

# Training in scientific journalism from the perspective of the national R&D&I system: the Spanish case

## La formación en periodismo científico desde la perspectiva del sistema nacional de I+D+i: el caso español

### Formação em jornalismo científico a partir da perspectiva do sistema nacional de I & D: o caso espanhol

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#### ABSTRACT

Nowadays, scientific culture has undoubted importance. Its advances and controversies are brought to us, among other ways, by journalism. To know if the journalistic formation in the social communication of science and technology in the studies of degree in journalism in Spain is pertinent, we analyzed, through an exploratory study and a quantitative methodology, their academic curriculum and their teaching guides, based on the scientific-technological Spanish structure and R&D&I budgets. The results reveal some logical and other paradoxical dynamics in the correlation between training and regional scientific level.

**Keywords:** public communication of sciences; R&D&I; journalism; scientific culture; science and society.

#### RESUMEN

*La cultura científica tiene una importancia indudable. Una de las vías por las que conocemos los avances y las controversias científicas es el periodismo. Para saber si la formación periodística en Comunicación Social de la Ciencia y la Tecnología en los grados de Periodismo en España es adecuada, analizamos –mediante una metodología exploratoria y cuantitativa– los planes de estudios y las guías docentes de las universidades españolas. Nuestras referencias han sido la estructura científico-tecnológica española y el gasto en I+D+i. Los resultados revelan unas dinámicas lógicas y otras paradójicas en la correlación entre formación y nivel científico nacional.*

**Palabras clave:** comunicación de la ciencia; periodismo; I+D+i; cultura científica; ciencia y sociedad.

#### RESUMO

A cultura científica tem indubitável importância. Uma das maneiras pelas quais conhecemos os avanços e as controvérsias científicas é o jornalismo. Para saber se o ensino jornalístico na comunicação social de ciência e tecnologia na carreira universitária de licenciatura em Jornalismo na Espanha é pertinente, analisamos com metodologia exploratória e quantitativa os planos de estudos e guias das unidades curriculares das universidades. Nossas referências foram a estrutura científico-tecnológica espanhola e os gastos em I&D. Os resultados revelam uma dinâmica lógica e outra paradoxal na correlação entre formação e nível científico nacional.

**Palavras-chave:** comunicação da ciência; jornalismo; I&D e inovação; cultura científica; ciência e sociedade.

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## INTRODUCTION

After ten years of implementation of the Journalism degrees and forty years of teaching the previous degrees on Information, Communication and Journalism Sciences, training in Social Communication of Science and Technology (SCST) is a subject of study with a continued academic presence in Spain. In this work, we explore the subjects of the degrees in Journalism, based on the Spanish System of Science, Technology and Innovation (SECTI, by its Spanish acronym), to find out if there is a correlation between the investment in R&D&I and the training offer in SCST of each autonomous community<sup>1</sup>.

Journalism students have, in general, a diploma on Humanities and Social Sciences. Many of them perceive SCST as a complicated field, related to subjects that they usually consider foreign to their academic and professional interests. On the other hand, Journalism professors tend to influence in writing aspects –use of technicalities and linguistic mechanisms to clarify them, and the use of journalistic genres– because they are the expressive resources for translating specialized language into journalism standard language (Gutiérrez, 1998; Giraldo, 2015).

However, along with the contents on journalistic writing, others focused on the structure and actors of the regional and national scientific system have been appearing, since it is convenient that future journalists know the various facets of R&D&I, given its impact in the social development and in the welfare of the people.

## FRAMEWORK

Since the nineties, American and European authors work on the consistency of SCST. In 1994, Lewenstein reviewed the trends of scientific culture in the United States, which led him to propose a definition. Today, this field of communication research encompasses public actions that promote citizen immersion in science and the penetration of science in citizenship (citizen science). In 2016, Sánchez-Mora proposed an organization of public communication of science, its objectives, mediums and results, effects and audiences. These actions mean new ties of citizens with highly specialized and restricted areas.

In this sense, and in order to order the complexity of the communicative phenomenon to which this work refers, Bucchi (2008) compiled the various meanings given to the public communication of science in theoretical

and empirical investigations recognizable in specialized literature, providing a framework of multimodal work based on the paradigm of prevailing communication, in what is emphasized (content/context), in the dominant versions of science communication, in its objectives and in the reference ideological contexts. These actions can also be promoted by citizens from outside the professional communicative classes; an example is the so-called *discurshow* (Mariño, 2016).

In this line of thought, it should be noted that in the journalism studies of the Spanish communication faculties the idea that specialization is a priority dominates, thus pushing the quality criteria to a second place, only below equipment and resources (Centro ESADE de Industrias de la Cultura, 2008). Given this priority, it is interesting to explore what is learned in the (pre)specialization in SCST derived from degree training.

## CONCEPTUAL STARTING PREMISES

The authors understand by social or public communication of science and technology the set of diffusion strategies and textual and discursive formats produced professionally, in order to inform the public, in a readable, understandable and applicable way, of the advances, discoveries and findings achieved in the different scientific and technological disciplines. These include journalism, dissemination, marketing, advertising and public relations. They include all the public communication actions external to scientific circles, in which the source texts are written and published with specialized academic languages. These SCST actions contribute to the democratization of scientific and technological knowledge, and to generalize the scientific culture understood as a social construct and appropriation for making individual decisions (Trelles & Rodríguez, 2013). We could say that SCST is the set of communicative actions that favors the immersion of science in citizenship and of citizens in science.

SCST thus understood makes three areas permeable: research, political-scientific and business, and facilitates the transcending of the flow of scientific and technological knowledge beyond where they are generated, acting as an engine of individual and social transformation. The presence of SCST in public discourse depends, among other factors, on the universities deploying their journalistic training function on the research system, R&D&I and the actors that participate in that system (Alcibar, 2015).

To this we must add that SCST is an object of study for communicologists and for the scientists themselves, whose investigations configure the theoretical corpus in which to instruct Journalism students. The title VII of the Organic Law 6/2001 of Universities, of December 21, establishes that the university has a leading role in the process of transformation of the ways of generating and transmitting knowledge derived from the scientific investigation and technological development. It is added that the degree courses in Journalism are organized, within the framework of the European Higher Education Area (EHEA), as a professional qualification.

Journalistic specialization by themes requires that students acquire conceptual competences and knowledge. In scientific journalism, a good professional training implies being trained in the scientific system, in its actors, and in the research lines prioritized by the scientific policy according to the new challenges in R&D&I that arise in a changing society such as ours. This basic complexity justifies that we aim to know the way in which the formative programs of the degrees of Journalism are structured to identify in them the formation oriented to SCST.

In the White Paper of the Degree in Communication (ANECA, 2005) compulsory credits were reserved for the subject of Specialized Journalism, assigning it to contents and competences referred to the “study of the informative production of different areas of journalistic specialization”. Based on this recommendation, each Spanish university developed this subject by referring it, according to that document, to “the different political, economic, cultural, social, sports, and scientific systems [...]”. The objective was to ensure that students acquired the “ability to use the argot and knowledge of the specific sources and themes of the corresponding specialty”.

This recognizes the need to train future journalists in scientific and technological issues. Since the implementation of degree studies, universities can design an offer of optional subjects that diversify specialization; this is where the specific SCST subjects are framed. At this point, there is interest in analyzing the nexus between Spanish scientific and technological development and university SCST education.

In addition to granting a professionalizing character to the degree qualifications, the EHEA conceives the university as inserted in society and connected to the business world, which is the natural work alternative for graduates. This idea gives prominence to the professional profiles demanded by the organizations

and broadens the university vision by contemplating companies as a collaborating agent in the training of their future employees. Thus, undergraduate education has taken a substantial turn by overcoming the conception of learning based on the accumulation of disciplinary knowledge to prioritize training that facilitates access to the labor market (Diezhandino, 2012; Rosique, 2013). The professional journalistic profiles require dealing with expert sources, specialized documents and the argot of the specialization fields (ANECA, 2005), as well as knowing how these areas are structured and work; one of them is the scientific-technological system, that is, the R&D&I.

The specificities of R&D&I journalism spur the debate on who should communicate the achievements of science and technology. The journalistic treatment of these issues has not always met the expectations of researchers (Meneses & Martín, 2015). Journalists and scientists disseminate content on both sides of the line that differentiates journalistic communication from scientific dissemination; the communicative actions of journalists and scientists differ in authorship, ethical responsibility, approaches, treatments, readability, intelligibility, rigor, precision, objectives, intentionality, recipients, types of texts and channels.

In fact, one of the distinctive elements of R&D&I journalism versus scientific divulgation is the component of public service, linked ethically to the first as a profession. The journalist should be trained to explain the benefits of scientific-technological advances and the advisable precautions when facing controversies, inherent to investigations. Moreno (1999) and Méndez (2013) argue that scientific journalism contributes to citizens understanding the technoscientific aspects that affect them, preventing them from the associated risks. This vision encompasses one of the transversal characterizations of specialized journalism: the service component, since how are journalistic actions addressed with a service component if one does not have mastery of the topic to identify where that component lies precisely?

We are facing a new relationship between science, journalism, higher education and society. This relationship demands more and better collaboration between journalists, scientists and teachers to improve SCST and the scientific culture of citizens. Such ends require journalists with training that confirms them as reliable interlocutors before the scientific community. This training requires subjects in accordance with the current scenario defined by R&D&I and the science system.

#### REGULATIONS AND SCIENTIFIC-TECHNOLOGICAL DEVELOPMENT IN SPAIN

In recent decades, two laws have regulated scientific and technological activity in Spain. The first, Law 13/1986 on the Promotion and Coordination of Scientific and Technical Research, of April 14, was later replaced by Law 14/2011 on Science, Technology and Innovation, of June 1. With this norm, still in development, Spain is endowed with an organizational framework in science and technology, one of whose objectives is to support the generation, dissemination and transfer of knowledge to solve the challenges of society.

Its article 3 refers to SECTI (CES, 2015), which integrates the public policies developed by the General State Administration and the autonomous communities. It includes three types of agents: coordination and management, execution (Art. 3.3 of Law 14/2011) and financing (CES, 2015).

Along with the State, the private sector is the other source of funding to generate scientific knowledge and technology, since the material and human resources of companies allow the exploitation of knowledge as an investment asset (García, 2011). These include technology centers and support centers for technological innovation in the private sector.

Another aspect contemplated by the law is the creation of the Information System on Science, Technology and Innovation, whose purpose is to capture data and analyze them to prepare and follow-up the Spanish Strategy of Science and Technology and Innovation 2013-2020 (SSSTI), and its development plans (MINECO, 2013).

In this legislative framework, the Spanish scientific policy does not recognize the importance of the work of the communicating actors—journalists and the media—in the scientific and technological diffusion. However, Law 14/2011 does request SECTI agents to assume the dissemination. In its Title III on the promotion of scientific and technical research, innovation, knowledge transfer, dissemination and scientific, technological and innovative culture (art. 38.2.b-d), it “encourages the agents of the Spanish System of Science, Technology and Innovation to foster scientific and innovative communication”, without referring to the public media or other disseminating actors. This lack of specificity leaves the interpretation of article 38.1, dedicated to scientific and technological culture, open. It states:

Public Administrations will promote activities conducive to the improvement of the scientific and technological culture of society through education, training and

dissemination, and will adequately recognize the activities of the agents of the Spanish System of Science, Technology and Innovation in this field.

This idea is addressed in points j) and l) of article 2 of general objectives, and in articles 13.1 and 34.1.e). This insistence on the promotion of scientific and technological culture links with the fact of being considered an indicator of the development of societies. Despite this, the economic parameters continue to prevail.

The recession that began in 2008 weakened the country's competitiveness in innovation (MINECO, 2013). The Cotec report (2014) also notes its consequences in the Spanish innovation system. In 2012<sup>2</sup>, the national R&D&I indicators began to fall with intensity. That year, Spanish spending remained below the reference countries of the EU-28 and the Organization for Economic Cooperation and Development (OECD), a negative trend accentuated by the decline in national investment in science since 2009.

This decrease in investment affected equally the administration, higher education and the private sector (CES, 2015), although the Ministry of Economy and Competitiveness affirms in the SSSTI 2013-2020 that the number of doctors, researchers and technical personnel dedicated to R&D&I increased by 65% in Spain in the last decade (MINECO, 2013). The Ministry attributes these figures, much lower than those of the EU-28 and the OECD countries, to the scarce contracting of researchers by companies and the lack of innovative capacity in the productive sectors of the country, whose low percentage of spending in R&D&I places it behind the rest of the EU countries (MINECO, 2013).

Another measure of the scientific and technological capacity of a country, region or institution are bibliometric indicators. Scientific articles with Spanish affiliation in all areas of knowledge grew by 4% in 2012 compared to 2011, despite the reduction in R&D&I investment. This paradoxical fact leads us to question who is assuming part of the expenses of scientific research in Spain.

A relevant data provided by the Global Innovation Index indicates that Spain's main weakness is not the production of knowledge, but the capacity of the Spanish innovation system to transform it into economic results (Cotec, 2014). The advances stay on paper and do not translate into economic results. Something similar happens with the number of European and international patents registered by Spain.

This situation places the country in a difficult position to progress in the indicators that measure the world's scientific and technological competitiveness. Spain rose one position in the index of the World Economic Forum of 2013, with respect to 2012, although in the classification of the Institute for Management Development it dropped five in a year.

The evolution of all these indicators of the Spanish R&D&I is reflected in the Map of Singular Scientific and Technical Infrastructures (STI) (MINECO, 2013, n.d.). Spain has experienced an important international opening in scientific and technological matters, which is reflected in policies designed to correct previous negative data; these include participation in transnational programs and projects, such as the Seventh Framework Program of the European Union, and adapting to the EHEA and the European Research Area (ERA), which is behind the university reform.

### TRAINING IN SCIENTIFIC AND TECHNOLOGICAL COMMUNICATION

Now that we have succinctly exposed the national R&D&I, we must review the situation of university education in SCST. In Spain, journalism degrees are taught in all the autonomous communities except Extremadura, La Rioja and the Balearic Islands, and the autonomous cities of Ceuta and Melilla. The review made of the Spanish Science and Technology System and R&D&I allows to know how the training offer in SCST relates to it.

The latest report on the National Science and Technology Strategy (NSTS) refers to the importance of communicating scientific-technological results to society (FECYT, 2007). The journalist must report results, but also about how science works, its management and scientific policies. The importance of the communication structures available to understand the relevance of the scientific-technological subject is expressed in the quote "scientific and technical knowledge, its production and its application to all areas of life in our societies, is one of the driving forces of the processes of economic growth and improvement of social welfare" (FECYT, 2007).

In the midst of changing regulations on educational and scientific policy to promote R&D&I, the figure of the journalist specialized in science, health, technology, biotechnology and the environment is diluted in the sea of attributions of the investigating agents, who do not have communication as their mission, as part of

their training or as a professional alternative. Thus, it is worth asking if in this scenario universities, Social Communication faculties and journalists value sufficiently their optimal position to assume what is stated in the Law of Science, Technology and Innovation. In this regard, fifteen years ago Moreno (2002, 2003) highlighted this gap, when he found out that "journalism curricula lacked subjects with contents specialized in scientific journalism or scientific dissemination".

This justifies our quest to relate the current training offer in SCST of Journalism degrees with the Spanish scientific-technical system, to find out how many degrees include scientific communication subjects in their curricula and if they address R&D&I. Thus, we will know the suitability of the training and if the students are instructed in the structure and importance of the scientific-technological system. In short, we will see if in recent years the training in R&D&I journalism taught in the first university cycle has evolved.

The change inherent to the scientific system and the journalistic labor market forces to update, with a certain frequency, the training in those professional competences that require, in this case, the complexity of the research activity. The component of provisionality, uncertainty, risk, controversy and caution that accompanies scientific advances, along with the challenges of society, should be considered in journalistic training, so they would be reflected in the curricula and in the subjects' teaching guides.

Although some authors recognize that specialization occurs in postgraduate studies (Rosique, 2013), the subjects of the degree in Journalism are an introductory way for students to discover fields of specialization or to reaffirm their preferences. Rosique emphasizes that the term competence refers to several degrees of thematic domain that journalists should acquire; in this vein, we consider that competency preparation begins in undergraduate studies. Despite the lack of consensus on what is the best training for journalists, the international academic community agrees that we are facing training programs with more convergences than divergences and with a well-defined professional profile, with a decisive role in shaping social reality (Fuente & Mera, 2013). Specific training, such as scientific-technological journalism, is aimed at specialization, many of whose credits are offered in the curriculum through elective courses. This leads us to ask not only the extent to which the universities contemplate SCST subjects, but also if their offer depends on belonging to an autonomous community with greater R&D&I development.

## OBJECTIVES AND HYPOTHESES

The objective we set were as follows:

- *O1.* To get to know the subjects on scientific-technological communication of the degree plans in Journalism in Spain.
- *O2.* To find out if in the autonomous communities with a more developed structure of science and technology, the local universities Journalism degrees include more subjects on SCST compared to other autonomous communities.
- *O3.* To determine to what extent the subjects of SCST instruct in the organization, operation and production of the national scientific and technological system.
- *O4.* To estimate to what extent the subjects of SCST prepare the student, in each university, in the knowledge of the scientific system and the scientific-technological production of the respective autonomous community.
- *O5.* To know if in the subjects of the degree in Journalism the diachronic evolution that has led to the current Spanish scientific-technological panorama is taught.

And, starting from the binomial announced in the title of this study, the hypotheses were:

- *H1.* The introduction in Spain of the degrees in Journalism and the consolidation of the regulations on science, technology and innovation and the national and regional R&D&I plans have encouraged the presence of SCST subjects.
- *H2.* The autonomous communities with a greater development and investment in R&D&I pay more attention to the formation in SCST, including at least one course on this subject in the degrees in Journalism taught in their territory.
- *H3.* The teaching guides of the courses consider the training in the scientific-technological reality of the country and in the Spanish System of Science, Technology and Innovation.
- *H4.* The teaching guides of the courses contemplate the training in scientific and technological

production of the country and of the autonomous community to which each university belongs.

## SOURCES AND METHODOLOGY

On the one hand, we identified the universities on the website of the Register of Universities, Centers and Titles (RUCT) of the Ministry of Education, Culture and Sports of the Government of Spain. The RUCT referred us to the websites of the universities with a degree in Journalism, given that the regulations on information transparency guarantee that these portals disseminate the current curricula and teaching guides. Both documents –teaching guides and curricula published in the Official State Gazette– constitute the official sources consulted. If needed, the degree verification memory was consulted. We reviewed the 37 universities with Journalism studies of the 85 that compose the Spanish higher education system (50 public and 35 private).

Since the degrees' curricula do not change from one academic year to another (it requires a modification process), we focused our analysis on the academic documents of 2014-2015. Therefore, we consider methodologically valid to focus on that course. Once the academic documents of the degrees in Journalism were located, we traced in them the subjects (variable 1) whose denomination linked them with SCST. In the search, we included the subjects called Specialized Journalism since there was a possibility that they contemplated contents of interest in this study; thus, if an epigraph of the guide of this course was devoted to some aspect of the SCST, we assigned it the value 1; if several sub-epigraphs appeared, the unit (1) was divided by the number of sub-epigraphs to weight the quantitative value of the presence of those contents. The data obtained was recorded in a code sheet that we then downloaded into a computer application in order to cross them. The results were synthesized in tables and figures.

On the other hand, the sources consulted to obtain the data of the scientific and technological panorama of the autonomous communities (variable 2) were, as it is deduced of the previous epigraph 2, the book of Indicators of the Spanish System of Science and Technology and the Map of R&D&I institutions, prepared by the Spanish R&D&I Observatory of the Spanish Foundation for Science and Technology (FECYT, 2014). The selected indicators, consistent with our objectives and hypotheses, included economic investment, investment in human capital, institutions and infrastructures.

Nº	University	SCST subjects	Autonomous community
1	of Valencia	More than one subject	Valencia
2	Complutense de Madrid	More than one subject	Madrid
3	of Murcia (public)	More than one subject	Murcia
4	of Málaga	More than one subject	Andalusia
5	of Valladolid	One	Castilla y León
6	of Zaragoza	One	Aragón
7	Carlos III de Madrid	One	Madrid
8	Europea de Madrid	One	Madrid
9	Camilo José Cela	One	Madrid
10	Miguel Hernández, Elche	One	Valencia
11	Pompeu Fabra	One	Catalonia
12	of La Laguna	One	Canarias
13	of Sevilla	One	Andalusia
14	Autónoma de Barcelona	One	Catalonia
15	Católica San Antonio	Specialized Journalism	Murcia
16	Antonio de Nebrija	Specialized Journalism	Madrid
17	Of the Basque Country	Specialized Journalism	Basque Country
18	Europea Miguel de Cervantes	Specialized Journalism	Castilla y León
19	Rovira i Virgili	Specialized Journalism	Catalonia
20	Abat Oliba CEU	Specialized Journalism	Catalonia
21	San Pablo-CEU	Specialized Journalism	Madrid
22	San Jorge	Teaching guide Specialized journalism without contents	Aragón

Table 1. Universities with SCST subjects in their Journalism degree.

Source: Own elaboration.

These official documentary sources disaggregate the indicators by autonomous communities, making it easier to correlate them with scientific-technological development and with SCST training of the Journalism degrees of each autonomous community.

## RESULTS

The sample was composed of 27 subjects, of which 19 are related to SCST and another eight are of Specialized Journalism with part of its contents dedicated to this topic. We analyze the correspondence between the academic data and the scientific-technological development of the autonomous communities.

### UNIVERSITIES WITH SCST SUBJECTS IN THE JOURNALISM DEGREE

Science, technology, health and environment journalism is included in the curricula of the degrees

in two ways. One is limiting it to one or several topics in the compulsory subject of Specialized Journalism, by way of introductory training. Another is offering specific SCST electives; in this case, we differentiate between universities with one or more specific subjects (table 1).

In the academic year on which we conducted this study (2014-2015), 37 public and private Spanish universities taught the degree in Journalism; of those, 22 include SCST content in their curricula. The remaining 15 do not even contemplate topics related to science and technology in the subject of Specialized Journalism (table 1). This implies that 40.5% of the grades do not initiate their students in this subject.

Of the 27 subjects analyzed in 22 grades, 19 (70.4%) are dedicated to SCST and eight (29.6%) Specialized Journalism subjects dedicate part of their syllabus to science and technology. Thus, four universities teach more than one subject related to SCST; ten teach a

Autonomous communities	N° of universities With SCST subjects (23)	N° of universities with degree in Journalism (28)	Percent distribution
Madrid	7	7	27%
Catalonia	4	6	18%
Valencia	2	3	10%
Murcia	2	2	10%
Castilla y León	2	2	10%
Andalusia	2	3	10%
Aragon	2	2	5%
Basque Country	1	2	5%
Canary Islands	1	1	5%

Table 2. Autonomous distribution of universities with SCST subjects.

*Source: Own elaboration.*

Subject	Topics dedicated to SCST	Total number of subjects of the course
Journalism Specialized in Science and Health	5	5
Specialized Journalism	10	10
Science and Technology Journalism and its treatment	7	7
Specialized Journalism 2	4	33
Scientific and Environmental Journalism	9	9
Scientific and Environmental Journalism	4	4
Specialized Journalism	1	10
Scientific Journalism	5	5
Cultural and Scientific Journalism	3	5
Scientific and Environmental Journalism	7	7
Journalism on Health and the Environment	7	7
Journalism Specialized in Science and Culture	1	10
Specialized Journalism: Science, Economics and Sports	1	4
Scientific and Environmental Journalism	9	9
Scientific and Environmental Journalism	5	5
Specialized Journalism 2	3	13
Specialized Journalism 2	1	3
Biomedical, Technological and Environmental Communication	9	9
Specialized Journalism	1	5
Dissemination of Scientific and Technological Information	0	0
Journalism on Science and Technology	6	6
Journalism Specialized in Economy and Environment	5	10
Disseminative Communication	12	12
Specialized Journalism	1	10
Theory and practice of Specialized Journalism	1	11
Communication and Health	14	14
Scientific and Environmental Journalism	4	4

Table 3. Comparison between the total number of subjects of each course and those dedicated to SCST.

*Source: Own elaboration.*



Subject (agglutinated by denomination)	University	Autonomous community
S. J. in Science and Health	Pompeu Fabra	Catalonia
Specialized Journalism	Abat Oliba CEU	Catalonia
	Antonio de Nebrija	Madrid
	Católica San Antonio de Murcia	Murcia Region
	Europea Miguel de Cervantes	Castilla y León
	of La Laguna	Canary Islands
	of the Basque Country	Basque Country
	Rovira i Virgili	Catalonia
	San Pablo CEU	Andalusia
Science and Technology Journalism and its Treatment	of Valencia	Valencia
Specialized Journalism 2	San Pablo CEU	Andalusia
	Abat Oliba CEU	Catalonia
Scientific and Environmental Journalism	Antonio de Lebrija	Madrid
	Miguel Hernández de Elche	Valencia
	Europea de Madrid	Madrid
	Carlos III	Madrid
	Camilo José Cela	Madrid
Scientific Journalism	Autónoma de Barcelona	Catalonia
	de Zaragoza	Aragon
Cultural and Scientific Journalism	de Valladolid	Castilla y León
Scientific and Environmental Journalism	de Sevilla	Andalusia
Journalism on Health and the Environment	de Murcia	Murcia Region
Journalism Specialized in Science and Culture	Complutense de Madrid	Madrid
S. J. Science, Economics and Sports	Católica San Antonio	Murcia
Biomedical, Technological and Environmental Communication	de La Laguna	Canary Islands
Dissemination of Scientific and Technological Information	Valencia	Valencia
Journalism on Science and Technology	de Murcia	Murcia Region
S. J. in Economics and the Environment	Complutense de Madrid	Madrid
Disseminative Communication	de Murcia	Murcia Region
Theory and practice of S.J.	Autónoma de Barcelona	Catalonia
	de Málaga	Andalusia
Communication and Health	Autónoma de Barcelona	Catalonia

Table 4. Filiation between subjects and universities.

*S.J.: Specialized Journalism**Source: Own elaboration.*

subject related to SCST; eight include Specialized Journalism with science and technology themes; one offers Specialized Journalism without any content specified and 16 lack subjects related to SCST.

Four (10.8%) of the 37 public universities (Murcia, Valencia, Malaga and Complutense de Madrid) include in their degrees in Journalism more than one subject of SCST; 10 (27%) have only one. These four degrees of Journalism with several subjects (up to four) on this subject are those that put more emphasis in SCST training, excelling in the overall of Spanish universities. Dedicating at least one elective course to this subject ensures that a part of the graduates possess competences in SCST, facilitating them to continue specializing in postgraduate studies.

We also analyze the correspondence between autonomous communities, universities, degrees and training in SCST (table 2), to then correlate the results with regional investment in R&D&I.

The autonomous communities of Madrid and Catalonia register the highest percentages of SCST subjects in the Journalism degrees, since they concentrate the largest number of universities in their territory. They are followed by Murcia, Castilla y León and Andalusia<sup>3</sup>. In the region of Murcia, one of the two universities with a degree in Journalism (University of Murcia) offers a compulsory subject (Science, Technology and Global Society in the 21st Century), plus three optional subjects (Journalism on Health and the Environment, Journalism on Science and Technology, and Disseminative Communication), plus the mandatory Specialized Journalism with a subject dedicated to scientific information; this degree is an exceptional case in the overall of Spanish universities. Thus, the region of Murcia stands out –with three universities, one of which is polytechnic– if we compare it with Madrid and Catalonia.

#### SUBJECTS AND CONTENTS TYPOLOGIES

In the set of universities, of the 27 subjects devoted to SCST, 15 are compulsory (54%) and 12 electives (46%). Tables 3 and 4 compare the total of themes from the 27 subjects analyzed and those of them dedicated to SCST. Since not all the themes of the compulsory subject of Specialized Journalism or, in fact, of others, deal with this issue, it is necessary to find out what part of the syllabus is assigned to them.

After analyzing the syllabus of the 27 subjects, we obtained that 16 (59.3%) completely focus on SCST. The remaining 11 (40.7%) only dedicate part of them to

it; of these, two dedicate more than half of the syllabus to science and technology. The national scientific and technological bibliographic production only appears in the contents of 10 of the 27 subjects, even when it is an indicator compelled by the universities.

In three subjects, the agendas include epigraphs dedicated to organizational aspects of science and technology in Spain, as is the case of the Spanish System of Science, Technology and Innovation. It is observed, therefore, that the organizational and normative aspects of science and technology are not usually present in the training given to students, as opposed to others of a journalistic-editorial nature. This objective data is subject to interpretation, because the denominations of the epigraphs of the syllabus only announce what will be studied during the course. As for the history of science and technology, and the media diffusion of its milestones, they only appear in one subject.

#### COMPARISON BETWEEN REGIONAL INVESTMENT IN R&D&I, JOURNALISM DEGREE AND SCST SUBJECTS

The nine regions with the highest investment in 2012 (last available data) were Madrid, Catalonia, Andalusia, the Basque Country, the Valencian Community, Castilla y León, Galicia, Navarra and Aragon. It should be remembered that the autonomous communities with the most population receive the largest budget in the national distribution, becoming those with the greatest potential to invest in R&D&I.

Murcia is relegated from the aforementioned group; despite its smaller investment in R&D&I, which depends on regional GDP (FECYT, 2014), it is a region that gives great importance to SCST training. It is followed by the Canary Islands. The communities with more spending are Madrid and Catalonia, but the largest investment in terms of percentage in relation to GDP corresponds to the Basque Country and Navarra, whose leadership displaces Madrid and Catalonia. In this regard, the data provided by the indicators of the Spanish System of Science, Technology and Innovation (FECYT, 2014), which compare the euros invested in relation to the number of inhabitants of the region, reveal that the primacy is from the Basque Country, followed of Navarra and Madrid, and Catalonia is further away.

Considering the investment in science and technology and journalistic training, the data reveal that the autonomous communities with SCST subjects in their Journalism degrees are correlated with those that allocate more investment to R&D&I. This correlation is not met in Murcia or the Canary Islands, since although

they are excluded from the top ten regions with the highest investment, they stand out academically in SCST training.

In addition, contrary to what might be expected, it is not the communities with the largest budget in the national distribution (Madrid and Catalonia) the ones that make a greater investment in R&D&I in relation to GDP and the number of inhabitants, but rather the Basque Country and Navarre. Thus, it is significant that SCST training is not contemplated in Journalism degrees in Navarre<sup>4</sup>.

In general, the nine communities in which SCST subjects are taught coincide with those with the largest number of R&D&I centers (Catalonia, Madrid and the Valencian Community, according to FECYT, 2014 and MINECO, n.d.). If instead of R&D&I centers we observe the mixed research institutes, Murcia and the Canary Islands get excluded from the group of nine, and Murcia, Aragon and the Basque Country, if we discriminate by university institutes. Five of the nine communities with training in SCST are the first to invest capital and human resources in R&D&I, as well as in the number of research institutes and avant-garde research structures in their territory.

Let us see what happens in the case of Science and Technology Parks (STPs) –projects associated with a physical space that acts as a pole of industrial development in which innovative technology companies emerge–. The nine autonomous communities with journalistic training in SCST are the first in number of STPs. In the case of public research organizations (PRO), these are concentrated in Madrid, except one based in the Canary Islands (Astrophysical Institute).

As for the Technological Centers (TC) –non-profit entities intended to contribute to the general benefit of society, and to improve the competitiveness of the business sector through technological knowledge and R&D&I activities–, the autonomous communities with SCST subjects are part of the group of the nine with more TC, except the Canary Islands, that does not appear in the 2017 TC registry of the Ministry of Economy and Competitiveness.

Considering the regional distribution of the 10 types of R&D&I institutions –including the public health organisms and the Research Results Transfer Offices–, in global terms, the autonomies of Catalonia, Madrid, the Valencian Community, Andalusia, Castilla y León, Aragon, the Canary Islands, the Basque Country and the Murcia region are the ones that host most of the scientific and technological institutions in Spain. Even if Murcia

is left behind, it is the autonomous community with the Journalism degree that offers more subjects (four) dedicated to SCST, one compulsory and three optative.

## CONCLUSIONS

The correlation we have established between the results of SCST training and the national and regional R&D&I leads us to the following conclusions.

1. We have analyzed the factors that affect SCST training in the Journalism degrees of the Spanish universities, fulfilling with the O1 of knowing the subjects on scientific-technological communication of the curricula of the Journalism degree in Spain. This has made it possible to determine to what extent these plans include SCST subjects, and with what character (compulsory or optative) were designed those dedicated entirely to SCST (19 or 70%) and those that dedicate it a part of their syllabus (eight or 30%). In addition, we identified the geographic distribution of the universities with degrees that teach these subjects, verifying how many are they in relation to the total of universities in Spain with a degree in Journalism, and by autonomous community. This made it possible to verify that Madrid gathers more universities with subjects dedicated fully or partially to SCST training. It is followed by Catalonia, Valencia, the region of Murcia, Castilla y León, Andalusia, Aragon, the Basque Country and the Canary Islands.

We have verified that the highest concentration of degrees in the most powerful communities does not imply that they give more importance to SCST, despite the fact that their level of development and economic budgets are well above those of lowest population and public budget allocation. Thus, communities of smaller size and development stand out in the formative offer in SCST. It is the cited case of the region of Murcia, where the University of Murcia excels with four subjects in the Journalism degree, plus part of the syllabus of the Specialized Journalism compulsory subject.

In general, the compulsory subject of Specialized Journalism stands out, with themes dedicated to SCST, since most of the subjects entirely devoted to this issue are optative, with some exceptions.

2. There is a correlation between the communities with the most development in R&D&I and greater budgetary investment, and the offer in their universities of SCST subjects. This result contributes to fulfill O2 to find out if in the autonomous communities with a more developed scientific and technological structure the degrees in Journalism of local universities include more subjects on SCST regarding other regions.
  3. We have met the O3 to determine to what extent the subjects of SCST influence the organization, operation and production of the national scientific and technological system, and the O4 to estimate to what extent these subjects prepare, in each university, their students on the scientific system and in the scientific-technological production of their respective autonomous community, since we were able to identify those that address the national bibliographic production; this is the case of the Disseminative Communication subject of the University of Murcia, which includes content on academic journals and indexes to measure its scientific impact. However, no subject alludes to the autonomous scientific production, despite being a source for local and foreign journalists.
  4. We have met the O5 to know if in the subjects of the Journalism degree the diachronic evolution that explains the current Spanish scientific-technological panorama is taught, since we have found out that in a large part of the teaching guides there are not training contents on the organization of the Spanish System of Science, Technology and Innovation or on the historical evolution of science and how it has been disseminated over time, despite the availability of publications. The cases that do contemplate them are isolated (University of La Laguna). On the other hand, the organization of the Spanish System of Science, Technology and Innovation is only present in subjects taught at Pompeu Fabra, Valencia and Carlos III universities.
  5. H1 (the introduction in Spain of the degrees in Journalism and the consolidation of the regulations on science, technology and innovation, and national and regional R&D&I plans have encouraged the presence of subjects on SCST) is refuted since not all Spanish universities with a degree in Journalism teach SCST subjects. It is complex to propose reasons that explain this. It has only been possible to determine that, usually, the ones that offer these subjects are the communities with the greatest development of R&D&I and a greater budgetary investment.
  6. This correlation verifies H2 (the autonomous communities with a greater development and investment in R&D&I pay more attention to SCST training, including at least one course on this subject in the Journalism degrees taught in their territory).
  7. Therefore, there is a clear concomitance between size, availability of resources and scientific development of the autonomous communities, and the importance that their universities give to SCST training. Thus, communities with fewer resources, far from the top positions in investment in R&D&I and economic development, such as Murcia and Canary Islands, stand out by giving special importance to this training with respect to communities with a more complex scientific-technological system and bigger investments.
  8. H3 (in the teaching guides of the subjects it is considered to train the students in the scientific-technological reality of the country, and in the Spanish System of Science, Technology and Innovation) is refuted for the reasons stated in points 2 and 5 of these conclusions.
  9. H4 is also refuted (in the teaching guides of the subjects it is contemplated to train the students in the scientific and technological production of the country and of the autonomous community to which each university belongs), as indicated in point 3.
- We conclude that, although the adaptation of the degrees to EHEA provides mechanisms for universities to adapt their curricula to social reality, there are imbalances between SCST training and Spanish R&D&I. These imbalances influence, in the short term, the training of journalists and, in the medium and long term, the quality of science and technology journalism and the scientific culture of citizens. Therefore, it would be important to grant a greater presence to the national scientific system in the degrees in Journalism. If specific

subjects are not taught, the room for maneuver to include them in the training of students depends on the teachers who teach related subjects.

## DISCUSSION

The results obtained are illustrative and diagnose an improvable educational situation. However, if we consider the notion of SCST proposed in our framework, this work has certain limitations. For example, although the preliminary test on double degrees of Journalism plus another degree show that the subjects related to SCST are usually the same as those taught in the [simple] degree of Journalism of the same university, it would be necessary to review the doubles and triple degrees exhaustively to corroborate or correct this idea. This revision should also cover postgraduate courses in Communication (masters).

It is difficult to estimate which is the most appropriate SCST training in the first cycle. The contents could be those mentioned in this work, and the desirable framework would be an optative subject thought as a continuity of the compulsory one of Specialized Journalism.

In any case, the situation described here reveals that the training in scientific and technological journalism requires to be encouraged, if not reformulated, so that graduates possess a certain command of the Spanish R&D&I system, appropriate to its complexity and

importance. The contents taught reflect that the Spanish System of Science and Technology and the productive sectors related to R&D&I are still not generalized and consolidated as a space for natural development, close to the interests of journalism teachers and students, despite being a work alternative for graduates.

The concomitance detected between the science system, investment in R&D&I and SCST training remains to be determined: if it is casual, if it derives from the inertia of the old degrees or if it obeys to decisions made during the design of the Journalism degrees in function of the scientific and technological regional and general context. Knowing it requires prolonging this study to explain the absences and exceptions detected. This would help to better understand the causes of the training deficit in the scientific-technological subject and the low scientific culture in Spain compared to the European Union (Fundación BBVA, 2012; López Cerezo y Cámara, 2009).

While this situation occurs in journalism, websites proliferate over the Internet with notorious quality, managed by graduates of various degrees (Biology, Physics, History, Engineering, Medicine) whose high scientific and communication skills allow them to disseminate, in a didactic and entertaining way, the advances and controversies of science, technology and the environment.

## NOTAS

1. Spain is governed by a system of distribution of competences among the various Public Administrations. Except for the powers reserved to the State (Article 149 of the Spanish Constitution of 1978), in the rest, the 17 autonomous communities (regions) and the two autonomous cities have a legislative role, exercising self-government; this is the case in education and universities.
2. Years between the 2008-2011 National Plan and the 2013-2016 National Plan. The most recent statistical data available correspond to 2012. We consider that they constitute a close context for dimensioning the revised teaching guides for the 2014-2015 academic year.
3. The two universities of Andalusia reviewed, of Malaga and Seville, include the attached centers, since they must provide the same curriculum and training program.
4. The elective subjects on medical communication and foundations of scientific journalism, of the University of Navarre, are taught respectively in the degree of medicine, and in the degrees of audiovisual communication and advertising and public relations.

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