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Integrating Artificial Intelligence and Big Data in Spanish Journalism Education: A Curricular Analysis

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Abstract: Artificial intelligence (AI) and big data have impacted different professional sectors in our society. Communication and journalism are clearly among them. From the automatic generation of content to the identification of topics of interest or monitoring of users' usage habits, AI introduces important training challenges for professionals in the field of communication. Meanwhile, big data analytics enables data journalists to handle large amounts of information in an automated manner, allowing them to perform in-depth analysis of disorganized data. This study analyzes the integration of artificial intelligence (AI) and big data in the curricula of journalism degrees offered by Spanish universities. The research employs quantitative and qualitative methods to examine the typology, syllabus, and distribution of subjects directly or indirectly addressing AI and big data topics, based on indicators such as structure, credit system, objectives, competencies, and professional profiles. The results reveal a scarce integration of AI and Big Data subjects in journalism curricula in Spain. Among the analyzed courses, only seven addressed data journalism as a complete course, while 19 introduced AI and Big Data as part of more general content. The study highlights the need for journalism education to adapt to the disruptive impact of AI and big data on the profession. It discusses the debate between focusing on teaching technological skills versus providing critical and ethical values. The research aims to contribute to the discussion on the readiness of journalism curricula to cope with technological advancements by analyzing the Spanish case.

Keywords: journalism; journalism education; university; curriculum; syllabus; data journalism; technological skills; artificial intelligence; big data

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1. Introduction

The emergence of artificial intelligence (AI) and machine learning has redefined numerous fields (Papadimitriou 2016). Journalism and communication are clearly among the professional scenarios most impacted by these new technological developments. Today, the production, distribution, and consumption of journalism have been so influenced by new technologies (Túñez-López et al. 2019) that professional journalism is forced to rethink its identity and its role in society (Wahl-Jorgensen et al. 2016; Calvo Rubio et al. 2024).

Almost a decade ago, the Reuters Institute (2017) *Journalism, Media and Technology Trends and Predictions* Report highlighted that among the main challenges faced by media and journalism, artificial intelligence and big data were the most significant. Today, AI opens up a new transdisciplinary form of journalism that integrates different areas (Cervi 2017; Creech and Mendelson 2015) and introduces a new way of interacting with information and dissemination in the media (Hansen et al. 2017; Carlson 2014).

Recent studies have highlighted how AI tools can expand journalists' capabilities and improve their work to standards never achieved before (Tejedor and Vila 2021; Thurman et al. 2017). Besides making journalists' work more efficient by freeing them from repetitive

or routine tasks (Wang 2016; Apablaza-Campos et al. 2024), such as the collection and organization of existing information (Diakopoulos 2014), AI can be used for the early detection of informative trends (Steiner 2014) and the development of news-recommendation systems (Noain-Sánchez 2022). Similarly, AI tools have proven to be extremely helpful in verification tasks, making them fundamental alliances in the fight against disinformation (Manfredi-Sánchez et al. 2019).

In addition, the growing amount of structured and unstructured information that humans and machines generate, often referred to as big data (Coddington 2015), is proving traditional tools for statistical analysis (Arcila-Calderón et al. 2016) insufficient: these datasets are so huge and complex in volume, velocity, and variety that traditional data management systems cannot store, process, and analyze them.

Accordingly, data journalism, which has become a key journalistic practice (Hewett 2015), not only requires interdisciplinary and the mastering of technological skills but also, as underlined by Bhaskaran et al. (2024), consistent up-skilling.

Nonetheless, recent studies (i.e., Noain-Sánchez 2022; Cervi et al. 2024) have shown that most Spanish journalists are not prepared to work with AI due to a lack of technological skills and training. Therefore, introducing AI into the journalism curriculum can help teach students to think critically about AI and understand the tools for reporting and investigating (Salgado 2022), as well as significantly improve their critical thinking and journalistic writing skills, preparing them for the AI-centric journalism industry (Irfan et al. 2023). Consequently, it is possible to state that while AI represents an opportunity, it also poses a challenge in journalism education.

Different studies (i.e., Hewett 2015; Vállez and Codina 2018) point out that for journalists to benefit from AI, they need to be technically trained to manage data visualization tools, have knowledge of natural language processing, and use content-sharing tools. Accordingly, different authors suggest (Vállez and Codina 2018; Gómez-Diago 2022) that since working with bots and algorithms requires specific skills, universities should equip students with these technical skills, taking an applied approach. Other scholars, however, fear that if universities focus too much on teaching technological skills, they will turn into job training centers (Wenger et al. 2018).

A particular stream of research stresses out that the development of AI has been accompanied by a harsh debate on the quality of outputs (Lemelshtrich 2018) and significant ethical concerns (Montal and Reich 2017; Díaz-Campo and Chaparro-Domínguez 2020; Ufarte-Ruiz et al. 2021). Therefore, many authors consider that universities should focus on teaching students to "reflect on" rather than "do with" AI, stressing the importance of taking a critical perspective. In other words, according to this view, journalism education should focus on adapting curricula to modern newsroom dynamics without losing the essence, principles, and values of journalism (Tejedor 2022), remembering that the core mission of journalism education is to provide future journalists with critical and ethical values.

This dichotomy between critical and applied approaches, besides animating the scholar debate, also impacts educational programs. As noted by Cervi et al. (2020), universities that follow a more critical approach tend to offer more theoretical/reflection-based courses, while those following a more applied approach offer more hands-on, skill-based courses.

Within this framework, this research intends to contribute to the discussion on the readiness of journalism curricula to cope with disruptive technological advancements by analyzing the Spanish case. It aims to answer the following research questions (RQs):

RQ1: Are Spanish journalism curricula integrating AI and big data into their courses?

RQ2: What types of courses deal with AI and big data?

RQ3: Does the critical or applied approach dominate?

2. Materials and Methods

The objective of this study is to analyze curricular proposals in journalism degrees related to artificial intelligence (AI) and big data. To this end, this research combined qualitative and quantitative methods in a content analysis of journalism curricula, a very

common method in studies on critical analysis of university pedagogy (i.e., Griffith et al. 2014; Stanny et al. 2015; Friedman 2019).

In this sense, through the quantitative method, the study defined the universe by identifying the universities in Spain and reducing the sample only to those that offer degrees in journalism to be able to study their curricula. From there, the study used the qualitative approach to identify the syllabi of all journalism degrees and collected the study plan of all the courses in each program to identify those that teach subjects related to automation, artificial intelligence, big data, and robotization. Based on an interpretative content analysis, the objectives, competencies, and topics of each one will be examined to provide a map of the emerging topics and discuss the results.

In Spain, according to statistics from the Ministry of Universities (Ministerio de Universidades 2022), there are 86 universities, of which 44 offer degrees related to Communication Sciences (Asociación Española de Universidades con Titulaciones de Información y Comunicación 2024). Of these 44 faculties, 41 offered a degree in journalism, 20 of which were public, and 21 were private institutions (Ministerio de Ciencia, Innovación y Universidades 2024) (Table 1).

Table 1. Universities in Spain that offer journalism degrees.

University	Degree	Type
University of Málaga	Journalism	Public
University of Seville	Journalism	Public
Loyola Andalusia University	Journalism and digital media	Private
University of Zaragoza	Journalism	Public
Saint George University	Journalism	Private
University of La Laguna	Journalism	Public
Fernando Pessoa-Canary Islands University	Journalism	Private
European University of the Atlantic	Journalism	Private
University of Valladolid	Journalism	Public
Pontificial University of Salamanca	Journalism	Private
Miguel de Cervantes European University	Journalism	Private
Isabel I of Castile International University	Journalism	Private
University of Castilla-La Mancha	Journalism	Public
Autonomous University of Barcelona	Journalism	Public
Pompeu Fabra University	Journalism	Public
Ramon Llull University	Journalism and corporate communication	Private
Rovira I Virgili University	Journalism	Public
University of Lleida	Communication and audiovisual journalism	Public
Central University of Catalonia-Vic	Journalism	Private
International University of Catalonia	Journalism	Private
Abat Oliba CEU University	Journalism	Private
Complutense University of Madrid	Journalism	Public
Comillas Pontificial University	Journalism	Private
Carlos III University of Madrid	Journalism	Public
San Pablo CEU University	Journalism	Private
Antonio de Nebrija University	Journalism	Private
European University of Madrid	Journalism	Private
Rey Juan Carlos University	Journalism	Public
Camilo José Cela University	Journalism	Private
Francisco de Vitoria University	Journalism	Private
Distance University of Madrid	Journalism	Private
University of Navarra	Bilingual journalism	Private
University of Valencia	Journalism	Public
Jaume I of Castellón University	Journalism	Public
Miguel Hernández of Elche University	Journalism	Public
Cardenal Herrera CEU University	Journalism	Private
University of Extremadura	Journalism	Public
Santiago de Compostela University	Journalism	Public
Basque Country University	Journalism	Public
San Antonio Catholic University	Journalism	Public
University of Murcia	Journalism	Private

Source: Ministerio de Universidades (2022).

Once journalism degrees were defined (n = 41), a review was made of all the courses that formed part of them (n = 1775, $\overline{X}$ = 43.29). For this purpose, a database was created using Microsoft Excel with a description of the courses, number of credits, and type of course (elective or mandatory). To define the courses of each degree on which the content analysis would be carried out, subjects related to the following topics (thematic grouping) were chosen for an initial screening: (1) General knowledge (social sciences, humanities, etc.); (2) research methodologies; (3) theory, structure, and history of communication; (4) theory and structure of journalistic professions; (5) expressive audiovisual techniques (such as audiovisual language); (6) expressive techniques (such as writing, Internet, and/or multimedia); (7) technology and technological skills; (8) journalistic genres: (9) business and business models; (10) specialized journalism; and (11) journalistic production. This screening also looked for subjects that included artificial intelligence, automation, data journalism, and/or big data, which were also included in the exploratory analysis.

After isolating specific courses explicitly dealing with AI or big data, we analyzed the content of the course to discover whether they deal with AI or big data and in what way. This has allowed us to disclose which courses tackle AI, the type of course, and whether they take a critical (ethics, responsibility, limits) or an applied (uses, practices, simulations) approach (Gómez-Diago 2022).

In particular, in order to deepen in the focus of the course and the way in which the topics are taught, following Cervi et al. (2020) we distinguish between critical or applied because approach. Courses with a critical focus are designed to foster deep understanding of the impact and broader context of emerging technologies in journalism. Such courses enable students to develop a critical mindset to understand the wider implications of IA and big data within the field. On the other hand, courses with an applied focus aim to teach students how to effectively use tools and software, essential for promoting innovation and improving efficiency in journalistic practices. This hands-on approach is suited for developing practical technical competencies required in the field. Distinguishing between these approaches allows academic programs to meet diverse objectives.

3. Results

A total of 1775 courses were identified, including all degrees in journalism in Spanish institutions. Within this sample, seven courses explicitly dealt with data journalism or big data, while 19 courses presented topics related to artificial intelligence, although this has not been incorporated in the title of the subject.

3.1. Specific Courses About AI or Big Data

This section describes the courses that make explicit reference to big data and that revolve around this topic. Of the seven courses, two had a practical approach, four combined practical and theoretical components into their content, and one did not have the information available (Figure 1).

The course "Statistics and Big Data in Communication" is taught by the Central University of Catalonia as a 6-credit mandatory course for second-year students. Its objective is to train on the extraction of large amounts of data and how to analyze it accurately and objectively. The subject, although it has a theoretical part to introduce the basic concepts, has a highly practical component in data analysis and visualization with SPSS and Flourish.

The subject of "Data Journalism and Visualization" is taught at Loyola University. It is a mandatory 6-credit subject that is taught in the fourth year of the degree in journalism and digital media. The course does not have an available teaching guide, so its objectives and approaches cannot be identified.

Isabel I of Castile International University offers "Data Journalism" as a 6-credit mandatory course for third-year students. It is designed to combine practical and theoretical aspects for the recompilation, analysis, and visualization of data applied to journalism. It is designed to combine practical and theoretical aspects of the collection, analysis, and visual-

ization of data applied to journalism. Its contents are open data, information visualization, and narrative structures based on data.

COURSE	UNIVERSITY	ECTS	TYPE		THEMATIC GROUPING
			Elective	Mandatory	
Statistics and Big Data in Communication	UNIVERSITAT DE VIC UNIVERSITAT CENTRAL DE CATALUNYA	6		✓	Specialized journalism
Data Journalism and Visualization	Universidad LOYOLA	6		✓	Specialized journalism
Data Journalism	Universidad Isabel I	6		✓	Specialized journalism
Data Journalism	UAB Universitat Autònoma de Barcelona	6		✓	Specialized journalism
Data Journalism and Information Visualization	upf. Universitat Pompeu Fabra Barcelona	6		✓	Specialized journalism
Data Journalism	uc3m | Universidad Carlos III de Madrid	6		✓	Specialized journalism
Data Journalism	Universidad de Sevilla	6		✓	Specialized journalism

Figure 1. Specific courses about big data or data journalism.

The "Data Journalism" course is offered by the Autonomous University of Barcelona as a mandatory 6-credit subject for first-year students. The subject is structured in a theoretical-practical way so that students internalize the skills related to data journalism while generating reflections on the datafied society. The main contents of the subject revolve around the presentation, management, construction, visualization, and mapping of data.

Pompeu Fabra University offers data journalism and information visualization as a mandatory 6-credit course for first-year students. The course is designed to combine theoretical and practical components to work with data applied to journalism. Its content focuses on the concepts of data journalism, visualization, tools, and writing.

The subject "Data Journalism" at the Carlos III University of Madrid is formed as a mandatory 6-credit course for fourth-year students. The subject is linked to the basic notions of the search and use of information sources, the analysis and visualization of data and information, and journalistic design. The course is framed in a practical theoretical model in which students learn history and then apply it using different tools.

The "Data Journalism" course at the University of Seville is a mandatory 6-credit class for fourth-grade students. The objective is to access and manage databases to produce journalistic projects. The subject has an initial theoretical part that is then reinforced with practical sessions to introduce the acquired knowledge. The main content is data journalism, sources of information, statistics, data processing, analysis, and visualization.

As shown in Figure 2, all the subjects had six mandatory credits. This curricular structure not only reflects a balanced academic load but also depth in the treatment of data

journalism. The assignment of credits ensures that students dedicate considerable and consistent effort to the subject.

When reviewing the syllabus of the courses, it was possible to identify that those that combine theoretical and practical approaches lean more towards one of these aspects. For example, the subject "Data Journalism and Information Visualization" at the Pompeu Fabra University, although methodologically it integrates practice and theory, its syllabus emphasizes the theoretical aspects that are taught, such as "sources of information, different types of analysis, software, and programming languages for data visualization".

In contrast, the subject "Statistics and Big Data in Communication" at the Central University of Catalonia mentions in its syllabus an initial theoretical approach to introduce basic concepts, followed by a significant practical application. This subject integrates theoretical knowledge, and at the end of each topic, students apply this knowledge in the SPSS statistical program, reflecting a highly practical component.

COURSE	UNIVERSITY	ECTS	TYPE		THEMATIC GROUPING
			Elective	Mandatory	
Multimedia Journalism and Digital Graphic Design		6	✓		Specialized journalism
Cyber Innovation in Journalism		6	✓		Technologies and technological skills
Cyberjournalism		6		✓	Specialized journalism
Journalistic Writing in Digital Media		6		✓	Expressive techniques: writing, Internet, multimedia
Technological innovations applied to Journalism		6		✓	Technologies and technological skills
Technological innovation in Communication		6		✓	Technologies and technological skills
Digital Marketing Fundamentals		6	✓		Technologies and technological skills
Technological foundations of Journalism		6		✓	Technologies and technological skills
Digital Documentation Formats		6		✓	Expressive techniques: writing, Internet, multimedia
Digital Content Management		3	✓		Journalistic production

Figure 2. *Cont.*

Analysis and creation of online content	Universitat de Lleida	**6**		✓	Journalistic production
Creativity and innovation	uic barcelona	**4**		✓	Technologies and technological skills
Journalism Lab: Comprehensive editorials	Universitat Abat Oliba CEU	**6**		✓	Expressive techniques: writing, Internet, multimedia
Technological innovations in Journalism	Universitat Abat Oliba CEU	**6**		✓	Technologies and technological skills
Digital Culture	COMILLAS UNIVERSIDAD PONTIFICIA	**6**		✓	Theory and structure of journalistic professions
Digital Journalism	COMILLAS UNIVERSIDAD PONTIFICIA	**6**		✓	Specialized journalism
Media Communication Theory	uc3m | Universidad Carlos III de Madrid	**6**		✓	Theory, structure and history of communication
New technologies and information society	Universidad Rey Juan Carlos	**6**		✓	Technologies and technological skills
Digital communication and information arquitecture	CEU | Universidad Cardenal Herrera	**6**		✓	Expressive techniques: writing, Internet, multimedia

Figure 2. Courses that offer AI or big data topics in their syllabus.

The seven subjects are designed to train students in data identification, analysis, and visualization. It was found that each subject offers content with different focuses; however, overall, they share specific content related to the topic of big data. They all began the course by introducing data journalism or big data and basic concepts, establishing a common theoretical base for all students.

On the other hand, the topic of transparency laws is taught in the subjects of Carlos III University of Madrid, Central University of Catalonia, University of Valencia, and Autonomous University of Barcelona, highlighting the understanding of the legal and ethical framework in data management.

Isabel I International University, Pompeu Fabra University, and the Autonomous University of Barcelona offer the topic of data cleaning. Meanwhile, the University of Valencia, Pompeu Fabra University, Autonomous University of Barcelona, International Isabel I University, and Central University of Catalonia teach the topic of data visualization for the effective communication of data through different tools.

Some subjects have a more generic approach to key aspects, while others show more specific content in their syllabus. The "Data Journalism" subject at the Autonomous University of Barcelona is an example of a more generic approach, addressing a wide range of topics that form the backbone of data journalism. The contents include "The data society, data journalism, data source and capture, data processing and analysis, narrating with data, visualization and cartography".

For its part, the data journalism subject at Isabel I International University delves into more specific and technical aspects, offering more specialized training in certain areas of data journalism such as "The inverted pyramid of the DDJ, extraction through APIs, Open Refine, Tools for the DDJ", etc.

The choice between a generic or specific approach depends on students' educational and professional objectives. Generic ones allow the creation of a solid base of knowledge to adapt to various roles in the career, while specific ones are suitable for the specialization of advanced technical skills in the area. Curricular design reflects a balance between practice and theory in developing the skills and competencies applicable in the field. The distribution of the topic provides comprehensive training that prepares future journalists for the data.

3.2. Courses with AI or Big Data Topics

This section describes the subjects with the topic of AI as part of their content and thematic blocks. A total of 19 courses had AI or big data topics as part of their thematic blocks; three of them had a practical approach, eight had a theoretical approach, and eight combined practical and theoretical components into their content (Figure 2).

As Figure 2 shows, 15 subjects were taught compulsorily and were divided into the following categories: two in specialized journalism; four in expressive techniques: writing, internet and multimedia; six in technologies and technological skills; one in journalistic production; and two in theory, structure, and history of communication. The four courses are electives and are divided into the following categories: specialized journalism, technologies and technological skills, and journalistic production.

The subject "Multimedia Journalism and Digital Graphic Design" is part of the academic program of the University of Seville. This optional course, of a theoretical–practical nature, is designed for third-year students to analyze the current panorama of journalism, influenced by technological advancement. The subject adopts a critical approach that allows students to reflect on the use of bots, automation of information, and artificial intelligence in the journalistic and communication fields. The course methodology combines the theoretical part with practical examples, favoring significant learning through expository classes. However, it is important to note that the teaching guide for this subject (Universidad de Sevilla, s.f.) does not specifically mention teaching the students about AI programs rather than explaining the use of this technology in journalism.

The University of Seville offers another optional course for fourth year titled "Cyber Innovation in Journalism". This course of 6 credits provides up-to-date training on emerging technologies that are shaping the future of the journalism profession. The structure of the course balances theoretical and practical components, allowing students to analyze and debate the contents before carrying out practices or work focused on cybernetics. Part of the course content involves the introduction of AI to journalists and machine learning practices. However, it is relevant to mention that although this subject has an applied focus, the practice is not specifically oriented toward teaching the use of AI programs.

The "Cyberjournalism" course by the University of San Jorge is a mandatory 6-credit course that analyzes the theoretical and practical foundations of journalism in the digital and online environment. It provides a theoretical–practical balance so that students can acquire journalism skills in digital formats. As part of their content, they teach the topic of big data, its opportunities, and limitations under the topic of journalistic production in cybermedia. This course takes a critical approach to this aspect.

The subject "Journalistic Writing in Digital Media" by the University of San Jorge has six credits and is mandatory. It is aimed at fourth-year students and is a continuation of a cyberjournalism course. This is a practical subject, with an applied approach that within its contents has a thematic block dedicated to AI in digital media.

"Technological innovations applied to journalism" is a course at the University of Valladolid with 6 mandatory credits during the first year. Present new technological tools used in journalistic creation, editing, and dissemination. As part of its content, it has a

block dedicated to journalism in the digital age, in which it offers the topic of "automation, bots, and algorithms" applied to journalism. This thematic block has a critical approach through theoretical classes that allow the contextualization of the digital landscape.

The subject "Technological innovation in communication" at the Pontifical University of Salamanca has six mandatory credits for third-year students. The course is designed in a practical way so that students can work on new platforms. It offers an initial critical approach followed by a more applied approach in which knowledge is put into practice. The course includes the topic of generative artificial intelligence as part of its content.

The subject "Fundamentals of digital marketing" offered by Isabel I of Castilla International University is a 6-credit optional course on the key aspects of marketing, social media search engines, and strategic planning in social media. The course offers as part of the content of mobile marketing: introduction and trends the topic of present and future: automation, connectivity, artificial intelligence, and omnichannel. The class was designed theoretically to offer students a critical and reflective approach.

The Autonomous University of Barcelona offers the course "Technological Fundamentals of Journalism", which has six credits and is mandatory for first-year students. It is designed to teach about the processes and technologies involved in audiovisual and multimedia journalism through a largely theoretical approach and a practical space to apply knowledge. As part of this content, it included the topic of artificial intelligence.

The "Digital and Documentation Formats" course at Pompeu Fabra University is a mandatory 6-credit course that trains first-year students in web design and editing for digital media and the impact of new technologies. This is a theoretical and practical subject with a critical approach. As part of their content, they have a block dedicated to the impact of new information technologies in journalistic contexts, such as generative artificial intelligence or new language models.

The subject "Digital Content Management", taught at Ramón Llull University, has three optional credits. The class is designed to combine a theoretical part to define digital strategies applied to journalism and corporate communication and another practical part to plan and execute the strategy. From a critical approach, it includes the topic of big data as part of its content.

The course "Analysis and creation of network content" from the University of Lleida has six mandatory credits taught during the first year. The class is divided into a theoretical part with a critical focus on the concepts and perspectives of cyberjournalism and another practical part to analyze and create content adapted to social networks and the digital sphere. In its content, they have a thematic block dedicated to algorithmic communication, artificial intelligence, and communication control.

The "Creativity and Innovation" course at the International University of Catalonia is mandatory and has 4 credits taught in the fourth year. This subject offers a practical and applied format in which students are introduced to the use of AI in communication. As part of its contents, it offers the thematic blocks of AI voice synthesis and audio verification, AI chatbots and text creation, AI image and video verification, AI image generation, and AI writing and automatic translation.

The subject "Lab Journalism: Comprehensive Writings" offered by Abat Oliba CEU University is a mandatory 6-credit course for first-year students. It is a course in the flipped class mode that combines theory and practice to approach the technological environments of journalism. With an applied and critical approach, it has as part of its content a topic dedicated to the Knowledge Society Ecosystem, in which it dedicates a section to artificial intelligence.

The course "Technological Innovations in Journalism" by the Abat Oliba CEU University is a course that has six mandatory credits taught in the third year. It offers a theoretical component and critical approach to the possibilities and impacts of technological innovations in journalism. As part of its content, it offers a thematic block dedicated to journalism network projects: artificial intelligence.

The subject "Digital Culture" at the Universidad Pontificia Comillas is a mandatory course that has 6 credits taught in the third year. It was developed with a theoretical component to address the problems of the cultural and communication industries and the relevance of users from a critical approach. As part of its content, it dedicates a thematic block to artificial intelligence: threats and opportunities. Legal issues, copyright, and social impact.

The subject "Digital Journalism" at the Universidad Pontificia Comillas is a 6-credit compulsory course in the fourth year. Through theory, it delves into journalism models derived from convergence with the internet. This offers a critical approach to the impact of new journalistic practices. In its content, it dedicates a thematic block to artificial intelligence: uses and applications for journalism professionals.

The course "Theory of media communication" at the Carlos III University of Madrid is a mandatory course of six credits taught in the first year. Through the theoretical model, it develops knowledge about the main communication theories and adopts a critical approach to the interpretation of current phenomena. Their content includes the topic of artificial intelligence, media, and power in the 21st century.

The course "New technologies and information society" at the Rey Juan Carlos University has 6 mandatory credits for first-year students. This is a theoretical class on the evolution of information and communication technologies (ICT). This offers a critical approach to the technological tools available for communication. In its content, they dedicate a thematic block to economic, social, and political transformations: the information society and the economy. Big data in the audiovisual industry.

The course "Digital communication and information architecture" is a mandatory 6-credit course in the fourth year taught by the Cardenal Herrera CEU University. The subject addressed the foundations of digital communication and its application in a journalistic environment. It offers a critical approach to the communication paradigm, and its content includes a section on the characteristics and challenges of digital transformation. Artificial intelligence and the change of the communicative paradigm.

As shown in Figure 2, 15 out of 19 courses have mandatory credits, while four offer the class as an elective. In addition, 17 courses consisted of a 6-credit subject. The assignment of credits ensures that students dedicate considerable and consistent effort to the subject. However, although they are mandatory courses with a number of credits that suggest depth in the topics, the classes are not focused on AI or big data, implying that a smaller amount is dedicated to these particular topics.

It was found that subjects that teach AI or big data topics are courses that deal with different technologies based on the emergence of the Internet and how new journalistic practices are transformed in the digital environment. The teaching guide for the subject "Digital Communication and Information Architecture" at the Cardenal Herrera CEU University explains that it addresses the fundamentals of digital communication and its practical application in journalistic communication. In particular, the change in the communication paradigm and its consequences for journalism, the elements and characteristics of the digital medium, and the main trends of information on web media and social platforms.

Likewise, the contents of the subject "Technological innovations applied to journalism" at the University of Valladolid are included in the main topics: technological prehistory of journalism, digital world and journalism, and the emergence of the Internet. For its part, the subject "Digital formats and documentation at the Pompeu Fabra University has as part of its contents "Impact of new information technologies in the journalistic context, such as generative artificial intelligence or new language models". This demonstrates that the recognition of the change in the communication paradigm and the understanding of these technologies is an integral part of modern journalism.

A particular case is shown by the University of San Jorge, which offers two complementary courses that address both the topic of AI and big data and that allow knowledge to be intertwined and create a more robust base for new technologies. The "Cyberjournalism" subject analyzes the theoretical and practical foundations of journalism in the digital and

online environment and specifically addresses the topic of big data: opportunities and limitations. For its part, the subject of "Journalism Writing in Digital Media" recalls theoretical concepts from another subject but proposes an eminently practical program. This addresses the topic of artificial intelligence in the digital medium through practical exercises and deals with other topics, such as the inverted pyramid, press conferences, and journalistic genres. This shows that the institution adopts a comprehensive and interdisciplinary approach in favor of the current journalistic context.

The integration of artificial intelligence (AI) in communication sciences has been addressed from various perspectives in academia, with a significant emphasis on its future potential and role in media transformation. Through the analysis of different teaching guides, we can see how AI is conceptualized and taught as an emerging innovation that, although not yet fully integrated into the media, is seen as a technology with the capacity to revolutionize journalism and digital communication.

Several subjects approach AI from a futuristic perspective, highlighting its potential and possibilities for journalism. The subject "Technological Innovations in Journalism" at the Abat Oliba CEU University aims to teach about the latest trends and explain the future possibilities of journalism and the changes it may experience. It includes AI, augmented reality, virtual reality, mobile communication, and blockchains.

Subjects such as "Digital Culture" from the Comillas Pontificia University and "Fundamentals of Digital Marketing" from the Isabel I University of Castilla deal with the topic of AI from a future perspective. "Digital Culture" explores AI and big data as "The future of new media". Meanwhile, the subject "Fundamentals of digital marketing" ventures into the thematic block: mobile marketing: introduction and trends, and the topic of present and future: automation, connectivity, artificial intelligence, and omniquality.

Other subjects emphasize the innovation aspect that AI offers. The subject "Journalism Lab" at the Abat Oliba CEU University addresses the new changes and shows "an innovative update of the processes that make journalism possible in the 21st century". Under the thematic block of "Thought and innovation", they address the topic of AI. Likewise, the subject "Creativity and Innovation" at the International University of Catalonia seeks to stimulate the development of innovative journalistic projects, which is why it offers an in-depth vision of information verification and AI techniques. Also, the subject "Technological innovation in communication" at the Pontifical University of Salamanca has generative artificial intelligence as part of its content on innovation and trends in journalism.

The analysis of teaching guides from various universities shows that AI is taught as an emerging technology with enormous potential to transform media and journalism. Although not fully integrated into everyday media practices, it is seen as a crucial innovation in the future of the field. The courses prepare students for this future by providing both a theoretical understanding of AI and opportunities to apply this knowledge practically and creatively. This dual approach ensures that future communications professionals are not only aware of the latest technological trends but are also prepared to lead innovation in journalism and digital communication.

3.3. Courses Approach

This section describes the approach of the courses as critical or applied, following the Gómez-Diago (2022) categorization. Of the 26 identified subjects, 13 were critical in nature, four had an applied approach, and eight mixed both approaches in their teaching (Figure 1). Subjects with a critical approach were designed to encourage deep reflection on the impact and context of new technologies in journalism. These subjects allow students to develop a critical mindset that enables them to appreciate the broader implications of AI and big data in journalism.

For example, the course "Digital Formats and Documentation" takes a critical approach. This course teaches students the impact and context of new technologies that can be applied to journalism. By approaching these issues from a critical perspective, students learn to value the ethical and social implications of technology in their fields. By contrast,

subjects with an applied approach are designed to teach students how to use various tools and programs, which is crucial for innovation and efficiency in journalistic practice.

The "Creativity and Innovation" course is designed with an applied approach, where students learn to use different AI tools for vine verification, image generation, writing, and translation. This hands-on approach allows students to acquire specific technical skills that can be directly applied to their daily work.

Subjects that combine critical and applied approaches offer more comprehensive training, ensuring that students not only learn to use advanced tools but also understand the underlying concepts and implications of their uses.

The "Data Journalism" course is an example of a mixed approach, combining practical application with critical reflection. This course ensures that students can effectively leverage AI for data-driven journalism, while understanding the concepts behind the practices they apply. This comprehensive approach ensures the preparation of students for using technological tools and addresses ethical and conceptual issues related to their use.

Differentiating between approaches allows academic programs to adapt to various educational and professional needs. Critical subjects are ideal for developing deep and reflective understanding, whereas applied subjects are ideal for acquiring technical skills. Programs that take both approaches, whether in separate classes or in one that offers both, allow for complete and versatile training.

As Figure 3 shows, 12 of the 26 identified courses (46.2%) use an approach that combines theory with practice, reflecting a tendency to combine both aspects for a more transversal and dynamic class. This is followed by eight courses with a critical approach, which reflects that they opt for theoretical approaches to the practice of these technologies, which only five courses offer.

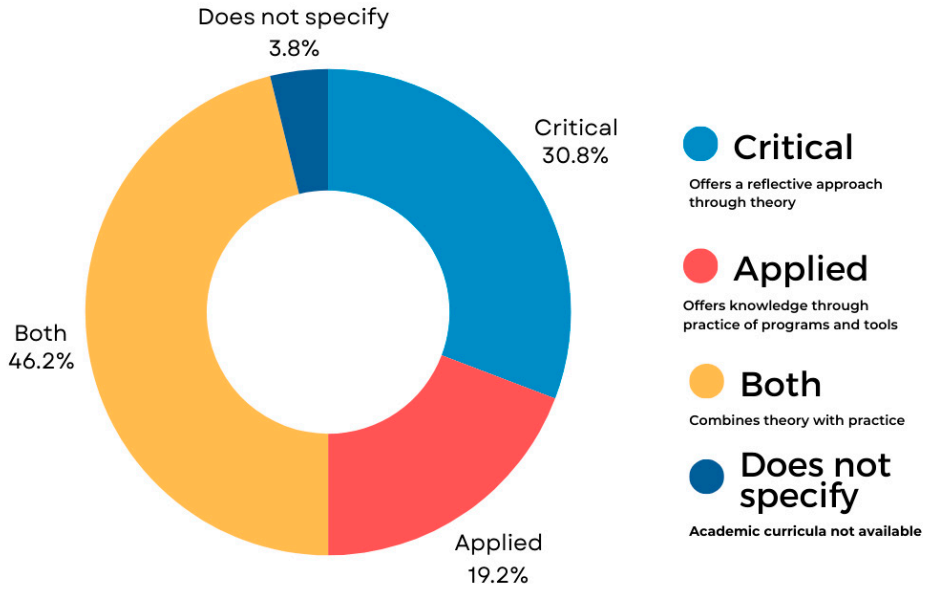

Figure 3. Percentage of courses approaches.

Figure 3 also shows that of the 26 courses identified, 12 (46.2%) combined theory and practice, 8 adopted a predominantly critical approach, and only five focused exclusively on the practice and application of these technologies.

The 12 courses that integrate practice with theory allow for comprehensive training; however, they require a well-designed curricular structure and adequate and adapted resources for the balance to be effective and understandable. In the case of courses in which theory with a critical approach predominates, it allows delving into the bases and conceptual aspects that promote the ability to evaluate and analyze technologies in the field. However, the absence of practical components can cause deficiencies in the technical skills necessary to implement what is learned in real-world contexts. Finally, courses

designed with an applied approach allow direct skills to be acquired through the use of technologies; however, they may limit the ability to understand their broader context and basic principles.

Comprehensive training in communication and journalism requires an appropriate balance between the theoretical, practical, and combined approaches. Each of these approaches plays a crucial role in developing the competencies necessary for future communicators; however, a disproportion in the distribution of these approaches can lead to unbalanced training and the creation of gaps in essential areas. An imbalance in the percentage of participants who adopt one approach over another can result in incomplete training. For example, excessive concentration on the theoretical approach can leave students without the practical skills necessary to apply their knowledge to real contexts. Similarly, overemphasis on practice without a solid theoretical foundation can limit students' ability to understand the broader context and implications of the technologies they use.

4. Discussion

The diagnostic analysis of the curricular offer that journalism studies present in Spain around artificial intelligence and big data, as thematic fields in growth and directly related, is consolidated as an area of reflection, research, and scientific dissemination of great interest and relevance in the current scenario. This type of approach offers interesting conclusions on the current training landscape of future journalism professionals, while identifying the main challenges in curriculum design and in the redefinition of teaching and learning strategies for graduates of a field in perennial transformation.

In this sense, among the main conclusions of the present study, it is important to highlight that the current curricular offer does not present specific courses dedicated exclusively to artificial intelligence in journalism degree programs. Instead, AI topics are added as part of thematic blocks in subjects of a more generic nature. This approach—generated, surely, by the conjuncture of the curricula and the particularity of the necessary procedures for their revision and updating—denotes a general and introductory approach towards the familiarization of students with AI, but also affects the relevance of devising and developing specialized courses that allow a deeper understanding, both socially, ethically, and technically, of this set of technological developments and their implication in the journalistic scenario.

The above point leads to the conclusion that there is remarkable potential in current courses to incorporate AI topics in their curricula. Specifically, the structure and content of many existing courses allow the addition of AI thematic blocks without the need to design new subjects from scratch, an aspect that would delay the process of change due to bureaucratic issues. This integration capability is a positive aspect, as it facilitates the updating and modernization of academic programs to include essential knowledge on emerging technologies.

Nonetheless, it is seminal to stress out that journalism education should produce graduates who are not only proficient in the use of AI but also aware of its broader impact. Only the integration of both the applied and the critical approach can successfully prepare students to navigate the complexities of modern journalism, where technological competence must be balanced with ethical and contextual awareness.

Ultimately, in other words, a thoughtful integration of AI into journalism curricula enhances the field's ability to adapt and responsibly shape the future media landscape.

In this sense, we agree with Peña-Fernández et al. (2023) regarding the need to equip these curricular designs with a broader and transversal component from a digital humanism perspective.

The previous point opens an interesting and prolific field of study for future work and lines of research that should surely be promoted from interdisciplinary teams and approaches. In relation to this point, the study of artificial intelligence and big data and their inclusion in the curriculum undoubtedly requires a variety of approaches, methodologies, and epistemological approaches. In the specific case of the curricular offerings analyzed,

the study identifies two major formative bets. On the one hand, there are the critical courses that develop an essential basis for understanding the ethical, social, and professional implications of AI. These are training spaces designed to encourage responsible use of technology. On the other hand, applied courses aimed at providing the technical skills and competencies needed to take advantage of AI tools stand out. In addition, we detect the existence of a set of combined courses that offer comprehensive training that bridges theory and practice, allowing students to take advantage of AI or big data while understanding the broader context, in a scenario marked by transmedia narratives and, as Scolari et al. (2019) point out, a leading role of content generated by users or, in the framework of the present research, students and future journalism professionals.

In general, the research stresses the importance of universities adapting their curricula to include more prominently and systematically the teaching of AI and big data, thus preparing students to face the challenges and take advantage of the opportunities that these technological innovations offer in the field of journalism. This set of results shows a still incipient integration of these topics in the academic training of future journalists in Spain. In this sense, the scarce presence of courses dedicated to AI and big data in journalism programs highlights the need for a greater incorporation of these contents in the curricula, given the growing relevance of these technologies in the field of communication and contemporary journalism.

On the other hand, this set of topics on artificial intelligence and big data are practically absent in Spanish undergraduate courses. In this line, this work reinforces the reflections of Gómez-Diago (2022) who, concentrating on the study of a limited number of teaching projects, concludes that universities should teach basic concepts on artificial intelligence and platform analysis, as well as data processing, automated content creation, and verification. In addition, it stresses the importance of enhancing the development of algorithmic accountability to understand how algorithms work. In the same line, this research connects with the proposals of Salgado (2022) or Irfan et al. (2023), which stress the need for training that enhances critical thinking and use of media from media literacy.

At a general level, the inclusion of artificial intelligence in the university curricula of communication sciences in Spain shows a disadvantageous panorama. While some universities have begun to integrate AI into their curricula, many others have not yet done so, an aspect that poses significant challenges for the training of future journalists and communicators. In addition to the above, there is a critical observation that a considerable number of universities in Spain have not adequately included topics related to artificial intelligence in their journalism degree curricula. This is a problematic shortcoming for several reasons. On the one hand, AI is rapidly transforming journalism, and the lack of training in this area leaves future professionals at a disadvantage, as they will not be prepared to use AI tools (and, therefore, their connection with big data) that are already beginning to be fundamental in the creation, distribution, and analysis of multimedia content.

In addition, the ability to innovate and adapt to new technologies is essential for modern journalism. Without a solid foundation in AI, future journalists may lack the necessary skills to lead innovative projects and adapt to the new demands of the digital environment. This set of findings supports the postulates of authors such as Noain-Sánchez (2022) and Cervi et al. (2024), who have stressed the lack of preparation of Spanish journalists to use these technological developments due to a general lack of technical competence.

In line with Hewett (2015), Vállez and Codina (2018), Tejedor and Vila (2021), and Sánchez-García et al. (2023), training in this type of emerging technology is key to understanding the change in the sector and being able to take advantage of its possibilities. In the university environment, in this sense, this research detects that, among the universities that do include AI topics in their curricula, these topics are not usually the exclusive focus of the subjects but are combined with other emerging technologies. This convergent approach has both advantages and disadvantages. On the one hand, such a combination offers a holistic approach in which the integration of AI and big data together with other emerging technologies, such as augmented reality, virtual reality, and mobile communication,

provides students with a more complete view of the current technological landscape. This holistic approach allows them to understand how different technologies can interact and complement each other in the field of journalism. On the other hand, however, a disadvantage lies in the superficiality of the training approach, as the combination of multiple technologies in a single topic can lead to a general and not very detailed coverage of each topic. AI, being a complex technology with multiple applications in journalism, may not be covered in the depth necessary for students to acquire a solid understanding and meaningful practical skills.

In conclusion, it is possible to point out that the insufficient inclusion of artificial intelligence topics and, by connection, big data in the communication curricula of many Spanish universities constitutes a deficiency that must be addressed to ensure that future journalists are adequately prepared for a rapidly evolving media environment. On the other hand, universities that integrate these technological developments along with other emerging technologies offer a holistic approach that, while beneficial in terms of holistic vision, may dilute the depth and specialization in AI. To maximize educational potential, it would be beneficial for universities to balance the inclusion of a variety of emerging technologies with a more detailed and specialized focus on AI, ensuring that students gain a broad understanding and deep practical skills in this crucial technology. The incipient irruption of this set of training proposals and the difficulty and slowness of the administrative processes demand a greater effort on the part of the academy to respond to this training need, which is undoubtedly transforming the journalism labor market, its production routines, and other scenarios of our daily lives. For all these reasons, this research provides a series of results and conclusions that, in a permanent way and from multidisciplinary approaches, will have to be the object of continuous study. In addition, there is a need to establish a close dialogue between academia and industry and, on the other hand, between different disciplines of knowledge: from journalism and communication to engineering, including linguistics, sociology, and even law.

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