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Perception of training and specialization of scientific journalism in Chile

Percepción de la formación y la especialización del periodismo científico en Chile

Percepção da formação e especialização do jornalismo científico no Chile

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ABSTRACT
This article analyses the perception that journalists and science communication professors have about the training and specialization of Chilean scientific journalists, using a mixed methodology, consisting of in-depth interviews and national surveys. Among the most outstanding results is that, although the pre-graduate and postgraduate training offer has increased in the country, the specialization in scientific communication in Chile continues to depend on self-training and labor specialization. Also, there are different levels of appreciation of this among professionals. It is concluded that this assessment responds to work trajectories, training and informational models.

RESUMEN
Este artículo analiza la percepción que tienen los periodistas y profesores de comunicación de la ciencia sobre la formación y la especialización de los periodistas científicos chilenos, mediante una metodología mixta, compuesta por entrevistas en profundidad y encuestas a nivel nacional. Dentro de los resultados más destacados está que, si bien la oferta formativa de pre y posgrado ha aumentado en el país, la especialización en comunicación científica en Chile sigue dependiendo de la autoformación y especialización laboral, existiendo diversos niveles de valorización de esta entre los profesionales. Se concluye que esta valoración responde a trayectorias laborales, formaciones y también a modelos divulgativos.

RESUMO
Este artigo analisa a percepção que os jornalistas e professores de comunicação da ciência têm sobre a formação e a especialização dos jornalistas científicos chilenos, por meio de uma metodologia mista, composta por entrevistas aprofundadas e enquetes a nível nacional. Entre os resultados mais destacados está que, embora a oferta de graduação e pós-graduação tenha aumentado no país, a especialização em comunicação cientifica no Chile continua dependendo da autoformação e especialização laboral, com diferentes níveis de valorização desta entre os profissionais. Pode-se concluir que esta valorização é resultante de trajetórias laborais, formações e também de modelos de divulgação.

Keywords: *science journalism; science journalists; teaching; specialization; science communication; popularization.*

Palabras clave: *periodismo científico; periodistas científicos; enseñanza; especialización; comunicación de la ciencia; divulgación.*

Palavras-chave: jornalismo científico; jornalistas científicos; ensino; especialização; comunicação da ciência; divulgação.

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INTRODUCTION

The first study on the training of Chilean scientific communicators conducted in 2012 showed significant results regarding the low specialization of professionals dedicated to this subject in the country (Valderrama, 2014). Since then, the training offer in undergraduate courses has expanded. In addition, the first diploma in science communication was created in 2014, and there has been a duplication of the websites, workshops or short courses in this subject and more than six meetings on public science communication have been held (Méndez & Pohl, 2018; Rojas, 2018).

Therefore, this article intends to investigate the perceptions of Chilean science communication teachers and scientific journalists about how the latter have been prepared, instructed, trained and educated, including undergraduate and postgraduate programs, complementary education, work experience and self-training[1]. It also seeks to know how both professionals and trainers value the contribution of each of these training experiences to specialization in the field. All the above on the framework of the recent creation of the Chilean Ministry of Science, Technology, Knowledge and Innovation (MINCYT, by its Spanish acronym), which invites to pose the question: How well prepared are journalists to report on these issues?

SPECIALIZATION IN SCIENTIFIC COMMUNICATION

Specializing in a subject implies "giving up the general to devote to the specific" (Fernández, 1998, par. 1). This knowledge division has resulted from the requirement of sectorized audiences, who seek in the media a higher information quality (Fernández del Moral & Esteva, 1993). In turn, it has become a necessary instrument to deepen into these issues and has become the subject of professional disputes between scientists and journalists (Nieto-Galán, 2011).

Considering a formal specialization (training, university) in the international field, some shortcomings in the journalists' specialization in scientific communication have been noted (Dellamea, 1996; Moreno & Gómez, 2002; Elías, 2002). In Latin America in general there is a notorious deficiency in scientific journalism, and most of the media professionals who cover areas of science and technology dedicate a personal effort and interest to these subjects, thus not assuring a permanence of this issue in the media (Almeida, Ramalho, Buys, & Massarani, 2011). This differs from the reality of countries such as Spain, for example, where training in Social Communication of Science and Technology has a continuous academic presence in careers belonging to Information Sciences, Communication and Journalism (Meneses & Rivero, 2017).

In Chile there has been a progressive increase in those interested in studying journalism. According to figures from the Chilean Ministry of Education, in 2018 1652 new students enrolled in the journalism career, adding a total of 7128 students nationwide (https://www.mifuturo.cl/buscador-de-estadisticas-por-carrera/). However, little is known about the areas of specialization, as is the case of scientific journalism.

A study conducted by Claudia Mellado and Andrés Scherman (2015) on the perception of the profession and future employment of journalism students in Chile concluded that they mostly opt for cultural news (74.7%), followed by travel (60.8%), international (51.4%) and showbusiness or entertainment journalism (49.4%). Meanwhile, 26.9% of the students chooses the field of science and 35.7% would choose to specialize in environmental issues.

Before the creation of MINCYT there were already information needs on scientific and technological issues. On the one hand, there was the need for social recognition of the work of scientific communities (Revuelta, 1999; Calvo & Calvo, 2013) and on the other, the promotion of critical thinking in the face of scientific practices and processes that have an impact on society (Briceño -León, 2003). However, now that the issue takes on a ministerial level, the public administration of science in Chile becomes a government policy in a context in which 48.37% of people living in the country feel little informed about science and 41.51% feel little informed about technology (Centro de Microdatos, 2019c).

In this context, the role played by the media becomes crucial (Lewenstein, cited in Boczkowski, 1998), because they are an information tool of great influence and, in addition, an important part of education in this globalized society (Fontcuberta & Borrat, 2006). Therefore, having trained professionals is indispensable.

The lack of specialization of scientific journalists has implied on numerous occasions that the messages disseminated or published are of poor quality (Moreno & Gómez, 2002). It is essential, then, that from the beginning journalism students learn to visualize what is happening in Chile in these subjects and develop the ability "to contextualize the scientific-technological activity in its social, political and economic

environment, and the society's impact on the system of science, technology and innovation" (Chiappe & Fazio, 2011, p. 347). This is highly relevant to achieve citizen participation around science (Fensham, 2000; Shen, 1975) and effective if citizens have relevant knowledge (Bauer, 2009).

SCIENTIFIC JOURNALISM. BEYOND DISSEMINATION.

Scientific dissemination and scientific journalism differ, mainly, in that the former does not need to be current or periodic but of public interest, since it transmits vertebrate information in the form of knowledge and culture, and those who divulge it are not necessarily journalists (Batlló, Cebrián, Olivier, Roca, & Ruiz, 2004). This is how the information on development and scientific innovation that is disseminated is transmitted to citizens, fundamentally, from the media (Moreno, 2010).

Scientific journalism, on the other hand, is a professional work that disseminates current information, through the media, referring to science and technology issues. It is intended for a mass audience with the purpose of establishing a bridge between the producers of scientific knowledge and the general public (Avogrado, 2005).

This journalistic action was born due to the need to disseminate science to professionals and industrialists (Calvo, cited in Moreno, 2003) and over the years it has become a discipline (Scherzler, 2009) that on many occasions is expected to act under the guidance of the deficit model, understanding the communication of science as a mere transmission of simplified information from a sender to a receiver (Hilgartner, 1990; Wynne, 1992). Thus, sometimes the dissemination of science and scientific journalism are considered to have a literacy role (Cortassa, 2010, 2012), in which people classified as experts would generate knowledge in isolation and then decide to communicate it to other people typified as clueless, profane or inexperienced.

Despite this, in international literature it has been suggested that scientific journalism must capture the attention of the public, impact and captivate it (Elías, 2008; Consolmagno, 2009; Cortiñas, 2009) but, above all, scientific journalists have a great responsibility with the community and they must disseminate all the necessary information to train citizens with critical thinking (De Semir, 2010), with a view to the development of a country (Vernal, 2015), not necessarily seeking to fulfill a literacy or educator role.

METHODOLOGY

This research corresponds to a concurrent mixed method approach (Hernández, Fernández, & Baptista, 2010). That is, the qualitative and quantitative data, obtained from questionnaires and interviews, were collected separately and simultaneously, although finally the analysis of the results is delivered together (Onwuegbuzie & Johnson, 2006).

ONLINE QUESTIONNAIRE

This online questionnaire was self-applied during the months of May and October 2017, under the title Second National Survey of Scientific Communicators. Its aim was to know what kind of professional training science communicators have in Chile and their vision of their training and preparation for professional practice. It was composed of 31 questions organized in five sections, with two control and filter questions. Of the 31 questions, 26 were closed and five were open.

The questions were collated and reviewed in two stages by seven peers –scientific journalists from different regions of the country– and approved by the Ethics Committee of the Universidad Finis Terrae. The final survey was sent, via email, to the database of the Chilean Association of Journalists and Professionals for the Communication of Science (ACHIPEC, by its Spanish acronym) [2], composed until then by 103 emails of its partners (of which 81 were journalists) and, in addition, to the database of the 2014 and 2016 Meetings of Communication and Scientific Culture, which included 116 emails of other scientific disseminators (not journalists) from all over the country.

The survey was answered by 137 professionals (29 more than in 2012), of which 81 had a degree in social communication or a professional journalist degree[3] and 57 were professionals in other disciplines dedicated to the dissemination of science. For this article, we have considered only the responses of journalists (hereinafter, the respondents).

Of the journalists consulted, 70% are women: 15% more than the average in America (Bauer, Howard, Romo, Massarani, & Amorim, 2013). The majority work in the capital, located in the Metropolitan Region (54.32%), a place that concentrates 48% of the country's universities and a large number of scientific institutions, science and technology museums, laboratories and observatories. Two university centers in the country also stand out in terms of the number of professionals: the Biobío Region (11.11%) and the Valparaíso Region (8.64%)[4].

These results are very similar to those of the 2012 consultation (Valderrama, 2014), led by one of the authors of this article, since scientific journalists mostly work in press offices of mixed research centers associated with universities (37%) or in press offices of universities (16%), study centers that, in turn, are concentrated in the Metropolitan, Valparaíso or Biobío regions. 24% of respondents currently work in traditional, digital or multimedia media, reporting science and technology issues (hereinafter, S&T) in the Metropolitan Region.

The first part of the questionnaire asked for general information on the characterization of the respondents and their professional trajectories. There was then a section dedicated to their training, with questions oriented to their undergraduate professional training where they answered whether they had any course, workshop or seminar on science communication and, if they had, they mentioned its total duration.

Regarding postgraduate training or complementary specialization, they were asked if they had completed a master's or Ph.D., updating course, specialization course, diploma, postgraduate diploma or any type of course, seminar or face-to-face or virtual workshop, certified by a Chilean or foreign institution.

In addition, they were asked questions of an evaluative nature and the respondents were asked to clarify how useful were the undergraduate, postgraduate or complementary training in their work as scientific journalists. The rating was based on a scale of 1 to 5, 1 being the worst rating (*It has not helped me at all* or *I have not used it*) and 5 the best rating (*It is what has served me the most*). Finally, the questionnaire asked about the self-training of the respondents, the self-training resources and their assessment.

INTERVIEWS

The qualitative stage of the research is descriptive-interpretive, due to its accuracy (Ruiz, 2007). This included eight semi-structured interviews referring to scientific journalism training in Chile (Hernández et al., 2010; Flick, 2004). Therefore, the interviewees were free to express their personal experiences, appreciations and opinions regarding the subject studied (Creswell, 2005). The interview guideline was made up of 27 questions that were evaluated by peers chosen by the researchers (De Arquer, 1996) and, in addition, was approved by the Bioethics Institute of the Universidad Finis Terrae.

The questions were directly related to the interviewees' professional training in scientific journalism, i.e., their experiences in undergraduate or postgraduate studies; their visions about scientific journalism in Chile, both in the university classroom and in the media, and the look of scientific journalism in the media. All responses were of an opinion, knowledge, background, simulation and sensitive nature (Mertens, 2005).

The interviewees were three women and five men (hereinafter, the interviewees) selected for their professional characteristics, career in scientific journalism and their teaching in the university field. That is, this sample was not probabilistic (Salinas & Cárdenas, 2009) and homogeneous (Hernández et al., 2010), since they all had a similar profile: journalism graduates with more than seven years working professionally in scientific communication and between one or two years of teaching experience in scientific journalism. It should be noted that two of the interviewees, at the time of participating in the study, had not teach for a long period. However, they were considered in the sample due to their historical contribution and their long professional career in the communication of science. Also, two other participants were not teaching undergraduate classes, as they were dedicated to postgraduate or complementary teaching for professionals. The above was not considered as an incidence of the sample and, therefore, did not alter the results of the study.

In addition, the selection of the sample avoided centralization and considered five interviewees from the central zone, two from the northern zone and one from the southern zone of Chile.

The interview guideline addressed the professional training of the participants, the assessment of this training, the contents that they prioritize or prioritized in their science communication classes at the university level, and their evaluation on the professional training of scientific journalism in Chilean universities (undergraduate and graduate) and among professionals working in the media.

All interviews had the informed consent of the participants. Due to the flexibility of qualitative research (Ruiz, 2007), during the interview it was possible that other questions were asked to complement the answers or help clarify some ideas. Likewise, the order in which the questions were posed was adapted for each interviewee and did not alter the study (Rogers & Bouey, 2005). The analysis of the interviews derived from qualitative data, processed through a clear, understandable, penetrating, reliable and even original analysis (Gibbs, 2012). In the first stage of the analysis, we defined pre-established general categories (Miles

& Huberman, 1994) and then generated subcategories that allowed to conclude in a final analysis. Data were sorted, categorized and grouped (Salinas & Cárdenas, 2009) inductively according to the opinions of the participants (Raymond, 2005).

In the analysis, the opinion is emphasized according to the interviewees. All this was done with citations and codes to differentiate them (letter E, accompanied by a number according to the order of the interview) and, in addition, to protect their anonymity.

RESULTS AND DISCUSSION

UNDERGRADUATE TRAINING AIMED AT SPECIALIZING IN S&T

Regarding undergraduate training in scientific journalism, this is "essential" (E4) and even "mandatory" (E7) for the interviewees, since the journalist is a bridge between science and the community. For trainers – in their capacity as teachers– there are certain areas of thematic specialization of journalism that can be acquired through work experience, while there are others, such as scientific journalism, that need a regulated and directed training from universities, since they possess more complex peculiarities than other society issues.

> I have a deep academic conviction that there are certain specialties that you cannot learn by doing. You can learn some things in practice, judicial journalism maybe or sports journalism, but not some others. I believe that economic journalism and scientific journalism require training in disciplinary fields that will later allow you to work as a journalist with a scientific knowledge base on how science operates (E5).

Regarding the essentiality and mandatory nature of this training, just under half of the current scientific journalists consulted had a course, workshop or seminar during their undergraduate degree aimed at specializing in S&T issues (46%). However, of 54% who said they had not had a course, workshop or seminar aimed at specializing in S&T issues during their undergraduate degree in journalism, 42% said they received similar content dispersed in the framework of other formal courses within the undergraduate program.

Among those who had a formal course aimed at specializing in S&T issues, for 47% it was mandatory within their curriculum, for 34% it was elective or of general training, 11% had it in seminar modality and 8%, in practical workshop modality.

There are no historical data on the existence of courses aimed at the specialization in scientific journalism that allow to know in depth the training of those consulted, but between 2012 and 2017 the incorporation of courses that provide tools or develop skills or abilities in journalism students about communication on S&T issues increased. The information gathering[5] made by the researchers regarding journalism careers in Chile that offer these contents shows that, currently, 48% of the country's journalism programs offer at least one such course. This corresponds to a doubling of the undergraduate offer in relation to 2012, where only 21% of journalism careers offered courses of these characteristics (Valderrama, 2014). There are even undergraduate programs that offer more than one course aimed at the communication of S&T within the career, such as the Journalism careers of the Universidad de Playa Ancha, Universidad de Chile, Universidad Austral and Universidad de las Américas (located in the center and south of the country). This differs from other research that indicate that undergraduate journalism programs in Chile "do not have in-depth courses related to health, environment or technologies, to name some aspects" (Tabja, Broitman, & Camiñas, 2017, par. 37).

Despite this, the interviewees consider that journalism students in Chile would not end their careers prepared to report on science, since training in scientific journalism would be "scarce" (E6) or practically "non-existent" (E2) during undergraduate degrees. The interviewees mention that there is a high disinterest in journalism schools for incorporating scientific journalism into the academic curricula, since they agree that universities seek to "graduate professionals" (E2) who work from immediacy. For some, even, the subject of Scientific Journalism would be being eliminated from some journalism careers.

> What I see with sorrow is that the course has been eliminated of many journalism schools and the worst thing is that it has been a super wrong decision, because we are in the information society, walking towards the knowledge society, and it is now that we need more science disseminators who can teach journalists to handle these types of concepts, and at the same time communicate them to society (E8).

> The training on scientific journalism has been eliminated from the curricula. In fact, I don't know another school, I know that there is one at the Universidad de Santiago and in the north, but even the Universidad Católica de Valparaíso has no scientific journalism. Thus, we can't talk much about what

> training they have, because there isn't any. In any case, it will have to be reinstated, especially in a scenario where the demands of the scientific community become increasingly evident (E7).

This feeling that teachers have about the low training in scientific journalism within universities that would imply, even, a quantitative decline in the offer of undergraduate in the field is due to several reasons. Although all the interviewees have taught in journalism careers in Chile, the majority conducted this activity through partial contractual agreements or by hours in different study centers, which does not allow them to get involved as members of the academic circle of journalism Chilean schools. That is, they have not been involved in making decisions about career structures and their course offerings. In addition, they have not followed up their students throughout the undergraduate program and, for most of them, because there are external agents, they have not been able to guide theses or final works. The majority does not conduct research, nor does it belong to national academic networks on scientific journalism that allows them to know the Chilean training scenario on this subject.

Although the panorama would show a modest increase in recent years regarding the number of courses offered, most are in "elective" mode. Only 36% of all undergraduate programs that include courses aimed at specializing in S&T issues make them mandatory, while 64% offer them in elective mode. Five years ago, the offer was smaller but, proportionally, there was less difference between the two modalities (43% mandatory and 57% elective). On the other hand, the trainers interviewed have a similar perception: that undergraduate students would have a low interest in scientific journalism and do not consider it to be a work niche.

> It may be because there is no interest on the part of the students and because, perhaps, they think there is no niche there. But mainly I think it may be for the (lack of) interest. When I was at the Universidad Mayor I was about to do a master's degree in scientific journalism for communicators and scientists and in the end it was not done because there was no quorum (E4).

POSTGRADUATE TRAINING AIMED AT SPECIALIZING IN S&T

Regarding postgraduate training, 35% of respondents have master's and 1% doctoral studies. In the specific area of scientific journalism, there is a higher proportion of professionals with postgraduate studies than on other areas, given that previous studies show that only 6.8% of Chilean journalists working in any area have postgraduate degrees (Mellado et al., 2010).

However, the majority of postgraduate scientific journalists consulted have obtained their specialization in master programs not related to the communication of S&T. Only 6% of them have a postgraduate degree specializing in science communication or S&T subjects, since all have reached the master's level, none have done it in Chile, and none currently work in the media[6]. On the other hand, among the teachers in scientific journalism interviewed, half have postgraduate studies in scientific journalism.

Both the professionals consulted online and the trainers interviewed have made their postgraduate degrees in S&T communication mainly in Spanish universities, followed by Brazil, due to the absence of programs in the country. For the interviewees, the lack of specialization in S&T communication of journalists who work in the media is due to the fact that they "have to rotate their position" (E2) to cover various areas such as police, politics, among others.

> In general, journalists from traditional media have to rotate and the worst of all is that when one of them stands out they promote him/her to editor, so they lose the ability to be on the field and develop more in depth on certain issues (E2).

This would translate into a lower interest in postgraduate specialization in general, especially since in Chile the investment of a postgraduate degree in communications, whether master's or doctoral degree, can cost more than US$18,000 (Pontificia Universidad Católica de Chile, 2017), while the monthly salaries of newly graduated journalists in the traditional media fluctuate between US$965 and US$1,800 and between US$1,300 and US$2,400 at the fifth year of graduation (WageIndicator, 2019). In addition to this, in Chile, there are currently only four masters and a Ph.D. in journalism or social communication certified by the National Accreditation Council, and only those who are enrolled in these programs can apply for State scholarships. However, in the 2017 and 2018 calls there were only two State scholarships for master's students and one for doctoral studies (Conicyt, 2019a, 2019b). The internal scholarships of these programs and of some non-accredited are partial scholarships, which cover 50% of the annual fee to only one best applicant per promotion. In addition, in Chile, the duration of postgraduate courses is up to three years in the master's

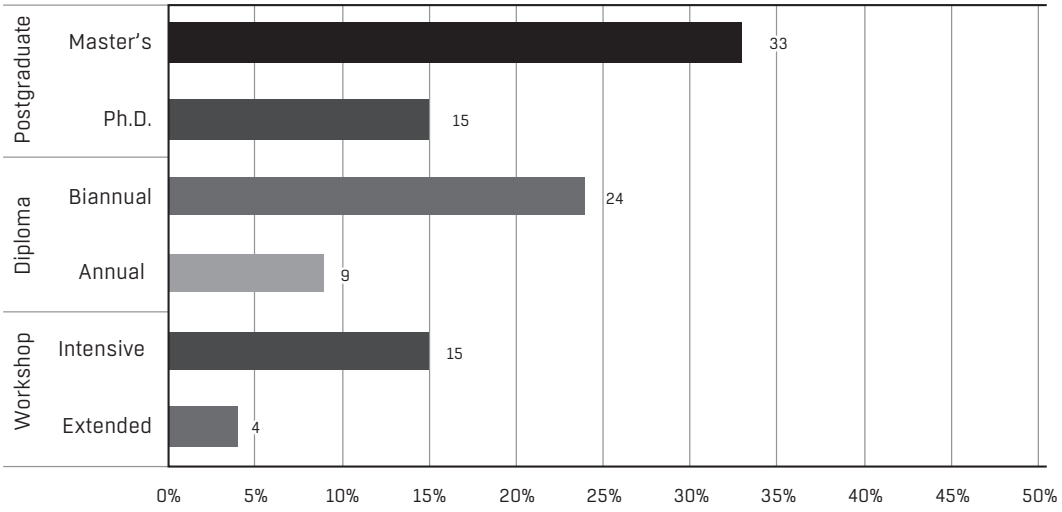

Figure 1. Training interests of the scientific journalists consulted separated by type of academic programs, according to online questionnaire

Source: Own elaboration.

degree and up to six years in for doctorates (Servicio de Información de Educación Superior, 2014).

Despite this, 83% of all respondents indicate that they would like to formally specialize in science communication; however, not all want to do it through a postgraduate program. 48% of the scientific journalists consulted would prefer to study a postgraduate degree and, of these, the majority would choose to pursue a master's degree (figure 1). Nevertheless, those who prefer postgraduate studies are mostly professionals who work in scientific institutions, since scientific journalists who work in the media prefer intensive workshops and only 25% would be willing to pursue a master's degree (none wish to enroll in a Ph.D. program).

As for complementary training, 67% of those consulted have completed diplomas, workshops or seminars on communication of science, technology, health or environment in Chile. These studies, for the most part, are part of the university offer, whether in its areas of extension, university-community engagement or continuing education that include certification. This is how an interest in university education is manifested, through short certified programs that become more compatible with the extensive working hours of the media.

ASSESSMENT OF TRAINING AND EXPERIENCE

Regarding the assessment given to the training received in undergraduate programs, 40% of those consulted said that the courses, workshops or seminars they had aimed at specializing in scientific journalism have served them during their work. Only 18% declare that they have served them *very much*. This may have to do with the quality of the teaching received or the coherence between the skills developed in the courses and the skills necessary for professional practice. Work experience, on the other hand, is highly valued by the scientific journalists consulted, given that 80% consider that it has been *very much* useful and 17%, that it has served *a lot*.

Among the respondents, 96% of journalists dedicated to S&T subjects stated that they have self-trained in the field of science communication, which is valued positively. 31% believe that this self-training has been *very* useful and 65% that it has been *very much* useful. Among the self-training activities, 90% declare that they read scientific news dealing with topics similar to those they communicate to better understand them. This differs minimally with the results of 2012, where 97% used this type of reading material (Valderrama, 2014).

85% also read scientific articles and specialized books on these subjects and 76% do the same with divulgation books. The use of the latter material as self-training text has increased compared to 2012, when only 59% of respondents resorted to these publications. In the Chilean case, this could be related to the increase of divulgation books for sale in Chilean bookstores

and, even, the increase in production of this literature nationwide in recent years (Espinoza, 2017).

The interviewees, having been in contact with the academic world, on the contrary, value training more than experience, since –for some– a journalist who works in the media should have a "basic training" (E3) in scientific journalism that allows the understanding of the investigative task, its assessment for society, the technicalities and the particularities of the area. Some even minimize professional experience, which they do not consider as a form of specialization.

> Training is essential, because you will get answers faster than with experience. You can capture and learn how to deal with scientific issues with experience, yes, but you can make more errors than if you learn it in a directed training process. In addition, more than ever it is necessary to understand science and technology to understand the world in which we live (E6).

> I find that there are very few scientific journalists in the media. There are many who write, but they are not specialized in the subject and never did a postgraduate program or anything. For example, going from *El Mercurio* to *La Tercera*, most journalists who work there are not even members of ACHIPEC. Let's not talk about those who work on television, those who cover politics cover science, those who cover science cover politics and so on (E4).

For the teachers interviewed, directed educational learning would help reduce errors in the professional dissemination of science. For them, dissemination errors would be those that arise from the poor precision of the scientific information. Thus, their role as pre and postgraduate teachers has focused on teaching to "simplify" (E1) science from the search for precision and civic scientific literacy on "regional reality" (E6) and "the current national scientific reality" (E4). Similarly, some interviewed trainers consider it important to teach how to create dissemination projects, either with journalistic projects or by assisting scientists in communicational aspects, moving away from journalism, as such, and getting closer to institutional communication. This interpretation of the role of communicator and scientific journalist as a translator and promoter of science and not as a professional in charge of investigating and denouncing S&T problems of public and social relevance, is in some measure consistent with the deficit model.

> We did many practical things where I urged them to do projects such as magazines, radio programs, television programs, field trips to places like the (scientific museum) MIM, to university laboratories, where they saw live how science was being done and how science was being glimpsed. That from that point of view they could create and invent, either alone or as a team, a scientific dissemination project that would remain for the future if they wanted to pursue it (E4).

This relates to the interests of the scientific journalists themselves, who mostly prefer to specialize in postgraduate or complementary training for the creation of dissemination projects (67%) and the institutional communication of scientific research (45%). These preferences are linked to the job opportunities of scientific journalists, that concentrate in universities and research centers in the country and that, in addition, depend on external funds to obtain resources and execute their activities.

For the teachers interviewed, the weak aspects of the training received in their postgraduate courses had to do with duplication of content and not with the quality of the program. Those who had studied journalism in Chile agreed that the master's classes taken abroad on communication issues were unnecessary for them, considering that some programs were composed of scientific students and journalists, and there was no separation between the contents for both.

> For someone who had studied journalism it was basic, since the application was like going back to the concept of news, going back to what communication is and trying to make the application with scientific subjects. I had colleagues from other areas, who were for example physicists, so it was useful for them (E6).

> I felt that many classes were very basic for me. They were like to teach scientists how to communicate and I had graduated four years ago as a journalist, I had been practicing as a journalist for four years, so that they taught me to write or to create a headline… for me it was already something very well known, I felt that in that area I wasted a lot of time. I think that in general, in the master's degree they always try to mix journalists with scientists, and they cannot be mixed (E4).

CONCLUSIONS

From this study it can be concluded that, although the country's journalism schools would be, lately, eliminating scientific journalism or the communication of science as a mandatory subject, it has increased in its elective modality in different universities in recent years; nevertheless, for the teachers interviewed, this type of course is disappearing from journalism careers in Chile.

The number of postgraduates in S&T communication has not changed in recent years. Although many scientific journalism professionals, currently in practice, have more complementary training (diplomas, seminars or workshops) and have conducted them in Chile, there is still a lack of programs in the country that cover these specialization needs. That is, it has been shown that there are complementary ways of specialization and that most of these instances have been conducted within the university. Its valuation, on the other hand, has not been greater than the work experience or the complementary specialization that the professionals in practice frame in the self-training field.

Although the interviewees consider that in the media there are no people with an adequate specialization in S&T issues and, in fact, most do not have postgraduate studies in this area, as already mentioned, they have conducted certified complementary training programs and, for the most part, are interested in formally specializing. However, unlike professionals working in S&T institutions, journalists in the media would prefer diploma programs over other specialization options.

As for the lines of specialization, current trainers in science communication and practicing scientific journalists prioritize teaching and learning about institutional communication of science and creation of dissemination projects, more related to job opportunities. In addition, the technical aspects of social communication are those that arouse and have aroused less interest at the training level.

Regarding the training received, although the trainers in science communication consider that undergraduate and work practice are not sufficient for the training of journalists who communicate S&T, a large majority of professionals continue to self-train and value, significantly, the experience they have acquired. In the last five years, divulgation books, for example, have been positioned as a valuable text to better understand the scientific topics communicated by professionals.

Specialization in scientific journalism, therefore, is a diffuse, intellectual and also practical process, which occurs over time, where the intellectual, the training and the formal aspects are prioritized by those who have worked in the university field, but the practical, acquired with work experience, is most valued by those who actually work as scientific journalists in the country.

Factors such as the lack of time, high postgraduate programs prices, the extended duration of programs or content that are not useful for the exercise of work could be impeding scientific journalists from opting to formally specialize in scientific journalism. In addition, postgraduate training is abroad, which could be an obstacle to enroll in a program in this line.

In order to integrate both types of specialization in scientific journalists, it is crucial to move towards the generation of cultural contexts that promote and stimulate the increase in the offer of undergraduate and postgraduate courses that consider the professional's training needs and their lack of time. All this by combining professional practice and the exercise of scientific journalism with more theoretical and intellectual work aspects of university education. A greater training offer is required, linked to research centers and media where professionals can put into practice what they have learned, along with programs aimed at developing skills and competences that allow the free and independent exercise of the profession, such as presentation of dissemination projects that promote contributing to close the gap between science and society.

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NOTES

1. Self-training will be understood as the resources –outside professional training– to which the journalists interviewed access to acquire knowledge in science communication.

2. The Chilean Association of Journalists and Professionals for the Communication of Science A.G. exists since 2014, heiress of the former Chilean Association of Scientific Journalists founded in 1976, under the shelter of the Chilean Association of Journalists. It is the only Chilean union institution that reunites journalists and scientists dedicated to the public communication of science in the country.

3. In Chile, some universities offer only the title of journalist when completing undergraduate studies for nine or 10 semesters and passing the exit exams or delivering the degree monographs. Other universities deliver a bachelor's degree in social communication upon the approval of the nine or 10 semesters and obtaining a professional degree is conditioned on the delivery and reading of a final monograph (undergraduate thesis). Both modalities are approved by the National Accreditation Council. However, public tenders for journalists require that applicants have a professional degree, which is not necessary to work in the media, that do not require such studies or certifications, and in which only 83.7% have studied journalism (Mellado , Salinas, Del Valle, & González, 2010).

4. The rest of the professionals are distributed in the following regions of the country: Antofagasta (2.47%), Atacama (2.47%), Araucanía (4.94%), Coquimbo (6.17%), O'Higgins (2.47%), Los Ríos (3.70%), Aysén (1.23%), Magallanes (2.47%).

5. The research group gathered information between 2017 and early 2019 regarding journalism careers in Chile and courses in scientific journalism or science communication that, until then, were offered in the curricula in mandatory or optional modality.

6. Currently, Chile does not have a postgraduate degree in Science Communication. Only in 2018 the first master's degree in Science, Technology and Society was opened in the country, which includes within its offer courses on social communication of S&T.

REFERENCES

Almeida, C., Ramlho, M., Buys, B., & Massarani, L. (2011). La cobertura de la ciencia en América Latina: estudio de periódicos de elite en nueve países de la región (The coverage of science in Latin America: study of elite newspapers in nine countries of the region). In C. Moreno (Ed.), *Periodismo y divulgación científica: tendencias en el ámbito iberoamericano* (Journalism and scientific dissemination: trends in the Iberoamerican scope) (pp. 75-97). Madrid: Biblioteca nueva.

Avogrado, M. (2005). Periodismo de la ciencia: aproximaciones y cronología (Science journalism: approaches and chronology). *Revista Razón y Palabra*, *10*(43), 3-15. Retrieved from http://www.razonypalabra.org.mx/anteriores/n43/mavogadro.html

Batlló, J., Cebrián, I., Olivier J. M., Roca, A., & Ruiz, P. (2004). *Astrònom i divulgador* (Astronomer and Popularizer). Barcelona: Ajuntament de Barcelona.

Bauer, M. (2009). The evolution of public understanding of science - discourse and comparative evidence. *Science, technology and society*, *14*(2), 221-240. https://doi.org/10.1177/097172180901400202

Bauer, M., Howard, S., Romo, Y., Massarani, L., & Amorim, L. (2013). *Global science journalism report: working conditions & practices, professional ethos and future expectations. Our learning series.* London: Science and Development Network.

Boczkowski, P. (1998). Entendiendo el entramado de procesos comunicacionales que acontecen en la construcción de prácticas y conocimientos científicos: una entrevista con Bruce Lewenstein acerca de la ciencia y los medios de comunicación (Understanding the framework of the processes of communication which arise in the establishment of scientific practices and knowledge: an interview with Bruce Lewenstein on science and the media). *Redes*, *5*(11), 165-184. Retrieved from https://www.redalyc.org/pdf/907/90711314008.pdf

Briceño-León, R. (2003). Las ciencias sociales y la salud: un diverso y mutante campo teórico (The social sciences and health: a diverse and changing theoretical field). *Ciencia & Saúde Coletiva*, *8*(1), 33-45. https://doi.org/10.1590/S1413-81232003000100004

Calvo, M. & Calvo, A. (2011). De la divulgación científica a la ciencia mediática (From scientific dissemination to media science). In C. Moreno (Ed.), *Periodismo y divulgación científica: tendencias en el ámbito iberoamericano* (Journalism and scientific dissemination: trends in the Iberoamerican scope) (pp. 15-38). Madrid: Biblioteca nueva.

Centro de Microdatos. Universidad de Chile. (2019). *Segunda Encuesta de Percepción y Apropiación Social de la Ciencia y la Tecnología en Chile* (Second Survey of Perception and Social Appropriation of Science and Technology in Chile). Santiago: Universidad de Chile. Retrieved from https://www.conicyt.cl/wp-content/uploads/2014/07/31072019-Informe-Final-Conicyt.pdf

Chiappe, D. & Fazio, M. E. (2011). La organización de actividades para promover la cultura científica (The organization of activities to promote scientific culture). In C. Moreno (Ed.), *Periodismo y divulgación científica: tendencias en el ámbito iberoamericano* (Journalism and scientific dissemination: trends in the Iberoamerican scope) (pp. 346-376). Madrid: Biblioteca nueva.

Conicyt. (2019a). *Resumen de Selección del Concurso Doctorado Nacional* (National Doctoral Contest Selection Summary). Retrieved from https://bit.ly/35kE2hv

Conicyt. (2019b). *Resumen de Selección del Concurso Magíster Nacional* (National Master's Contest Selection Summary). Retrieved from https://bit.ly/35lh8qu

Consolmagno, G. (2009). Journalists and Astronomers. *CAP Journal*, *6*, 5-6. Retrieved from https://www.capjournal.org/issues/06/06_05.pdf

Cortassa, C. (2012). *La ciencia ante el público. Dimensiones epistémicas y culturales de la comprensión pública de la ciencia* (Science in front of the public. Epistemic and cultural dimensions of public understanding of science). Buenos Aires: Eudeba.

Cortassa, C. (2010). Del déficit al diálogo, ¿y después? Una reconstrucción crítica de los estudios de comprensión pública de la ciencia (From deficit to dialogue, and then what? A critical reconstruction of studies of public understanding of science). *Revista Iberoamericana de Ciencia, Tecnología y Sociedad e Innovación*, *14*(5), 117-124. Retrieved from http://www.revistacts.net/files/Volumen%205%20-%20N%C3%BAmero%2015/cortassa_rev.pdf

Cortiñas, S. (2009). *História de la divulgaciò científica* (History of scientific dissemination). Barcelona: Eumo.

Creswell, J. (2005). *Educational research: planning, conducting, and evaluating quantitative and qualitative research*. Upper Saddle River: Pearson Education.

De Arquer, M. (1995). *Fiabilidad Humana: métodos de cuantificación, juicio de expertos* (Human Reliability: quantification methods, expert judgment). Madrid: Ministerio del Trabajo y Asuntos Sociales.

De Semir, V. (2010). *Science communication & science journalism: media for science forum*. Barcelona: Fundación Española de Ciencia y Tecnología.

Dellamea, B. (1996). La formación del periodista científico, un problema prioritario (The training of the scientific journalist, a priority problem). *Chasqui*, (55), 34-37. Retrieved from https://revistachasqui.org/index.php/chasqui/article/view/1053

Elías, C. (2002). Periodistas especializados en ciencia: formación, reconocimiento e influencia (Journalists specialised in science: training, recognition and influence). *Mediatika. Cuadernos de medios de comunicación*, (8), 389-403. Retrieved from http://ojs.eusko-ikaskuntza.eus/index.php/mediatika/article/view/116

Elías, C. (2008). *Fundamentos del periodismo científico y divulgación mediática* (Fundamentals of scientific journalism and media outreach). Madrid: Alianza Editorial.

Espinoza, C. (2017, June 11). Editoriales reconocen un gran aumento de interés por libros de ciencia en Chile (Publishers recognize a large increase in interest in science books in Chile). *La Tercera*. Retrieved from http://www.latercera.com

Fensham, P. (2002). De nouveaux guides pour l'alphabétisation scientifique (New guides for scientific literacy). *Canadian Journal of Science, Mathematics and Technology Education*, 2(2), 133-149. https://doi.org/10.1080/14926150209556506

Fernández, F. (1998). Especialización, futuro del periodismo (Specialization, future of journalism). *Revista Latina de Comunicación Social,* (7). Retrieved from http://www.revistalatinacs.org/a/latina_art83.pdf

Fernández Del Moral, J. & Esteve, F. (1993). *Fundamentos de la información periodística especializada* (Fundamentals of specialized journalistic information). Madrid: Síntesis.

Flick, U. (2004). *Introducción a la investigación cualitativa* (Introduction to qualitative research). Madrid: Ediciones Morata.

Fontcuberta, M. & Borrat, H. (2006). *Periódicos: Sistemas complejos, narradores en interacción* (Newspapers: Complex systems, interaction narrators). Buenos Aires: Ediciones La Crujía.

Gibbs, G. (2012). *El análisis de datos cualitativos en investigación cualitativa* (The analysis of qualitative data in qualitative research). Madrid: Ediciones Morata.

Hernández, R., Fernández, C., & Baptista, P. (2010). *Metodología de la investigación* (Research Methodology). Mexico D. F.: McGraw-Hill.

Hilgartner, S. (1990). The dominant view of popularization: conceptual problems, political uses. *Social Studies of Science, 20*(3), 519-539. https://doi.org/10.1177/030631290020003006

Méndez. M. & Pohl, N. (2018, October). Cuatro años del Postítulo en Comunicación de la Ciencia, Universidad de Chile: aprendizajes y proyecciones (Four years of the Postgraduate in Science Communication, University of Chile: learnings and projections). In L. B. Valderrama (Chair), *Encuentro Multidisciplinar ciencia y Comunicación* (Multidisciplinary Science and Communication Meeting). Conference conducted at the meeting of Universidad Alberto Hurtado, Journalism School, Santiago, Chile.

Mellado, C. & Scherman, A. (2015). *Estudiantes de periodismo en Chile: percepción sobre la profesión, su futuro laboral y el desempeño de los medios* (Journalism students in Chile: perception of the profession, its future work and the performance of the media). Santiago: UCV/UDP.

Mellado, C., Salinas, P. Del Valle, C., & González, G. (2010). Estudio comparativo de cuatro regiones: mercado laboral y perfil del periodista (A comparative study in four regions: Labor market and profile of the Chilean journalist). *Cuadernos.Info,* (26), 45-64. https://doi.org/10.7764/cdi.26.11

Meneses, M. D. & Rivero, Y. (2017). La formación en periodismo científico desde la perspectiva del sistema nacional de I+D+i: el caso español (Training in scientific journalism from the perspective of the national R&D&i system: the Spanish case). *Cuadernos.Info,* (41), 107-122. https://doi.org/10.7764/cdi.41.1145

Mertens, D. (2005). *Research and evaluation in education and psychology: Integrating diversity with quantitative, qualitative, and mixed methods*. Thousand Oaks: Sage.

Miles, M. B. & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*. Thousand Oaks, Estados Unidos: Sage.

Moreno, C. (2010). La construcción periodística de la ciencia a través de los medios de comunicación social: hacia una taxonomía de la difusión del conocimiento científico (Journalistic construction of Science through the Mass Media: Towards a taxonomy of the broadcast of Scientific knowledge). *ArtefaCTos. Revista de estudios sobre la ciencia y la tecnología*, (3), 109-130. Retrieved from http://revistas.usal.es/index.php/artefactos/article/view/8431

Moreno, C. & Gómez, J. L. (2002). Ciencia y tecnología en la formación de los futuros comunicadores (Science and tchnology in journalists training). *Comunicar,* (19), 19-24. Retrieved from http://hdl.handle.net/10272/1027

Nieto-Galán, A. (2011). *Los públicos de la ciencia. Expertos y profanos a través de la historia* (The public of science. Experts and laymen throughout history). Madrid: Marcial Pons.

Onwuegbuzie, A. J. & Johnson, R. B. (2006). The validity issue in mixed research. *Research in the Schools*, *13*(1), 48-63. Retrieved from http://www.msera.org/docs/rits-v13n1-complete.pdf#page=55

Pontificia Universidad Católica de Chile. (2017). *Aranceles de posgrado 2019* (Posgraduate tariffs 2019). Retrieved from http://arancelesybeneficios.uc.cl/posgrado/#facultad-de-comunicaciones

Raymond, E. (2005). La teorización anclada (Grounded Theory) como método de investigación en ciencias sociales: en la encrucijada de dos paradigmas (Grounded Theory as a Research Method in Social Sciences: at the crossroads of two paradigms). *Cinta de Moebio. Revista de epistemología de ciencias sociales*, (23). Retrieved from https://revistaestudiosarabes.uchile.cl/index.php/CDM/article/view/26082

Revuelta, G. (1999). Relaciones entre científicos y periodistas (Relationship between scientifics and journalists). *Revista Alambique*, (21), 27-34. Retrieved from https://www.grao.com/es/producto/relaciones-entre-cientificos-y-periodistas

Rogers, G. & Bouey, E. (2005). Participant Observation. In R. M. Grinnell & Y. A. Unrau (Eds.), *Social work: research and evaluation. Quantitative and qualitative approaches* (pp. 231-244). New York: Oxford University Press.

Rojas, M. (2018, October). SciCommChile: Ciencia en el espacio público (SciCommChile: Science in the public space). In L. B. Valderrama (Chair), *Encuentro Multidisciplinar ciencia y Comunicación* (Multidisciplinary Science and Communication Meeting). Conference conducted at the meeting of Universidad Alberto Hurtado, Journalism School, Santiago, Chile.

Ruiz, J. L. (2007). *Metodología de la investigación cualitativa* (Qualitative research methodology). Bilbao: Universidad de Deusto.

Salinas, P. & Cárdenas, M. (2008). *Métodos de investigación social. Una aproximación desde las estrategias cuantitativas y cualitativas* (Social research methods. An approach from quantitative and qualitative strategies). Antofagasta: Ediciones Universidad Católica del Norte.

Scherzler, D. (2009). How can we make a friend out of an enemy? How astronomers and journalists can get along better. *CAP Journal*, *7*, 30-33. Retrieved from https://www.capjournal.org/issues/07/07_30.php

Shen, B. (1975). Views: Science Literacy: Public understanding of science is becoming vitally needed in developing and industrialized countries alike. *American scientist*, (63), 265-268. Retrieved from https://www.jstor.org/stable/27845461

Servicio de Información de Educación Superior. (2014). *Duración real de las carreras en Chile. Programas de Pregrado y Posgrado* (Actual duration of university careers in Chile. Undergraduate and Postgraduate Programs). Santiago: Ministerio de Educación.

Tabja, J., Broitman, C., & Camiñas, A. (2017). Percepción de los científicos y periodistas sobre la divulgación de la ciencia y la tecnología en Chile (Perception of Scientists and Journalists on the Dissemination of Science and Technology Issues in Chile). *Revista Latina de Comunicación Social,* (72), 1107-1130. https://doi.org/10.4185/RLCS-2017-1210

Valderrama, L. B. (2014). Comunicar las Ciencias en Chile. Problemas formativos del Periodismo y la Divulgación Científica Actual (Communicating Science in Chile. Formative problems of Journalism and Current Scientific Dissemination). In R. Torres (Ed.), *Ciencia y sociedad en el siglo XXI. Estrechando vínculos desde una mirada franco-latinoamericana* (Science and society in the 21st century. Strengthening links from a Franco-Latin American perspective) (pp. 35-49). https://doi.org/10.13140/2.1.4262.2407

Vernal, T. (2015). La comunicación científica para el desarrollo cultural y económico: el caso de las potencialidades astronómicas de la Región de Antofagasta en Chile (Scientific communication for cultural and economic development: the case of a zone with astronomical potentials in the Region of Antofagasta in Chile). *Cuadernos.info,* (37), 213-224. https://doi.org/10.7764/cdi.37.691

WageIndicator. (2019). *Tusalario.org/Chile - Comparador salarial*. Retrieved from https://tusalario.org/chile/salario/Comparatusalario?job-id=2642010000000#/

Wynne, B. (1992). Public understanding of science research: new horizons or hall of mirrors? *Public Understanding of Science, 1*, 37-43. https://doi.org/10.1088/0963-6625/1/1/008

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