000                     |
| N of valid cases   |                   | 7507  |                          |

Table 5.72: **Symmetrical measurements:** Informal chats \* Do the scientific people you follow share anecdotes or evidence about science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,041  | ,385                     |
|                    | V for Cramer      | ,041  | ,385                     |
|                    | Contingency ratio | ,041  | ,385                     |
| N of valid cases   |                   | 2506  |                          |

The answer choice of (others) reveals the same as discussed above: there is no remarkable relationship.

Table 5.73: **symmetrical measurements:** Others \* Has something happened to you or someone in your family that made you change your mind about science or become interested in science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,023  | ,249                     |
|                    | V for Cramer      | ,023  | ,249                     |
|                    | Contingency ratio | ,023  | ,249                     |
| N of valid cases   |                   | 7507  |                          |



Table 5.74: **Symmetrical measurements:** Others \* Do the scientific people you follow share anecdotes or evidence about science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,039  | ,430                     |
|                    | V for Cramer      | ,039  | ,430                     |
|                    | Contingency ratio | ,039  | ,430                     |
| N of valid cases   |                   | 2506  |                          |

Table 5.75: **Symmetrical measurements:** I do not know \* Has something happened to you or someone in your family that made you change your mind about science or become interested in science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,224  | ,000                     |
|                    | V for Cramer      | ,224  | ,000                     |
|                    | Contingency ratio | ,219  | ,000                     |
| N of valid cases   |                   | 7507  |                          |

Table 5.76: **Symmetrical measurements:** I do not know \* Do the scientific people you follow share anecdotes or evidence about science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,120  | ,000                     |
|                    | V for Cramer      | ,120  | ,000                     |
|                    | Contingency ratio | ,119  | ,000                     |
| N of valid cases   |                   | 2506  |                          |

Table 7.77: **Symmetrical measurements:** Prefer not to answer \* Has something happened to you or someone in your family that made you change your mind about science or become interested in science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,272  | ,000                     |
|                    | V for Cramer      | ,272  | ,000                     |
|                    | Contingency ratio | ,263  | ,000                     |
| N of valid cases   |                   | 7507  |                          |

Table 5.78: **symmetrical measurements:** Prefer not to answer \* Do the scientific people you follow share anecdotes or evidence about science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,120  | ,000                     |
|                    | V for Cramer      | ,120  | ,000                     |
|                    | Contingency ratio | ,119  | ,000                     |
| N of valid cases   |                   | 2506  |                          |

On the question of whether there are known initiatives that encourage citizens to participate in gender-related science initiatives, we see that interactions with family members who have an interest in science have virtually no impact (Phi of 0.108); but the near zero significance of the data suggests that we cannot really know whether or not there is any impact on the relationship between these two variables.

Table 5.79: **symmetrical measurements**: Could you tell us about any initiative you know of to encourage citizen participation in science related to gender - Others \* Has something happened to you or someone in your family that made you change your mind about science or become interested in science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,108  | ,999                     |
|                    | V for Cramer      | ,062  | ,999                     |
|                    | Contingency ratio | ,108  | ,999                     |
| N of valid cases   |                   | 7507  |                          |

In the case of having interactions with people who share anecdotes or evidence about science on the networks, the data indicate that the relationship is non-existent (but the response is not significant at all). Therefore, we cannot know whether or not following people who share anecdotes about science topics has (or does not have) any effect on participating in initiatives that encourage people to participate in gender-related science.

Table 5.80: **symmetrical measurements**: Could you tell us about any initiative you know of to encourage citizen participation in science related to gender - Others \* Do the scientific people you follow share anecdotes or evidence about science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,098  | 1,000                    |
|                    | V for Cramer      | ,049  | 1,000                    |
|                    | Contingency ratio | ,098  | 1,000                    |
| N of valid cases   |                   | 2506  |                          |

On the other hand, when asked whether the people who participated in the survey have participated in any action to talk about science discoveries on gender issues, having someone in the family with an interest in science does seem to have some impact on such participation (Phi of 0.454).

Table 5.81: **symmetrical measurements**: Have you participated in any action to talk about scientific discoveries on gender issues, either face-to-face or online \* Has something happened to you or someone in your family that made you change your mind about science or become interested in science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,454  | ,000                     |
|                    | V for Cramer      | ,262  | ,000                     |
|                    | Contingency ratio | ,413  | ,000                     |
| N of valid cases   |                   | 7507  |                          |

But following people on networks who share anecdotes about science has no relevance whatsoever to participating, or not, in actions to talk about scientific discoveries on gender issues.

Table 5.82: **symmetrical measurements**: Have you participated in any action to talk about scientific discoveries on gender issues, either face-to-face or online \* Do the scientific people you follow share anecdotes or evidence about science

|                    |              | Value | Approximate significance |
|--------------------|--------------|-------|--------------------------|
| Nominal by Nominal | Phi          | ,187  | ,000                     |
|                    | V for Cramer | ,094  | ,000                     |

|                   |      |      |
|-------------------|------|------|
| Contingency ratio | ,184 | ,000 |
| N of valid cases  | 2506 |      |

The same is true when asked whether the respondent has learned of any scientific evidence on education or gender through newspapers, magazines, scientific publications, TV, YouTube, social networks, etc. It seems that in this case, as before, family interactions carry more weight (Phi of 0.433).

Table 5.83: **symmetrical measurements:** Have you learned of any scientific evidence on education or gender through information sources such as newspapers, magazines, scientific publications, television, YouTube, social networks, etc. \* Has something happened to you or someone in your family that made you change your mind about science or become interested in science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,433  | ,000                     |
|                    | V for Cramer      | ,250  | ,000                     |
|                    | Contingency ratio | ,397  | ,000                     |
| N of valid cases   |                   | 7507  |                          |

In contrast, following people on networks who share anecdotes about science seems to have no noticeable impact.

Table 5.84: **symmetrical measurements:** Have you learned of any scientific evidence on education or gender through information sources such as newspapers, magazines, scientific publications, television, YouTube, social networks, etc. \* Do the scientific people you follow share anecdotes or evidence about science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,196  | ,000                     |
|                    | V for Cramer      | ,113  | ,000                     |
|                    | Contingency ratio | ,192  | ,000                     |
| N of valid cases   |                   | 2506  |                          |

Being active and talking to others about scientific evidence related to education seems to be somewhat influenced by having interactions at home with people who are interested in science (although the relationship, as shown by the Phi value, is rather discrete: 0.381).

Table 5.85: **symmetrical measurements:** Have you ever talked to other people about scientific evidence related to education \* Has something happened to you or someone in your family that made you change your mind about science or become interested in science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,381  | ,000                     |
|                    | V for Cramer      | ,220  | ,000                     |
|                    | Contingency ratio | ,356  | ,000                     |
| N of valid cases   |                   | 7507  |                          |

In any case, the impact of family is much greater than that of other people, as can be seen in the table below. Following people who share science anecdotes on social media does not seem to have any impact on whether or not one talks about scientific evidence with other people.



Table 5.86: **symmetrical measurements:** Have you ever talked to other people about scientific evidence related to education \* Do the scientific people you follow share anecdotes or evidence about science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,148  | ,000                     |
|                    | V for Cramer      | ,085  | ,000                     |
|                    | Contingency ratio | ,146  | ,000                     |
| N of valid cases   |                   | 2506  |                          |

In the case of sharing information and talking about scientific evidence related to gender, the data indicate that the impact of family interactions is slightly larger (Phi of 0.463), than in the previous case. For gender issues, the support that the family can provide is fundamental, and is perhaps the key.

Table 5.87: **symmetrical measurements:** Have you ever talked to other people about scientific evidence related to gender \* Has something happened to you or someone in your family that made you change your mind about science or become interested in science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,463  | ,000                     |
|                    | V for Cramer      | ,267  | ,000                     |
|                    | Contingency ratio | ,420  | ,000                     |
| N of valid cases   |                   | 7507  |                          |

Similarly, as before, when looking at data on interactions with people other than family, we see that the relationship we had seen before now disappears. Following people who share anecdotes about science on social media has no impact on talking to other people about gender-related scientific evidence.

Table 5.88: **symmetrical measurements:** Have you ever talked to other people about scientific evidence related to gender \* Do the scientific people you follow share anecdotes or evidence about science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,134  | ,000                     |
|                    | V for Cramer      | ,077  | ,000                     |
|                    | Contingency ratio | ,133  | ,000                     |
| N of valid cases   |                   | 2506  |                          |

On the impact of information sources or phase-to-face or digital conversations with other people to learn about scientific evidence, having interactions with family members interested in science seems to be somewhat related, but very discrete (Phi of 0.335).

Table 5.89: **symmetrical measurements:** To what extent have you learned about scientific evidence related to education through information sources or from face-to-face or digital conversations with other people \* Has something happened to you or someone in your family that made you change your mind about science or become interested in science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,335  | ,000                     |
|                    | V for Cramer      | ,193  | ,000                     |
|                    | Contingency ratio | ,317  | ,000                     |



|                  |      |
|------------------|------|
| N of valid cases | 7507 |
|------------------|------|

In any case, the role of the family is much more important than following other people who tell science anecdotes on social media. As we can see, in these cases it seems to have little to do with learning about scientific evidence related to education through information sources, or from phase-to-face or digital conversations with other people.

Table 5.90: **symmetrical measurements:** To what extent have you learned about scientific evidence related to education through information sources or from face-to-face or digital conversations with other people \* Do the scientific people you follow share anecdotes or evidence about science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,289  | ,000                     |
|                    | V for Cramer      | ,167  | ,000                     |
|                    | Contingency ratio | ,277  | ,000                     |
| N of valid cases   |                   | 2506  |                          |

In the case of gender, something similar to what we have just seen with scientific evidence in education happens: family has more impact than following other people who share anecdotes about science, in the networks.

Table 5.91: **symmetrical measurements:** To what extent have you learned about scientific evidence related to gender through information sources or from face-to-face or digital conversations with other people \* Has something happened to you or someone in your family that made you change your mind about science or become interested in science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,328  | ,000                     |
|                    | V for Cramer      | ,190  | ,000                     |
|                    | Contingency ratio | ,312  | ,000                     |
| N of valid cases   |                   | 7507  |                          |

Table 5.92: **symmetrical measurements:** To what extent have you learned about scientific evidence related to gender through information sources or from face-to-face or digital conversations with other people \* Do the scientific people you follow share anecdotes or evidence about science

|                    |                   | Value | Approximate significance |
|--------------------|-------------------|-------|--------------------------|
| Nominal by Nominal | Phi               | ,241  | ,000                     |
|                    | V for Cramer      | ,139  | ,000                     |
|                    | Contingency ratio | ,235  | ,000                     |
| N of valid cases   |                   | 2506  |                          |

## 5.7 Conclusions for the Analysis of the associations between items in terms of interactions

In conclusion, some relevant results can be drawn:

- One of the results we have obtained is that although the data suggest that being able to participate (or not) in actions on scientific discoveries in education (either phase to phase or online) does seem to be related to the interactions that the respondent

maintains (both with other members of their family, and with people who share anecdotes or evidence about science on the networks), when asked specifically about participation in different types of activities (informative sessions in schools, workshops, talks or informative sessions, etc.), then it seems that this participation has no relationship whatsoever. We think that this result is affected by the effect of the sample size: as the number of people responding to each category is small, then the possible effects (the possible impact) is diluted, so that a relationship that we found when we asked the question globally (collecting the whole sample), seems to disappear when we examine the responses disaggregated by response categories. In conclusion, we can say that interaction does have an effect on participation in events on scientific discoveries in education (but we cannot know which type of event has the greatest weight of all those mentioned above).

- Another relevant aspect is that in topics such as scientific discoveries on gender issues, family interaction is much more relevant than following other people in the networks, having an interest in science, or sharing anecdotes related to science. Some of the people who take part in actions on talks about science discoveries on gender issues do so because it is part of their family context. In fact, the data for all the questions on gender evidence reveal that the support one may receive from one's family is fundamental in feeling able to participate and share scientific evidence on gender issues. In any case, family support is much more crucial than following people on networks, for example, who share anecdotes about science.
- Finally, it seems that interactions with people who are followed through networks, even if those people share anecdotes about science, do not seem to have a noticeable impact on respondents' willingness to participate in science performances, to talk about science (neither in relation to evidence on education, nor in relation to evidence on gender).

## 6. CONCLUSIONS

The aim of this report was to respond to O3) identify awareness-raising initiatives succeeding at engaging citizens in scientific participation, including the Open Access movement. In order to do so, this report has identified which elements facilitate (transformative) and hinder (exclusionary) the success of initiatives to encourage citizens' participation in science, including the open access movement. The main conclusions in this regard point that when initiatives incorporate the following four elements, they achieve social impact and foster citizens science: 1) Interactions with science and among citizens, 2) Inclusion of all sectors of society, 3) Informal learning spaces promoted by educational settings and 4) Scientific evidence in open access.

### Interactions with science and among citizens; two key elements for the participation of citizens in science

Existing scientific studies had already pointed to this direction. The literature review conducted in this report concluded that one of the common characteristics of interventions that succeed in fostering citizen participation in science is their interactive nature. In the analysed cases, interactions were fostered through different strategies, such as games, online tools, peer discussions or mentorships. Qualitative and quantitative data reinforce this conclusion. On the one hand, participants in the FG expressed that innovative these initiatives and projects succeed in getting the public involved in different activities. In addition, the SMA identified that a great extent of the initiatives aimed to **invite citizens to scientific events, share and discuss scientific knowledge on open access or organize hackathons and other co-creation projects**. In these initiatives, citizens were expected to play an active role, interacting with each other and with science. Thus, being actively engaged imply in most cases, participating in research, discussing and learning about scientific topics, submitting scientific contributions or co-creating scientific knowledge. On the other hand, quantitative data from the survey showed that **interactions with science**, and especially when citizens interact with science by following on social media someone who often publishes about science, increase both citizens' **knowledge about and their participation in initiatives to foster citizens' engagement in science**, with increases ranging from 27.45% to 122.38%.

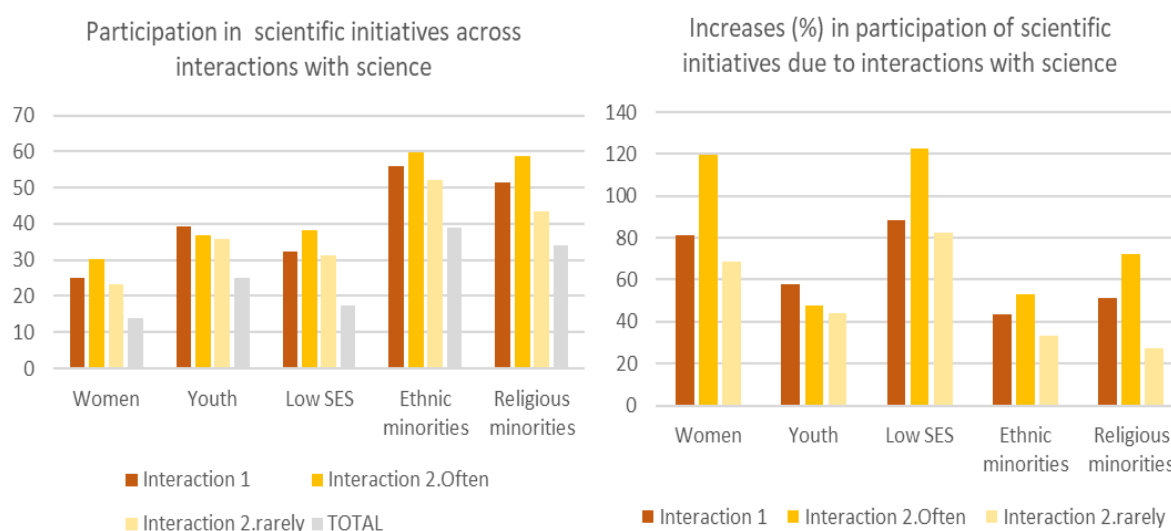


Figure 1. Increase in the participation of people from vulnerable groups in scientific initiatives across interactions with science.

Finally, more than one third of the respondents (37.7% in education and 33.4% in gender) expressed

sharing conversations about scientific evidence with other people, which reinforce the importance of interactions in the promotion of citizen science.

### Inclusion of all sectors of society, including vulnerable groups.

Those initiatives that succeed in fostering citizen participation in science are characterised by their community approach, which includes those people who have been traditionally excluded from science. In this line, SMA enabled the identification of existing **initiatives targeting specifically people from vulnerable groups**, including people from ethnic minorities (such as Black, Asian and Minority Ethnic (BAME), BIPOC, Māori or Pacifica Islander or aboriginal communities, among others), children and youth (with special attention to poor and disadvantaged children, bullying victims, refugees or orphans), women (including widows or teen mothers), or people with disabilities, among others. Additionally, some of these actions were bottom-up and emerged from individual citizens, citizens' platforms, NGOs and associations, including youth, women and families' associations. The review of existing scientific literature had already demonstrated that the **inclusion of the voices of the participants can provide enriching feedback** that contributes to the achievement of social impact, as it ensures that the interventions respond to the real needs of the participants. In this line, qualitative evidence gathered in the FG showed that participants perceive the importance of the involvement of diverse people in research and think that the scientific community should implement specific actions to encourage them to do research. In addition, participants perceived the benefits of doing research 'with' rather than doing 'on' communities and remarked the necessity of highlighting this to the general public. The results from the survey are aligned with this finding and demonstrated that, in general, **respondents from vulnerable groups were more likely to express having participated in actions to discuss scientific evidence in gender and education** compared with the total of respondents, ranging from 14.39% to 41.49%.

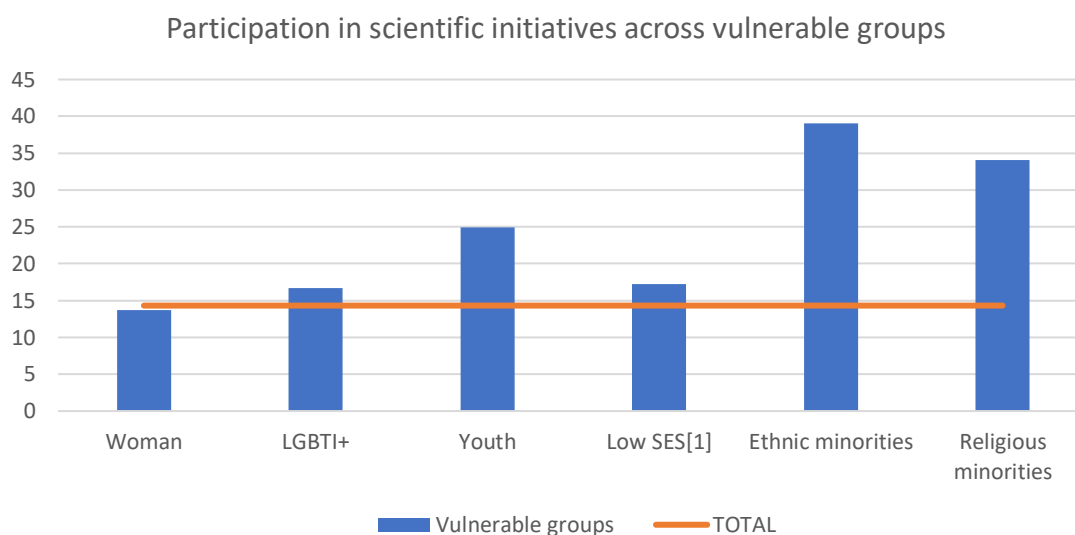


Figure 2. Participation in scientific initiatives of vulnerable groups compared with the total of respondents

### Informal learning spaces promoted by educational settings foster citizen participation in science

The analysis of the data collected in this report pointed that educational settings (including schools, universities and museums) have an important role in the promotion of citizens participation in science through the organization of informal learning spaces. Respondents of the international survey **expressed that initiatives held in educational centres were the most known**, including: workshops in

educational centres such as schools, universities and similar (19.32%) and informative sessions in schools (18.36%).

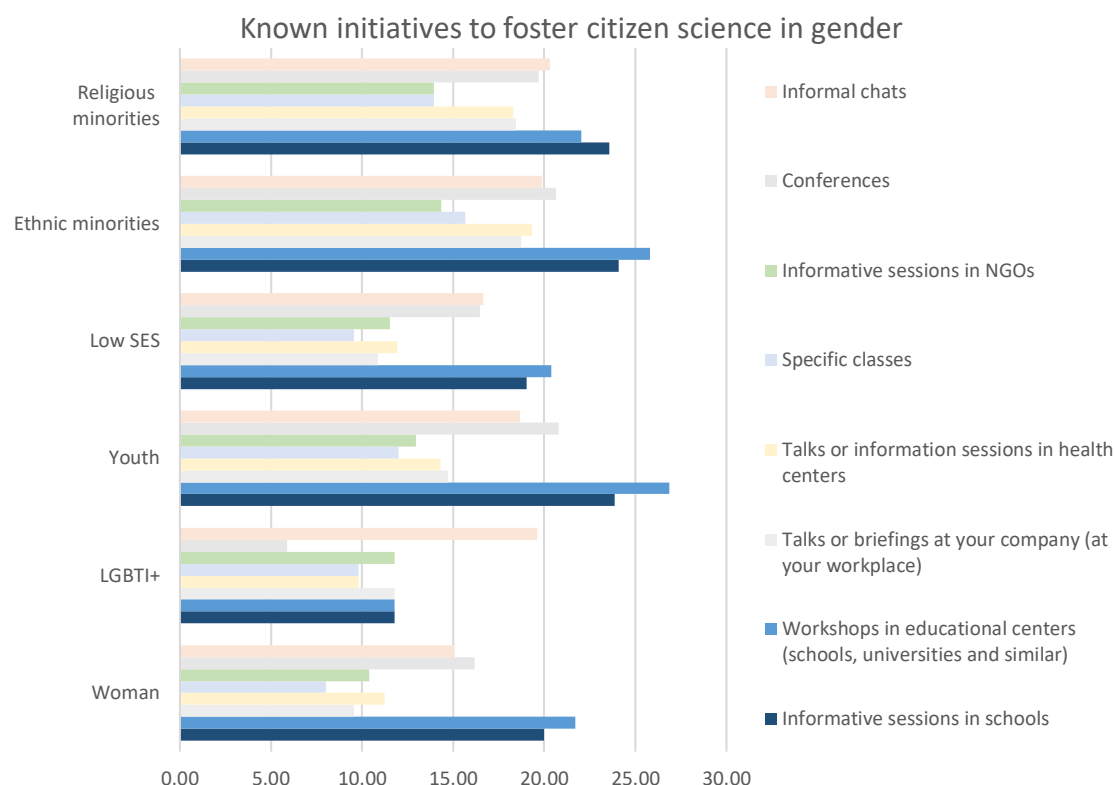


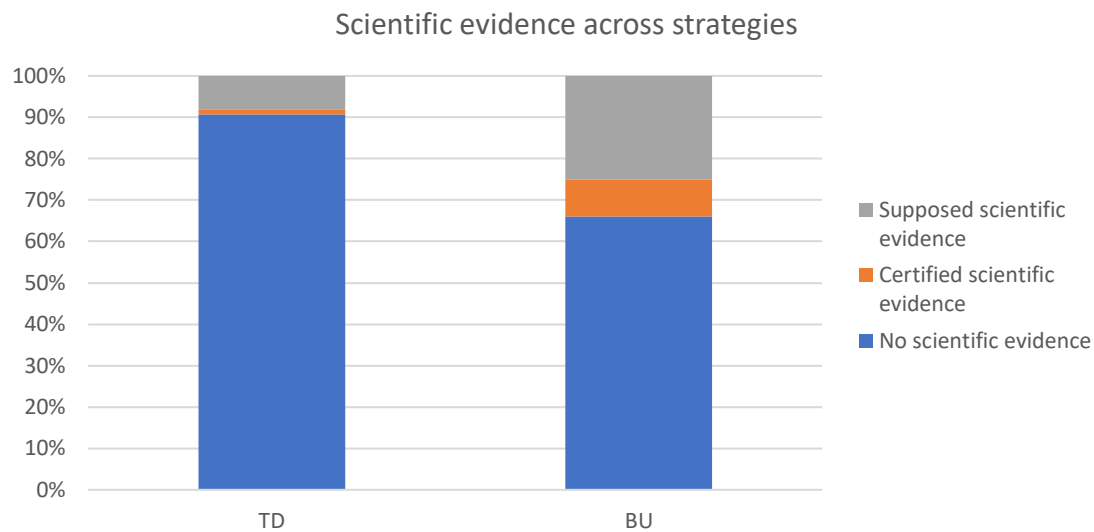
Figure 3. Known initiatives to foster citizen science in gender.

Based on their personal experience, respondents from FG highlighted the success of university outreach activities, Open Days, Science Festivals, Women in Science Days, Science Museums, popular science shows, Citizen Science websites, online lectures and talks, and projects that sought to involve citizens as public contributors. Therefore, participants think that **outreach initiatives can help generate interest in what scientists do** and that it is important to take people outside of the classroom. The SMA enabled the identification of numerous initiatives that promote informal learning, most of them organized by universities (20.89%-68.18%). This finding is aligned with existing scientific literature that shows that an effective approach to engage citizens in science is through **informal learning spaces**, including museums and other scientific settings, social media or, in the case of children and students, in activities and programs that extend their learning time beyond the school schedule.

### Scientific evidence in open access

According to the survey, almost 3 out of 10 (29.7%) of **citizens use information sources to learn** about scientific evidence on education and gender and **this percentage increases when citizens interact with science**, reaching percentages ranging from 44.79% to 74.31%. This result demonstrates the importance of sharing scientific evidence in open access, especially on the social media, since the most effective interaction is following someone on social media who often publishes about science. In this vein, although most of the initiatives identified in the SMA did not mention whether participants had access to scientific evidence or not, in most cases scientific evidence was not present on the tweet or message itself, but on the conference, webinar or event that were announcing. Among those that include scientific evidence, **open access was common**. The use of scientific evidence was mainly through the provision of data or statistics, and it **was more widespread in education than in gender**

(ranging from 9.80%-35.47% in the first case and from 8,28% to 11,11% in the second) **and in bottom-up than in top-down** (9,24% compared to 33.92%).



*Figure 4. Presence and access to scientific evidence on SMA in top-down and bottom-up strategies.*

Qualitative evidence from FG support this finding and the majority of participants believed that Open Access was useful, and they gave examples of accessing Open Access journals and articles. In addition, all the articles of the literature review that reported evidence of social impact, implemented evidence-based interventions, and were based on other interventions that had successfully achieved impact before. This result highlights the importance not only of scientific evidence but also of scientific evidence of social impact. Between 72.67% and 100% of the messages analysed in the SMA did not contain any mention of the social impact achieved by the initiatives. However, this does not necessarily imply that the initiatives did not achieve social impact, but that society is still not used to collecting evidence of the social impact achieved by the initiatives.

In conclusion, among the elements that facilitate the success of initiatives to encourage citizens' participation in science, including the open access movement (transformative), this report has identified: 1) Interactions with science and among citizens, 2) Inclusion of all sectors of society, 3) Informal learning spaces promoted by educational settings and 4) Scientific evidence in open access. On the contrary, the main barriers that hinder the achievement of social impact (exclusionary) are the lack of plain English summary of research, the overwhelming amount of information, digital access to scientific research and reaching diverse social agents.