



Lost opportunities for science communication in Spanish universities

Pérdida de oportunidades para la comunicación científica en las universidades españolas

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Abstract

It is increasingly recognized that communicating science to the general public is part of a scientist's role. However, many researchers still do not consider communication as a priority task in their agenda and most of them have no training in science communication. Moreover, most scientific researchers have no training in science communication or training in outreach to non-scientific audiences. These graduates thus currently enter a professional environment that requires communication skills that are not usually taught them during undergraduate studies. Ignoring the issue further fosters mistrust and further alienates the general public from scientific research. This article investigates the different perceptions that biomedical undergraduates at the University of Barcelona have about science communication. The aim of the study was to

Resumen

Cada vez es más reconocido que comunicar la ciencia al público en general es parte del papel de un científico. Sin embargo, muchos investigadores aún no consideran la comunicación como una tarea prioritaria en su agenda y la mayoría de ellos no tiene formación en comunicación científica. Además, la mayoría de los investigadores no tienen formación en comunicación científica o formación para llegar a audiencias no científicas. Por este motivo, los estudiantes de ciencias ingresan en la actualidad en un entorno profesional que requiere habilidades comunicativas que no se les suelen enseñar durante los estudios de grado. Ignorar el problema fomenta aún más la desconfianza y aliena aún más al público en general de la investigación científica. Este artículo investiga las diferentes percepciones que tienen los estudiantes de biomedicina de la Universidad

determine whether future biomedical researchers consider science communication to be important, whether they have any plans to consider it as a career and whether they receive sufficient information and training at university to be able to develop such a career. A key finding of the study is that students know the importance of science communication, but motivation, information and training at university level is lacking. This would suggest a perceived loss of opportunities to foster effective science communication in universities.

Keywords: Health communication; science communication; science in society; science popularization; university

Introduction and objectives

It is increasingly recognized that communicating science to the general public is part of a scientist's role (Brownell et al., 2013; Greenwood & Riordan, 2001), most especially in the biomedical field, crucial to the public understanding and protecting their health. However, most biomedical researchers have no training in science communication (SC) or training in outreach to non-scientific audiences (Tan, 2018). Biomedical graduates thus currently enter a professional environment that requires communication skills that are not usually taught them during undergraduate studies (Neeley et al., 2014). To explain and present biomedicine to the general public requires specific communication techniques that are not taught even in the best science programmes (Miller et al., 2009; Silva & Bultitude, 2009). This lack has led to a growing distrust of scientists and the creation of a climate of rejection of scientific and medical knowledge. The response of the science community to this rejection –almost always ineffective– is to present the public with evidence-based studies or simply ignore the issue (Tan, 2018).

Ignoring the issue further fosters mistrust and further alienates the general public from scientific, biomedical and health research. Educating the public has been ineffective due to the lack of SC training and of SC training opportunities for scientists (Baron, 2016; Brownell et al., 2013), which, in turn, leads scientists to feel uncertain about their communicative skills (Baron, 2016; Singh et al., 2014). This situation could be addressed by offering more communication training designed specifically by scientists (Baron, 2016; Singh et al., 2014).

Previous studies show that science and health experts consider that the information transmitted to the media is often unclear or inaccurate (Hoffman-Goetz et al., 2003; Yeaton et al., 1990), or that information is presented in too brief a form for its significance to be understood (Moyer et al., 1995; Tanner, 2004). Inaccuracies often occur because journalists themselves have no training in science or in SC. Journalists often blame scientists for a basic lack of understanding of journalistic processes and of the communication skills needed to convey information to the public (Nelkin, 1996; Tanner, 2004; Wouldems, 2003).

de Barcelona sobre la comunicación científica. El objetivo del estudio fue determinar si los futuros investigadores biomédicos consideran importante la comunicación de la ciencia, si tienen algún plan para considerarla como una carrera y si reciben suficiente información y formación en la universidad para poder desarrollar dicha carrera. Un hallazgo clave del estudio es que los estudiantes conocen la importancia de la comunicación científica, pero falta motivación, información y formación a nivel universitario. Esto sugeriría una pérdida percibida de oportunidades para fomentar la comunicación científica eficaz en las universidades.

Palabras clave: Ciencia en sociedad; comunicación científica; comunicación de la salud; divulgación científica; universidad

Given that SC is not broken when people do not understand scientific facts, but when scientists do not understand or speak to the core values of their audience (Seethaler et al., 2019), improved training for future biomedical researchers would ensure that science was communicated more smoothly and dynamically from experts to society (Besley et al., 2015; Dudo, 2013).

Studies from different countries suggest that older scientists are more predisposed to transmit information than younger scientists (Bentley & Kyvik, 2011; Besley, Oh, & Nisbet, 2013; Crettaz von Roten, 2011; Kreimer et al., 2011; Kyvik, 2005; The Royal Society, 2006; Torres-Albero et al., 2011), even though online outreach is more typical among young people (Besley, 2014; Besley et al., 2013). It has also been observed that scientists communicate more if they see communication as positive and beneficial (Besley et al., 2013; Marcinkowski et al., 2013) and especially if they feel confident regarding their communication skills (Besley, 2014; Besley et al., 2013; Dudo et al., 2014; Dunwoody et al., 2009; Poliakoff & Webb, 2007). Further studies show that training in science outreach also increases the willingness of scientists to communicate their work (Dudo, 2013; Dunwoody et al., 2009).

A 2006 study of scientists and research engineers, for example, found that scientists with prior training in SC are more likely to engage in public engagement (The Royal Society, 2006). Such training is increasingly being offered to working scientists and to undergraduate and graduate students (Basken, 2009; Turney, 1994). A study from 2009 found that scientists participating in SC workshops found that training equipped them with useful skills to discuss science with the general public (Miller et al., 2009).

A study from 2018 showed that SC training produced positive changes in presentation skills (better eye contact, clearer speaking, less formality), persuasion techniques (capturing attention, establishing credibility, summarizing) and storytelling (relating a topic to a general audience, avoiding or explaining jargon, making good use of numbers and of visual resources) (Rodgers et al., 2018).

Typically, SC training consists of activities (courses, workshops and seminars) designed to train scientists to interact more often and more clearly with the public, the media, and policymakers (Basken, 2009; Peters et al., 2008a, 2008b). In some cases, SC workshops trains professional journalists in specific science and health topics (Besley & Tanner, 2011). Training content typically includes skills related to presentations, message finetuning and use of information and communication technologies such as video, audio and online publishing (Besley et al. al., 2016). SC trainers can be full-time or part-time professional trainers, communication academics, museum, zoo and aquarium professionals, or researchers with communication experience, but who have not formally studied communication (Besley et al., 2015). However, the findings of several researchers suggests that there is still a substantial disconnect between SC training and SC in practice (Besley et al., 2016; Besley & Tanner, 2011; Miller et al., 2009).

The SC field in general appears to be growing (Miller et al., 2009; Peters et al., 2008a; Trench and Miller, 2012). In North America, some 40 active SC training programmes were identified in 2009 (Besley et al., 2016), but since then the number of programmes offered to undergraduate and graduate students has grown considerably (Basken, 2009). In Catalonia, its 12 universities offer five postgraduate degrees in SC, some specifically focused on health: two at the University of Barcelona, one at Pompeu Fabra University and two at the University of Vic (Barcelona School of Management, 2020; Universitat de Barcelona, 2020a; Universitat de Barcelona, 2020b; Universitat de Vic, 2020a; Universitat de Vic, 2020b).

Previous research has found that, in general, scientists have positive attitudes toward SC training (Besley et al., 2015), whose importance has been recognized not only by scientists, but also by researchers in communication, especially those specializing in SC. Besley and Tanner (2011) explored the perceptions of SC experts regarding the training needs of scientists, finding broad consensus that scientists would benefit from additional SC training.

The aim of this study was to explore the opinions of University of Barcelona biomedical undergraduates regarding SC referring specifically to health, to determine whether future biomedical researchers consider SC to be important, whether the students have any plans to consider SC as a career (either full-time or part-time), and whether they receive sufficient information and training in SC at university to be able to develop a career in SC.

Methods

The study was based on a survey and in-depth interviews conducted with students enrolled in the four-year biomedical sciences degree offered by the Faculty of Biology of the University of Barcelona (UB) in the 2019-2020 academic year. The UB, one of the few universities in Spain that offers a degree in biomedical sciences, is ranked as the best university in Spain and among the 200 top universities in the world according to QS Rankings 2020 (University of Barcelona, 2020c). It excels in employability, academic services and teaching quality, and is also highly internationalized, with some 1,000 ex-students working at universities and research centres around the world). The city of Barcelona is also ranked among the 25 best cities in the world to study according to QS Best Cities (University of Barcelona, 2020c).

According to the head of studies of the biomedical sciences degree at the UB, 450 students were enrolled in the degree in the 2019-2020 academic year. This number therefore represents the maximum study population.

The survey was administered in person during different classes in November 2019 to 186 randomly selected students, for a 95% confidence interval and 6% error approximately, for a 100% response rate. No distinctions were drawn on the basis of sex and students from all four years were represented. All respondents were previously informed of the purposes of the study and were free to not answer questions and to withdraw at any time. To study the relationships between the different variables, a Pearson chi-square test was performed using the SPSS statistical software, version 23. The survey consisted of a questionnaire with eight questions, answered YES, NO or NK/NA.

With the aim of exploring their perspectives on the survey responses, semi-structured in-depth interviews were conducted with 20 biomedicine students in June 2020. Interviews were conducted online, due to the coronavirus pandemic and safety measures imposed at the UB, although the original intention had been to conduct face-to-face interviews. A semi-structured open interview format was used so as to be able to explore opinions in depth.

The interviews aimed to explore if and why students considered SC to be important for the advancement of biomedicine, whether they would have participated more in SC in the course of their studies if encouraged to do so by their instructors, whether or not they would dedicate time to SC once they become researchers and why, if they were aware of any specific SC training available, and if and why they would find it useful to have SC included in their biomedical degree.

Results

Importance of SC for biomedicine

All students (100%) considered that SC is important for the advancement of biomedicine. No significant differences were observed between the different years or when the students were grouped according to the first and second degree cycles ($p=0.01$). (Table 1)

	1st year	2nd year	3rd year	4th year	TOTAL
Yes	47 (25.2%)	39 (20.9%)	63 (33.8%)	37 (19.8%)	100 (100%)
No	0	0	0	0	0
NK/NA	0	0	0	0	0
TOTAL	47 (25.2%)	39 (20.9%)	63 (33.8%)	37 (19.8%)	186 (100%)

Table 1. Do you think that science communication is important for the advancement of biomedicine? (N=186). NK/NA: not known/not answered. Source: Authors.

Arguments in favour of SC were that it is crucial to inform the general public regarding biomedical research and advances, and to do so using a vocabulary accessible to all, since understandable health information should be available to all. An informed public would be able to express informed opinions, would understand the importance of investing in and promoting biomedical research and would help develop a positive feedback loop.

The opinion was that SC is the only way that the public, and therefore the political class, will link knowledge with biomedical research, because if the public and politicians are fully aware of current research and future research directions, and of its importance, this would enhance funding. This is crucial, because without funding science cannot advance and, in Europe, this funding must be mostly public. If the entire population is aware of the importance of health research, it would not be researchers in isolation fighting for more funding.

Other arguments were that SC is crucial to collaboration and multidisciplinary projects involving scientists from various fields, increasingly linked to the advancement of biomedicine and that it also fosters biomedical progress by attracting new talent.

Over half the students (55.3%) stated that their instructors did not elucidate on the importance of SC and did not encourage them to participate in outreach activities. No significant differences were observed between the different years or when the students were grouped according to each degree cycle ($p=0.01$). (Table2)

	1st year	2nd year	3rd year	4th year	TOTAL
Yes	13 (6.9%)	23 (12.3%)	18 (9.6%)	13 (6.9%)	67 (36%)
No	28 (15%)	12 (6.4%)	41 (22%)	22 (11.8%)	103 (55.3%)
NK/NA	6 (3.2%)	4 (2.1%)	4 (2.1%)	2 (1%)	16 (8%)
TOTAL	47 (25.2%)	39 (20.9%)	63 (33.8%)	37 (19.8%)	186 (100%)

Table 2. During your studies, have your instructors explained the importance of biomedical communication or encouraged you to participate in outreach? (N=186). NK/NA: not known/not answered. Source: Authors.

The students felt that the university should better explain the different professional opportunities, including SC, available in biomedicine outside of research, and were of the opinion that options should be offered for electives, workshops and seminars on career options.

One of the biggest shortcomings of the university, according to the students, was that they were not trained in SC and in how to transmit knowledge to society: "We do some oral presentations, but nothing that comes anywhere near the notion of transmitting knowledge", explained one of the students.

SC was considered not to receive much attention in the university; according to one student: "If you are lucky enough to do an internship in a laboratory where SC is rated highly, then you learn about it – but university instructors of theory subjects never touch on the topic."

Another student summed the situation up as follows: "During our degree all the instructors underline the importance of reading scientific articles to keep up with advances, but they overlook many other forms of science communication and, consequently, so do the students. In fact, I was unaware of SC or even that it could possibly be a career option for me. By now I'm better informed and so I plan to independently contribute to health communication alongside my main work."

Time dedication to SC

Only just over half (53.7%) of the students have participated in science outreach activities. No significant differences were observed between the different years or when the students were grouped according to each degree cycle ($p=0.01$). (Table 3)

	1st year	2nd year	3rd year	4th year	TOTAL
Yes	25 (13.4%)	20 (10.7%)	40 (21.5%)	15 (8%)	100 (53.7%)
No	19 (10.2%)	19 (10.2%)	22 (11.8%)	21 (11.2%)	81 (43.5%)
NK/NA	3 (1.6%)	0	1 (0.5%)	1 (0.5%)	5 (2.6%)
TOTAL	47 (25.2%)	39 (20.9%)	63 (33.8%)	37 (19.8%)	186 (100%)

Table 3. Have you ever participated in outreach activities as either an organizer or a participant? (N=186). NK/NA: not known/not answered. Source: Authors.

The students who had never participated in SC or outreach activities, either as organizer or spectator, explained that this was mostly because instructors did not encourage them or inform them of options for doing so. They also pointed out that their instructors had not underlined the importance of such activities for both their own career or for biomedicine in general.

Many students considered that if they had been more motivated by their instructors during their studies, they would have participated more in outreach activities, whether as organizers or spectators.

Just over half of the students (50.5%) stated that they expected to work as biomedical researchers on completion of their studies, while just over a third (39.7%) remained uncertain. No significant differences were observed between the different years or when the students were grouped according to each degree cycle ($p= 0.01$).

Among those who were unsure that they wanted to pursue research, only 11.2% considered working in the SC area. No significant differences were observed between the different years or when the students were grouped according to each degree cycle ($p=0.01$).

Those who consider SC as a career possibility said it was because SC is an option they are attracted to and that they believe requires reinforcement. Some of those students referred to SC in the educational sector and others to SC in the pharmaceutical industry.

While 41.9% of students considered that they would dedicate some time to SC once they became researchers, 49.4% were unsure. No significant differences were observed between the different years or when the students were grouped according to each degree cycle ($p=0.01$). Students who were uncertain about their future career argued that they would only dedicate time to SC if it was necessary to win projects. Those who say that they would dedicate time to SC thought that they would do so to transmit the health benefits of their research to their colleagues and the public, and also to explain to the public why biomedicine requires research to be done in ways that sometimes may be perceived as unethical, e.g., experimenting on animals. They also pointed out that SC is nowadays greatly facilitated by the social media.

"I think – even though research work involves long hours and might be difficult to do in combination with other disciplines – that I would like to be able to participate in outreach in some way," said one of the students. "I think that I would like to dedicate time to science communication, talks, conferences and writing up research results. It's about taking what is already known, reviewing it, developing it or studying a new concept and then informing the rest of the biomedical community so as to move knowledge forward," explained one of the students.

SC as a subject in biomedical degrees

Only 53.7% of students were aware that specific SC training was available. No significant differences were observed between the different years or when the students were grouped according to each degree cycle ($p=0.01$).

Those who were aware that SC training was available were informed by either colleagues themselves interested in SC or by online postgraduate offers and social media advertising (e.g., in LinkedIn) – not because university instructors informed them or encouraged them to embark on this alternative career path.

Some of the students expressed interest in knowing more about this type of training: "I would like to know more, because, if I came across some interesting training course that I could combine with work on my thesis I would not rule out doing it. In the end, presenting a thesis is communicating your work, and the more prepared you are the better," said one of the students.

Almost all the students (89.7%) considered that it would be useful for bioscience degrees to include SC as a subject. No significant differences were observed between the different years or when the students were grouped according to each degree cycle ($p=0.01$). (Table 4)

	1st year	2nd year	3rd year	4th year	TOTAL
Yes	42 (22.5%)	38 (20.4%)	54 (29%)	33 (17.7%)	167 (89.7%)
No	0	0	6 (3.2%)	2 (1%)	8 (4.3%)
NK/NA	5 (2.6%)	1 (0.5%)	3 (1.6%)	2 (1%)	11 (5.9%)
TOTAL	47 (25.2%)	39 (20.9%)	63 (33.8%)	37 (19.8%)	186 (100%)

Table 4. Do you think it would be useful to include science communication as a subject in biomedical degrees? (N=186). NK/NA: not known/not answered. Source: Authors.

The students indicated that this type of subject was very necessary, to help them with writing scientific articles for publication and, more broadly, to communicate their work generally. They pointed to the importance of SC, suggesting that the best approach to enhancing it would be to equip young scientists with the necessary tools. "If SC was encouraged from early on at university, it would be less intimidating for us in the future, because training would remove our fear and, above all, help overcome embarrassment and improve our time management," explained one student.

They considered that it would be very useful to learn effective SC in order to communicate health issues to the general public in an accessible way and to enhance and broaden possible career opportunities after university. Most students believed that, if more information and motivation regarding SC were offered at university, many more students would opt for a career in SC.

One of the students explained: "After several dense and repetitive subjects, I feel that there would be no harm in having SC as a subject or at least part of a subject, over and above the few oral presentations that we give. If SC was a subject, the need for communication in the world of work would have explained." Another students concluded: "The truth is that I would feel freer to communicate if I knew more about techniques."

Discussion and conclusions

The conclusions of this research are summarized in the following points:

1. Students are fully aware of the importance of SC. All UB biomedical science undergraduates, without exception, considered that SC is important for the advancement of biomedicine. This is in line with other studies such as the study that reports that scientists at the Spanish Advanced Scientific Research Council (CSIC) have a high level of awareness of the importance of SC and of a scientific culture (Martín-Sempere et al., 2008). The students argue that it is essential to inform the general public on biomedical research and advances using non-technical language, so that people can talk in an informed way about their health, better understand what biomedicine achieves, appreciate the importance of funding for science and provide the kind of positive feedback that will pressurize governments to provide more funding.
2. Students do not routinely participate in outreach. Although students rate the importance of SC highly, only half have ever participated in any SC or outreach activities. Studies from other countries also underline this trend, suggesting that younger scientists are less likely to participate in outreach

- than older scientists. (Bentley & Kyvik, 2011; Besley et al., 2013; Crettaz von Roten, 2011; Kreimer et al., 2011; Kyvik, 2005; The Royal Society, 2006; Torres-Albero et al., 2011). Students who have never participated in outreach explain that this is because university instructors have not informed them of SC possibilities and options, nor have they underlined the importance of participation in SC for their own scientific career, for biomedicine and for society.
3. Instructors do not encourage students in SC. Most instructors did not explain the importance of SC nor encourage students to participate. This may explain why these students do not participate in SC; previous studies suggest that younger and more junior members of a profession (e.g., predoctoral fellows and technicians on temporary contracts) often follow the lead of highly motivational persons such as their instructors (Martín-Sempere et al., 2008). It is becoming increasingly recognized that SC aimed at the general public is a duty of scientists (Brownell et al., 2013; Greenwood & Riordan, 2001) and, for this reason, it is crucial to emphasize the importance of SC to young scientists from the early training stages. Universities also need to raise awareness that, outside of research, other professional options, including SC, for science graduates exist.
 4. Students are not sure that if would dedicate time to SC once they become researchers. Almost half of the students in our survey did not know if they would dedicate time to SC once they become researchers, probably because most instructors have not explained the importance and benefits of SC. Previous studies have shown that scientists participate more in outreach if they see it as something positive and advantageous for them (Besley et al., 2013; Marcinkowski et al., 2013). Biomedicine undergraduates therefore need to be informed of the key role played by SC in advancing both biomedicine and their careers. SC is a skill that students should acquire before entering the professional world. New generations of scientists need to understand SC as crucial to their work, yet this is not the case according to a recent study (Revuelta, 2018).
 5. Many students are unaware of specific training in SC. More than 40% of the students did not know that specific training in SC is available. This may be one of the reasons why many scientists fail to communicate adequately, as a precondition for successful SC is to be aware that training in SC exists. According to one study, more than 40% of scientists stated that they had not received any formal training in SC in the previous year (Besley & Tanner, 2011). Several studies demonstrate that training in SC increases the willingness and motivations of scientists to participate in SC and outreach (Dudo, 2013; Dunwoody et al., 2009).
 6. Students do not see SC as a possible career path. Only a very small percentage (11.2%) of the students have considered working in the SC area, which was a surprising finding as only 50% of them are sure that they want to pursue research. It would therefore be useful for the university to raise awareness among its biomedicine students that SC is as valid and as necessary a professional outlet as laboratory-based biomedical research.
 7. Progression through university education does not lead to greater awareness of SC. The fact that no significant differences were observed between the responses of first and final year biomedical students would suggest that progression through university does not lead to students to being better or more informed about SC. Instructors clearly need to encourage students to participate in SC during their degree and, above all, once they engage in research. It would have been desirable to find that final year undergraduates had acquired a greater awareness of the importance of SC and outreach than first year students.

8. Students want SC to be included in bioscience degrees. Almost all the students (89.7%) felt it would be useful to include SC subjects in the bioscience degree because – apart from the fact that SC would represent an optional post-university career – it would train them in suitable SC approaches and techniques and help them overcome fears related to communicating with broader audiences. This finding is corroborated by previous research that found that scientists have positive attitudes toward SC training (Besley et al., 2015). The number of SC training programmes for university students and graduates has grown in recent years (Basken, 2009); in North America, for instance, some 40 active SC training programmes have been identified (Besley et al., 2016). This kind of training helps to substantially improve SC skills and leads to more effective and dynamic transmission of knowledge from scientists to society (Besley et al. al., 2015; Dudo, 2013). As other studies have shown, and as confirmed by this research, scientists who feel they have the necessary skills will be more inclined to participate in SC (Besley, 2014; Besley et al., 2013; Dudo et al., 2014; Dunwoody et al., 2009; Poliakoff & Webb, 2007), and such skills are developed through training (Rodgers et al., 2018). The importance of training in SC has been recognized not only by scientists but also by researchers in communication, especially those who investigate topics related to SC (Besley & Tanner, 2011). A main line of action should therefore be to include SC subjects in bioscience degrees.

Our findings suggest that SC in the context of biomedical degree is considered to be important, but as yet is paid mere lip service. The current situation of widespread inaction represents an opportunity to address an issue that is widely recognized as important but which remains unresolved. Health is a crucial issue for society and, therefore, for all the related professions aimed at protecting and improving health. Effective communication by scientists is the first step to ensuring that the general public and governments value the sciences as they deserve.

Research limitations

This study had some limitations. The first one and the most important one is that the sample, although was huge enough, was all from the same Faculty because the study was carried out on a single Faculty of Biology (from the University of Barcelona) in the 2019-2020 academic year. It could be interesting to do the same analysis in different universities and countries to see if the results are the same or have some differences.

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