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RESEARCH ARTICLE

Engineering and Technology Education in University Studies: Driving Digital, Sustainable, and Resilient Development–A Case Study in Andalusia, Spain

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ABSTRACT An investigation was conducted to examine the impact of training in intelligent systems within engineering courses at the university level, considering the parameters and reports on business trends for 2030, as well as the Sustainable Development Goals (SDGs). The study analyzed 2309 subjects across 66 undergraduate degrees offered at nine universities in the Andalusia region, which is the most populous region in Spain. The objective of this research is to assess whether the training in intelligent systems, specifically in the fields of electrical engineering, electronics, computer science, and telecommunications, adequately prepares students in their final years of study to meet the demands of the labor and business market. Reports and trend studies have identified the urgent areas that require attention, including training in sensors, smart grids, smart cities, IoT, artificial intelligence, embedded systems, among others. The investigation provides insights into the current state of training in intelligent systems within the final years of engineering programs. These findings will inform future curriculum development and teaching guidelines, with the goal of enhancing students' knowledge and skills in line with technological and engineering trends. The study will analyze subjects across various Spanish universities in Andalusia, considering their rankings. Based on the analysis of the results, recommendations for improvement actions and strategies to strengthen the curriculum will be proposed.

INDEX TERMS Educational institutions, engineering education, intelligent systems, business trends, smart systems, sustainable development goals (SDGs).

I. INTRODUCTION

According to the latest reports by the Gartner agency on technology trends, titled "Top Strategies Technology Trends 2023," ten key trends have been identified for this year. These include Sustainable Technology, AI TriSM, Wireless-Value Realization, Industry Cloud Platforms, Digital Immune System, Platform Engineering, Superapps, Adaptive AI, Applied Observability and Metaverse [1]. Moreover, esteemed technological institutions like the Massachusetts Institute of Technology (MIT) have also identified various innovative technological trends for 2023. These encompass Health Technology, focusing on areas such as genetics, telemedicine, and artificial organs, as well as Artificial Intelligence in its various domains. Other areas of interest include the Chip Industry, Military Drone Industry,

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Electric Vehicles, Aerospace Technology, Recycling, among others [2]. Additionally, the World Economic Forum, relying on the McKinsey & Company report, has highlighted several principal technology trends for 2023 and beyond. These encompass Robotics, Industrial Internet of Things (IoT), Digital Twins, 3D or 4D printing (also known as additive manufacturing or AM), 5G Connectivity, Distributed Technology Infrastructures, Adaptive Artificial Intelligence in all its facets, Cybersecurity, Biorevolution, and Advanced Materials [3]. Research has demonstrated the significance of higher education in educational centers and institutions, emphasizing the necessity of transferring education and innovation to industry and regional economies. For instance, within the realm of Artificial Intelligence (AI), it has provided students with enriched learning experiences, enabling personalized and customized learning materials tailored to their individual needs and capabilities [4], [5].

Universities must equip students with advanced skills, particularly in the domains of smart cities, environmental management, and energy resource optimization through AI systems, sensors, IoT, and other technologies. The world is experiencing rapid changes, and future professionals in the energy, environmental, and digital engineering sectors cannot afford to lag behind [6], [7].

Furthermore, teaching criteria, academic guidelines, laboratory practices, and research in the realm of intelligent systems and environments necessitate continuous improvement and adaptation to meet industry demands. The industry evolves rapidly, with technological developments and innovations emerging on a yearly, and even monthly, basis. Universities must provide challenges and updates that offer engineering students a realistic and effective understanding of the latest-generation technologies, without delay in modifying the academic teaching guides [8]. The success of flexible, intuitive, and resilient developments in engineering and technology, as applied to society, relies on the adequate training of professionals who will spearhead these initiatives [9], [10], [11]

The ever-advancing technology landscape and shifting business and institutional strategies, influenced by the changing realms of economics, geopolitics, and global health management following the COVID-19 pandemic, urge us to reflect and investigate the foundations of education in intelligent systems applied across all disciplines of knowledge [11].

For many years, university training in engineering and technology has remained rigid and static, with syllabus design and teaching guides remaining unchanged for extended periods, typically ranging from 4 to 8 years, or even longer. While this approach ensures consistency in writing syllabi, textbooks, internships, and coordinating teaching and research activities, it hinders progress in the industrial and environmental realms beyond the confines of classrooms and laboratories [12]. To foster resilience, it is crucial to strengthen the essential synergy between universities and industries. The rigidity of syllabi does not align with the dynamic nature of industrial advancements. Investments in technology are key to organizational success, necessitating the anticipation of system demands and the training of future engineers in advanced, multidisciplinary intelligent systems [13], [14]. Therefore, the world is changing and university education must adapt flexibly and continuously to these changes, which can be very rapid and require research professionals and PhDs in technological disciplines to be up to the task [15], [16], [17].

This study undertakes a comprehensive investigation into higher education training and education in the field of Intelligent Systems and Technology, specifically focusing on their adaptability to societal changes and the construction of new educational paradigms. Our analysis encompasses 66 official Engineering Degrees and 2309 teaching guides from the university system of Andalusia, the region with the largest population in Spain. With its significant economic and strategic potential, Andalusia maintains autonomy and a commitment to continuous improvement in its educational system. Within this context, we have closely examined the various criteria of higher education, particularly in the areas of Smart Grids, Smart Cities, IoT, AI, and other parameters related to advanced technologies for sustainability and efficiency. This research can serve as a blueprint for replication in larger territories, such as Spain or the European Union, which will be the focus of our next phase of analysis.

To achieve this, we will employ the innovative methodology of Gartner Hype Cycles, which utilizes graphical representations to depict the maturity of technologies and their applicability in solving problems across various domains. In this research, we will apply this methodology to align the curricular content of universities in the field of intelligent systems. Figure 1 presents Gartner's Hype Cycle graph, which showcases the upcoming technological trends and innovations, along with their projected expectations and evolutionary trajectories over time. By utilizing this framework, we aim to gain valuable insights into the future developments in the field of intelligent systems and utilize them to enhance the educational offerings of universities.

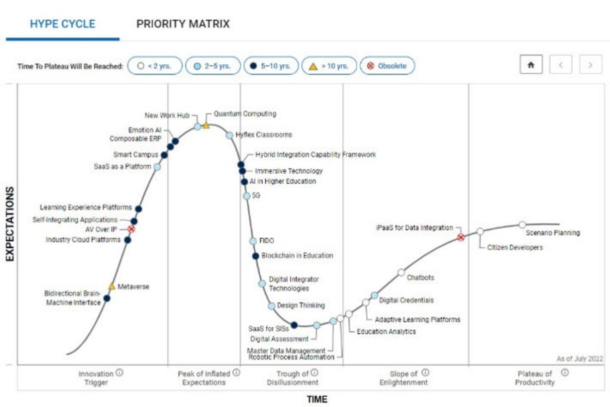

FIGURE 1. **Gartner hype cycle chart. Technology evolution and expectations. 2022 [18].**

Furthermore, we have extensively reviewed global studies and reports that provide forecasts in various areas, including:

- Smart Cities IoT and data analytics for sustainable resilience [19], [20].
- Climate change and sustainable growth for balancing financial, environmental and economic opportunities in cities [21].
- Implementation strategies that deliver data-driven industrial and social ecosystem engagement in carbon reduction and innovation to deliver clean and green technology solutions [22].
- Review of the SDGs and their alignment with intelligent systems and advanced technologies in applied engineering [23].

Considering this information, we pose the following questions:

- Is higher educational planning and training resilient to the technical-economic, strategic and social changes of the 19th century? We will analyze a set of 9 European university institutions and 2309 subjects to obtain the results.
- Would it be wise to reinvent and holistically transform the current education system according to the aspirations of stakeholders, industry, governance, society, health, etc.? We will write some final recommendations and analysis, after observing the data obtained from the research.
- What macro and micro level changes would be required in the current education system if it were to be redesigned for the Smart Cities of the modern globalized world? Based on the research carried out, we will obtain a decalogue of changes and proposals.

Our study aims to comprehensively evaluate all engineering degrees offered at nine Andalusian universities, with a particular focus on disciplines such as electricity, electronics, computer science, telecommunications, and related fields. We will meticulously analyze the subjects and teaching guides implemented during the 2022-2023 academic year across these institutions. Furthermore, we will align these degrees through meticulous textual analysis of their contents, considering the forecasts and trend reports provided by renowned international agencies such as Gartner and others. Our ultimate objective is to propose a comprehensive work plan that will enhance and evolve engineering studies at the analyzed Andalusian universities. To accomplish this, we will conduct a comparative analysis and provide well-founded recommendations based on the insights gained from our research. By undertaking this comprehensive examination, we aim to contribute to the advancement of engineering education and its alignment with the emerging demands of the industry.

This paper is organized as follows. Section II provides a comprehensive review on the integration of SDGs in universities for Engineering and Technology, focusing on the Andalusian University Context. Section III describes the methodology employed in this research, including an analysis of engineering degrees in Andalusian universities, with a particular emphasis on their alignment with future trends and strategic improvements. In Section IV, we present the findings and results obtained from the textual analysis of engineering degrees, considering the incorporation of intelligent systems and technologies in university studies. Section V discusses the implications and significance of these findings, highlighting the potential improvements and advancements in engineering education. Finally, Section VI concludes the paper by summarizing the key findings, discussing their implications and future developments in this field.

II. PRELIMINARIES

A. INTEGRATION OF SDGS IN UNIVERSITIES FOR ENGINEERING AND TECHNOLOGY

In recent decades, there has been a growing recognition among higher education institutions, universities, research institutes, and other centers regarding the importance of incorporating the Sustainable Development Goals (SDGs) into their work programs. This integration extends to areas such as energy efficiency, equality, and various other parameters outlined in the UN Agenda 2030 [24]. The adoption of the SDGs entails addressing significant social, economic, and environmental challenges.

Additionally, it is crucial to equip engineering and technology students with the necessary skills to navigate complexity, engage in effective dialogue and communication, foster deep reflection, develop a holistic worldview, and demonstrate sensitivity to values. Furthermore, they should be able to assess whether their activities contribute to or hinder the achievement of the SDGs. By fostering these skills, knowledge, and vocational experiences, we can actively contribute to expediting progress across all SDGs [25].

The promotion and integration of sustainability education across various academic disciplines, including engineering and technology, poses a significant challenge for the higher education sector that requires urgent attention. Industries, companies, and organizations are increasingly placing demands on the education sector to provide students in scientific and technological fields with training in sustainability and compliance with the SDGs [26], [27].

Universities and higher education centers play a crucial role in driving development, training, and paradigm shifts towards resilience in various domains, including social, economic, strategic, and technological areas. As outlined in the 2030 Agenda, universities have a dual responsibility. Firstly, they need to integrate the Sustainable Development Goals (SDGs) into their core activities, encompassing teaching and research, to generate interest and promote education and research on the SDGs. Secondly, they are expected to act as transformative agents in society [28]. Extensive research supports the necessity and significance of integrating the SDGs at the university and higher education levels [29]. These institutions not only contribute to societal changes but also facilitate improvements and adaptations in higher education. Incorporating sustainability is a significant challenge in terms of implementing measures for environmental protection, managing energy and water resources, and promoting resilient and environmentally-friendly construction, among other aspects [6].

The analysis of various sources and research indicates a lack of significant emphasis on aligning the Sustainable Development Goals (SDGs) within higher education systems, universities, and research centers. While there is public interest in the SDGs, their integration into teaching guides, curriculum content, technical planning, and strategy reports in the short and medium term is limited [28]. Notably, the guide provided by the Spanish Network for Sustainable Development (REDS) offers valuable insights into the implementation of sustainability in teaching and research, outlining the necessary procedures and resources [30]. To effectively address this issue, universities must promptly develop an agenda and strategy for SDG integration, considering the crucial role of technological factors in facilitating institutional improvement and societal impact, as depicted in Figure 1.

Additionally, the Conference of Rectors of Spanish Universities (CRUE) provides an online tool that allows universities to evaluate their sustainability efforts through a questionnaire-based assessment [31]. These resources can aid universities in actively engaging with sustainability and advancing the necessary changes within their institutions.

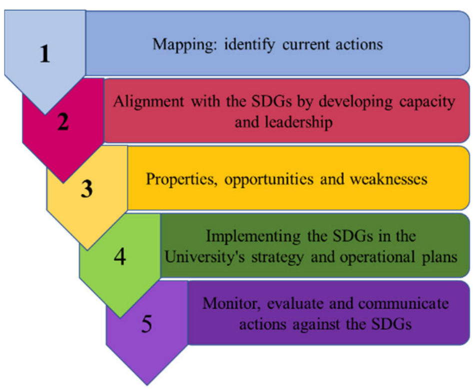

FIGURE 2. Sustainable development planning at the university. REDS 2020 [30].

B. ANDALUSIAN UNIVERSITY CONTEXT

It is important to highlight the existence of prestigious university rankings that analyze institutions worldwide based on indicators such as research output, publication of high-impact studies, citations, and awards. One notable example is the Shanghai Ranking, also known as the Academic Ranking of World Universities [32]. This ranking evaluates universities with Nobel laureates, highly cited researchers, and articles published in renowned journals like Nature or Science. It also considers the number of articles indexed in the Science Citation Index-Expanded (SCIE) and Social Science Citation Index (SSCI). The ranking includes over 2500 universities globally, with the top 1,000 being published.

Within this ranking, it is possible to narrow down the analysis to specific areas or subjects. In the scope of this research, the focus is on Electrical and Electronic Engineering, Computer Engineering, and related fields, as they are closely related to the research proposal (Table 1). Among the 76 Spanish universities ranked, 16 are included in the Shanghai Ranking for Electrical & Electronic Engineering in Spain. Notably, three universities from the region of Andalusia—Seville, Malaga, and Granada—are part of this group. These three universities represent 18.75% of the top-ranked universities in Spain, positioning them among the 500 best worldwide according to the Shanghai Ranking.

TABLE 1. Shanghai ranking of academic subjects 2022. Electrical & electronic engineering. Spain [32].

Academic Subjects: Electrical & Electronic Engineering		
World Rank	**University of Spain**	**Q1***
76-100	University of Extremadura	20.6
101-150	Polytechnic University of Catalonia	42.4
101-150	**University of Seville**	**30.0**
151-200	University of Valencia	22.2
201-300	Carlos III University of Madrid	32.0
201-300	**University of Malaga**	**25.1**
301-400	University of Alcalá	21.4
301-400	**University of Granada**	**24.6**
301-400	University of the Basque Country	21.1
301-400	University of Vigo	23.5
301-400	University of Zaragoza	20.2
401-500	Autonomous University of Barcelona	22.6
401-500	Polytechnic University of Madrid	37.3
401-500	Polytechnic University of Valencia	33.5
401-500	Universitat Jaume I	12.8
401-500	University of Salamanca	17.0

In Table 2, which corresponds to the Shanghai Ranking of Computer Science Engineering in Spain, there are 14 universities ranked among the top 500 worldwide. Notably, four of these universities are located in the region of Andalusia, accounting for 28.57% of the highest-ranked universities in Spain.

Considering the above, it is crucial to highlight the essential subjects that contribute to a comprehensive education in Electrical Engineering, Electronics, Computer Science, and related fields. These subjects equip students with the necessary knowledge and curriculum to meet the demands of the industry and institutions in areas such as intelligent systems, Internet of Things (IoT), advanced engineering systems, artificial intelligence, embedded systems, and other relevant disciplines.

In Spain, the coordination of engineering degrees, contents, and subjects is governed by the Registry of Universities, Centers, and Degrees (RUCT). This registry provides essential information on universities, including the registration of new Bachelor's, Master's, and Doctorate degrees [33].

TABLE 2. Shanghai ranking of academic subjets 2022. Computer science & engineering. Spain [32].

Academic Subjects: Computer Science & Engineering		
World	University of Spain	Q1*
101-150	**University of Granada**	**51.3**
201-300	Polytechnic University of Catalonia	46.3
301-400	Polytechnic University of Madrid	44.2
301-400	Polytechnic University of Valencia	42.7
301-400	Pompeu Fabra University	28.1
301-400	**University of Jaen**	**26.6**
301-400	University of the Basque Country	34.6
401-500	Autonomous University of Barcelona	26.9
401-500	Carlos III University of Madrid	37.1
401-500	Universidad Publica de Navarra	22.0
401-500	**University of Malaga**	**33.6**
401-500	University of Salamanca	23.6
401-500	**University of Seville**	**35.0**
401-500	UOC Universitat Oberta de Catalunya	18.5

According to the aforementioned information, it is crucial to consider the essential subjects for comprehensive training in Electrical Engineering, Electronics, Computer Science, and related fields. This ensures that students acquire knowledge and a curriculum that aligns with the business and institutional requirements in areas such as intelligent systems, Internet of Things (IoT), advanced engineering systems, artificial intelligence, embedded systems, and other relevant disciplines. The coordination of engineering degrees, contents, and subjects in Spain is regulated by the Registry of Universities, Centers, and Degrees (RUCT), which provides vital information on universities, including the registration of new Bachelor's, Master's, and Doctorate degrees [33].

The Spanish Strategy for 2050, a report endorsed by the European Union, proposes significant reforms in the country's education system to leverage the benefits of digitalization and demographic changes. These reforms aim to transform the teaching profession, modernize the curriculum, establish an effective evaluation system, and more [34].

Based on the reviewed literature and the parameters outlined, this research will analyze and provide insights on nine universities in the region of Andalusia, Spain. The findings are summarized in Table 3. Andalusia, located in southern Europe on the Iberian Peninsula, borders the Atlantic Ocean and the Mediterranean Sea. It is the largest region in Spain, covering 87268 km2, with a population of over 8 million, of which 25% have higher education. Figure 3 illustrates the geographical location of Andalusia within Europe, while Figure 4 provides an overview of the Andalusia region within Spain.

The context of Andalusia can serve as a representative model for other Spanish or international territories, considering similar population, social, and economic characteristics. As depicted in Table 3, higher education studies in engineering in Andalusian universities encompass various degree programs, including single and double degrees. Some degrees

FIGURE 3. Situation of the region of andalusia in europe. UE 2023.

FIGURE 4. Andalusian provinces, spain. EU 2023.

are also offered internationally through collaborations with other European universities. This research focuses on analyzing degrees in the areas of Electrical and Electronic Engineering, Computer Engineering, Telecommunications Engineering, and Industrial Engineering.

These disciplines were selected based on analysis from multiple sources and technology strategy agencies such as Gartner and others, which will be examined in the following section [33]. These analyses identify the key strategic areas for the future, not only for enhancing university education but also for creating new professionalization channels and job opportunities centered around technology [36], [37].

III. ANALYSIS OF ENGINEERING DEGREES IN ANDALUSIAN UNIVERSITIES: ALIGNMENT WITH FUTURE TRENDS AND STRATEGIC IMPROVEMENTS

This section provides a comprehensive analysis of research conducted by Gartner and other sources, focusing on the future challenges in higher engineering professions. The research aims to enhance the labor market environment and lay the foundations for the development of smart territories, including Smart Cities, IoT, Artificial Intelligence, Embedded Systems, 5G Technology, and more [35].

The collected data offers a broad and strategic perspective that serves as a foundation for our proposed research. Firstly, we evaluate the various undergraduate engineering degrees offered in specific areas such as electricity, electronics, computer science, telecommunications, and related fields. This

TABLE 3. Undergraduate engineering studies in andalusian universities.

University		Engineering Degree	Number of subjects assessed	Total
Jaén (UJA)	1	Electrical	47	264
	2	Computer Science	46	
	3	Industrial Electronic	25	
	4	Telecommunication Technologies	25	
	5	Telematics	24	
	6	DD* Electrical and Mechanical	23	
	7	DD* Industrial Electronic & Mechanical	25	
	8	DD* Electrical & Industrial Electronics	21	
	9	DD* Telecommunication Technologies	28	
Cordoba (UCO)	10	Electrical	29	136
	11	Computer Science	43	
	12	Industrial Electronic	32	
	13	DD*Energy & Mineral Res. & Electrical	32	
Sevilla (US)	14	Electrical	27	480
	15	Computer Science	35	
	16	Computer Science-Software	29	
	17	Computer Science-Computer	28	
	18	Industrial Electronic	27	
	19	Aerospace	56	
	20	Industrial Technologies	121	
	21	Telecommunication Technologies	70	
	22	Energy	37	
	23	DD* Electronic, Robotic & Mechatronics	28	
	24	DD* Electrical & Industrial Electronics	22	
Huelva (UHU)	25	Electrical	21	180
	26	Computer Science	41	
	27	Industrial Electronic	23	
	28	Energy	22	
	29	DD* Electrical & Energy	36	
	30	DD* Industrial Electronic & Mechanical	37	
Cádiz (UCA)	31	Electrical	56	360
	32	Computer Science	46	
	33	Industrial Electroni	48	
	34	Aerospace	25	
	35	Industrial Technologies	58	
	36	Radioelectronic	16	
	37	DD* Electrical & Industrial Electronics	37	
	38	DD* Industrial Electronic & Mechanical	39	
	39	DD* Computer Science and Mathematics	35	
Málaga (UMA)	40	Electrical	28	546
	41	Health	38	
	42	Computer Science	48	
	43	Software	36	
	44	Computer	36	
	45	Industrial Electronic	25	
	46	Industrial Technologies	70	
	47	Telecommunication Systems	21	
	48	Electronic Systems	21	
	49	Sound and Image	22	
	50	Telecommunication Technologies	26	
	51	Telematics	21	
	52	DD* Electrical & Mechanical	36	
	53	DD* Electrical & Industrial Electronics	34	
	54	DD* Telecommunic.Tech.& Math.	24	
	55	DD* Computer Science and Mathematics	24	
Granada (UGR)	56	Computer	76	217
	57	Computer Engineering (Ceuta)	22	
	58	Industrial Electronic	28	
	59	Telecommunication Technologies	38	
	60	DD* Computer & Business	30	
	61	DD* Computer Eng. and Mathematics	23	
Almería (UAL)	62	Electrical	25	108
	63	Computer Science	35	
	64	Industrial Electronic	23	
	65	DD* Industrial Electronics & Industrial	25	
P. Olavide	66	Computer Eng. in Information Systems	18	18
* Double Degree (DD)		Subjects Evaluated	**2309**	

evaluation includes an analysis of the subjects and teaching guides implemented during the 22-23 academic year. Additionally, we align these degrees by conducting a textual analysis of their contents, drawing insights from forecasts and trend reports provided by international agencies like Gartner and others. This analysis enables us to develop a comprehensive work plan for improving and evolving engineering studies in Andalusian universities (Spain). Finally, we present a comparative analysis and provide recommendations based on the findings.

Our review also explores the studies and strategic trends that drive the improvement and adaptation of university degrees in Andalusian universities. By examining these trends, we aim to contribute to the enhancement of university degrees not only in Andalusia but also in other Spanish and European universities [33].

It is worth noting that university education undergoes minimal changes in terms of the teaching contents provided to students. While there are yearly revisions, extensive modifications are limited, mostly focusing on minor formal aspects. However, the continuous strategic and technological changes in the field necessitate effective improvements that have an urgent impact on territories.

Therefore, higher education in engineering, particularly in electrical, electronic, computer, and telecommunications fields, plays a vital role in meeting these challenges and driving progress.

We are witnessing significant changes in European territories, particularly in the community of Andalusia, which is the focus of our research. These changes include:

1) Demographic changes: The population pyramid poses a major challenge for some young universities, such as Jaén or Almería. These institutions must adapt, leverage their advantages, and reorganize their academic curriculum to seize opportunities for growth and innovation [38], [39].

2) Changes in workforce demands: The rapid growth of technology, AI, and intelligent systems in various industries and sectors is a paradigm that continues to expand. Engineering teaching guides need to be resilient and adaptable to these changes [40], [41].

3) Changes in the value and perception of degrees: Higher engineering studies hold significant value in the industrial and employment sectors. They are highly sought after and crucial. We must leverage this value within universities and engineering schools to promote the enhancement of content and its alignment with the evolving environment [41], [42].

4) Financial support in universities: It is imperative to explore funding options and strengthen existing sources through innovation and changes in engineering degrees, considering their content and strengths. Continuous adaptation, resilience, flexibility, improved quality, and providing students with a path to success are essential factors [43], [44].

Within Gartner's cycle of strategic reports on Higher Education, we have identified several reports that will serve as the foundation for our research. Specifically, we will focus on the field of intelligent systems engineering to highlight insights that can enhance engineering education in the analyzed universities and potentially align with other international institutions.

Gartner's report presents four plausible scenarios of educational trends for 2030, driven by two main axes. These quadrants revolve around Axis 1, which focuses on types of educational accreditation (Figure 6), and Axis 2, which emphasizes the role of AI (Figure 7). These driving axes have been adapted to the context of higher education in intelligent systems engineering.

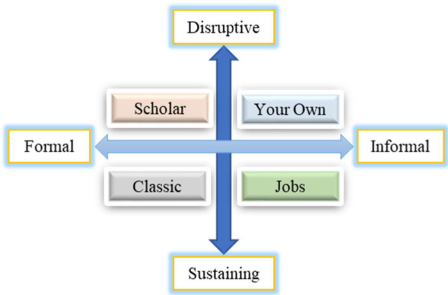

FIGURE 5. Plausible scenarios in higher education 2030. Gartner [35].

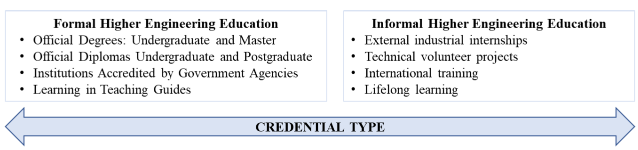

FIGURE 6. The driving force 1 of engineering education 2030.

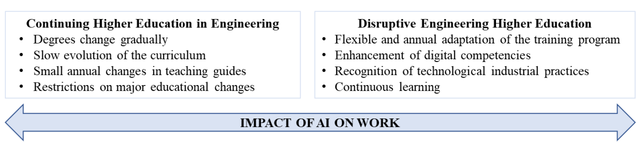

FIGURE 7. The driving force 2 of engineering education 2030.

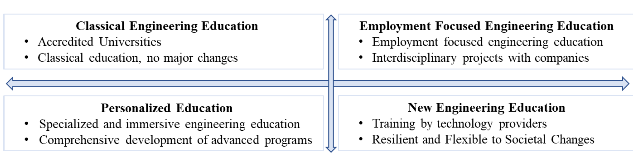

FIGURE 8. Plausible scenarios for higher education in engineering in 2030 [33].

Furthermore, the Gartner report presents four plausible scenarios for Higher Education in Engineering (Figure 5), each proposing training strategies that focus on different areas while maintaining interconnectedness. These four educational ecosystems, as suggested by the Gartner report, are specifically tailored to Higher Education in Engineering and are depicted in Figure 8.

In this analytical context, the subsequent section aims to examine the educational curriculum of universities in the region of Andalusia, Spain. The objective is to assess the alignment of engineering degrees in fields such as electricity, electronics, computer science, telecommunications, and other related areas with the projected scenarios outlined in the reports and analyses conducted by Gartner and other reviewed sources.

IV. TEXTUAL ANALYSIS OF ENGINEERING DEGREES: INCORPORATION OF INTELLIGENT SYSTEMS AND TECHNOLOGIES IN UNIVERSITIES STUDIOS

In the previous section, we conducted an evaluation of various reports and trend analyses that outline the desired state of higher education by 2030. Our focus was on four distinct areas or quadrants, which vary depending on the institution or university of choice. To validate these studies, we selected Andalusian universities and conducted a textual analysis to determine if undergraduate degree programs include training in IoT intelligent systems, Smart Grids, AI, and other related subjects.

Intelligent systems and innovative technologies aim to bring about social and economic innovation while improving environmental aspects and energy efficiency. These systems, including fields like electrical and electronic engineering, computer science, and telecommunications engineering, empower individuals and the environment, promoting a sustainable and dynamic lifestyle.

As engineering professionals, our goal is to incorporate smart systems and devices in a resilient and flexible manner, driving new paradigms in the 21st century [45].

The transformations brought by these technologies should yield industrial, academic, and social improvements, enhancing the quality of life and the environment in different regions. Engineering education in higher institutions is crucial in providing a promising future for our technologically advanced society [46], [47], [48].

Urgent transition and transformation in engineering educational systems is necessary to avoid falling behind in student training. With demands from companies, technology industries, and society at large for qualified personnel in innovative areas, it is essential to offer new educational techniques aligned with societal needs and sustainability [46], [47], [48], [49], [50], [51].

Table 4 displays the acronyms of the analyzed Andalusian universities along with their corresponding table numbers for data extraction. In each university, we conducted a search for texts, words, or phrases related to intelligent systems. These texts were analyzed in the teaching guides of the Engineering Schools' degree programs within the respective universities.

The selection of words and phrases was based on the previous analyses, including Gartner reports and other sources highlighting innovative technological subjects or disciplines essential to engineering studies (Table 5).

We presents an analysis of the texts and titles found in the academic programs of various fields such as electrical engineering, electronics, computer science, telecommunications, automation, and robotics (Table 3).

TABLE 4. Andalusian universities analyzed 2023.

University	Acronym	Number of degrees evaluated	Number of subjects evaluated	Table Nº
Jaén	UJA	9	264	Table VI
Córdoba	UCO	4	136	Table VII
Sevilla	US	11	480	Table VIII
Huelva	UHU	6	180	Table IX
Cádiz	UCA	9	360	Table X
Málaga	UMA	16	546	Table XI
Granada	UGR	6	217	Table XII
Almería	UAL	4	108	Table XIII
P. Olavide	UPO	1	18	Table XIV
Total		**66**	**2309**	

TABLE 5. Items in the textual analysis of subjects.

	Textual analysis	Reinforcement sources
1	Smart Grid/s	[52]
2	Smart City/ ies	[18]
3	Smart Systems	[53]
4	Intelligent Networks	[54]
5	Internet of Things (IoT)	[35]
6	Sensors	[55]
7	Energy Internet	[56]
8	5G	[41], [57]
9	Embedded System	[58]
10	Artificial Intelligence (AI)	[59]

These analyses provide a summary and snapshot of the modules that are considered crucial for the evolution and perspectives in the field of Intelligent Systems, IoT, sensors, and other investigated items [60].

Our evaluation primarily focused on the advanced courses, specifically the third, fourth, and fifth years, as these are where the specialized subjects of each discipline are distributed. After reviewing the data, a textual correspondence analysis will be conducted to provide a clearer graphical representation of the situation (Figure 8). The data obtained from each of the nine evaluated university institutions are presented in tabular format for better visualization and review of the quantitative data.

These tables also indicate the frequency of correspondence for the searched intelligent systems texts through data analysis in each of the subjects or teaching guides analyzed.

The data obtained from each of the nine evaluated universities are shown in tables to better see and review the quantitative data. These tables also indicate the frequency of correspondence for the searched keywords related to intelligent systems through data analysis in each of the analyzed syllabi.

Quantitative text analysis employs various extraction methods to provide statistical data and evaluate concepts, parameters, etc. [61]. In this case, we will use textual analysis to identify words, phrases, and texts present in the Teaching Guides of the evaluated degree subjects. The analysis will be based on structured data, specifically predefined words (Table 5).

As mentioned earlier, the research evaluated 66 academic degrees in the field of engineering at 9 Andalusian universities. A total of 2309 Teaching Guides were analyzed,

TABLE 6. Textual analysis of the syllabi of the evaluated degrees. University of jaén.

Engineering Degree	Keywords evaluated											
	Smart Grids	Smart City	Smart Systems	Intelligent Networks	IoT	Sensors	Energy Internet	5G	Embedded System	AI	Total	% Total
Electrical	6		1				2				**9**	**14.06**
Computer					6	5			1	6	**18**	**28.13**
Industrial Electronic		1			1	2	3				**7**	**10.94**
Telecommunication Technologies					1	1					**2**	**3.13**
Telematics					10	5					**15**	**23.44**
DD* in Electrical &Mechanical	4										**4**	**6.25**
DD* in Industrial Electronic & Mechanical						5					**5**	**7.81**
DD* in Electrical & Industrial Electronics	1					2					**3**	**4.69**
DD* in Telecommunication Technologies & Telematics			1								**1**	**1.56**
Total	**11**	**1**	**2**	**0**	**18**	**20**	**5**	**0**	**1**	**6**	**64**	
% Total	**17.19**	**1.56**	**3.13**	**0.0**	**28.13**	**31.25**	**7.81**	**0.0**	**1.56**	**9.38**		

* Double Degree (DD)

TABLE 7. Textual analysis of the syllabi of the evaluated degrees. university of córdoba.

Engineering Degree	Keywords evaluated											
	Smart Grids	Smart City	Smart Systems	Intelligent Networks	IoT	Sensors	Energy Internet	5G	Embedded System	AI	Total	% Total
Electrical						6					**6**	**22.23**
Computer Science			1			2			1	5	**9**	**33.33**
Industrial Electronic					1	7			4		**12**	**44.44**
DD* in Energy Mineral Resources & Electrical												
Total			**1**		**1**	**15**			**5**	**5**	**27**	
% Total	**0.0**	**0.0**	**3.70**	**0.0**	**3.70**	**55.56**	**0.0**	**0.0**	**18.52**	**18.52**		

* Double Degree (DD)

along with 10 items/texts and sentences in both Spanish and English, within the subjects under analysis.

Tables 15 and 16 provide a summary of the obtained data, which can be visualized in a network format to illustrate the relationships between the extracted data/items.

The evaluated words and texts from various titles and subjects are grouped and dispersed based on their frequency of occurrence. Different degrees, universities, and subjects/teaching guides are grouped together.

In Table 15, the different undergraduate and double degree programs are categorized into five major areas to provide an overview of the results:

1) Electrical and Electronic Engineering Area (EEE): Includes all degrees and double degrees in Electrical Engineering, Industrial Electronic Engineering, and combinations of both specialties.
2) Computer Engineering and Computer Science Area (CS): Encompasses all degrees and double degrees in

TABLE 8. **Textual analysis of the syllabi of the evaluated degrees. university of sevilla.**

Engineering Degree	Smart Grids	Smart City	Smart Systems	Intelligent Networks	IoT	Sensors	Energy Internet	5G	Embedded System	AI	Total	% Total
	Keywords evaluated											
Electrical											0	0.00
Computer Science						2					2	4.88
Computer Science-Software			1								1	2.44
Computer Science-Computer Technologies			1			1					2	4.88
Industrial Electronic						7					7	17.07
Aerospace						3					3	7.32
Industrial Technologies		1				4					5	12.19
Telecommunication Technologies		2				8					10	24.39
Energy[1]											0	0.00
DD* in Electronic, Robotics & Mechatronics[1]						6			2		8	19.51
DD* in Electrical & Industrial Electronics						3					3	7.32
DD* in Industrial Electronic & Mechanical											0	0.00
Total	0	3	2	0	0	34	0	0	2	0	41	
% Total	0.0	7.32	4.88	0.0	0.0	82.93	0.0	0.0	4.88	0.0		

* Double Degree (DD)

TABLE 9. **Textual analysis of the syllabi of the evaluated degrees. University of huelva.**

Engineering Degree	Smart Grids	Smart City	Smart Systems	Intelligent Networks	IoT	Sensors	Energy Internet	5G	Embedded System	AI	Total	% Total
	Keywords evaluated											
Electrical						1					1	1.35
Computer Science			1			6			3	1	11	14.86
Industrial Electronic						17	1		6		24	32.43
Energy	3					1			1		5	6.76
DD* in Electrical & Energy	3					2			1		6	8.11
DD* in Industrial Electronic & Mechanical						17	1		9		27	36.49
Total	6	0	1	0	0	44	2	0	20	1	74	
% Total	8.11	0.0	1.35	0.0	0.0	59.46	2.70	0.0	27.03	1.35		

* Double Degree (DD)

Computer Science, Computer Engineering, and Software Engineering.

3) Telecommunication and Telematics Engineering Area (TTE): Includes all degrees and double degrees in Telecommunications, Telematics, Radioelectronics, Sound and Image, and related areas.
4) Health Engineering (HE): Includes all degrees and double degrees in this field.

TABLE 10. **Textual analysis of the syllabi of the evaluated degrees. University of cádiz.**

Engineering Degree	Smart Grids	Smart City	Smart Systems	Intelligent Networks	IoT	Sensors	Energy Internet	5G	Embedded System	AI	Total	% Total
	Keywords evaluated											
Electrical	3					7			3		13	9.56
Computer Science			3		10	2			16	5	36	26.47
Industrial Electronic		3			1	12	2		7		25	18.38
Aerospace						8					8	5.88
Industrial Technologies						8	1		1		10	7.35
Radioelectronic						8					8	5.88
DD* in Electrical & Industrial Electronics	2	1			1	8	1		2		15	11.03
DD* in Industrial Electronic & Mechanical	2					2					4	2.94
DD* in Computer Science & Mathematics			3		1					13	17	12.51
Total	7	4	6	0	13	55	4	0	29	18	136	
% Total	5.15	2.94	4.41	0.0	9.56	40.44	2.94	0.0	21.32	13.24		

* Double Degree (DD)

TABLE 11. **Textual analysis of the syllabi of the evaluated degrees. University of málaga.**

Engineering Degree	Smart Grids	Smart City	Smart Systems	Intelligent Networks	IoT	Sensors	Energy Internet	5G	Embedded System	AI	Total	% Total
	Keywords evaluated											
Electrical						2					2	0.98
Health[1]						19				3	22	10.78
Computer Science	3					4		4			11	5.39
Software			2			5			14		21	10.29
Computer	3					3		4	1		11	5.39
Industrial Electronic						5			1		6	2.94
Industrial Technologies						38					38	18.63
Telecommunicat. Systems						1		1	1	1	4	1.96
Electronic Systems					3	13			18		34	16.67
Sound and Image						1		1		3	5	2.45
Telecommunicat. Technologies					1	2		3	16		22	10.78
Telematics					3	2			2		7	3.43
DD* in Electrical & Mechanical						1					1	0.49
DD* in Electrical & Industrial Electronics						3			1		4	1.96
DD* Telecommunicat. Technologies & Mathematics					1				14		15	7.35
DD* in Computer Science & Mathematics										1	1	0.49
Total	6	0	2	0	8	99	0	13	68	8	204	
% Total	2.94	0.0	0.98	0.0	3.92	48.53	0.0	6.37	33.33	3.92		

* Double Degree (DD)

5) Aerospace Engineering (AE): Includes degrees and double degrees in this area.

In Table 15, we observe that the field of Electrical and Electronic Engineering exhibits the highest overall correspondence, accounting for 50.66% of the analysis. It is followed by Computer Engineering and related areas with

TABLE 12. Textual analysis of the syllabi of the evaluated degrees. University of granada.

Engineering Degree	Keywords evaluated											
	Smart Grids	Smart City	Smart Systems	Intelligent Networks	IoT	Sensors	Energy Internet	5G	Embedded System	AI	Total	% Total
Computer			3		1	14			9	7	**34**	**32.08**
Computer (Ceuta)						2					**2**	**1.89**
Industrial Electronic	2	1	5		9	14	1		2	1	**35**	**33.02**
Telecommunication Technologies			1		4	12		1	3		**21**	**19.81**
DD* in Computer & Business Administration and Management						1				6	**7**	**6.60**
DD* in Computer & Mathematics						1				6	**7**	**6.60**
Total	**2**	**1**	**9**	**0**	**14**	**44**	**1**	**1**	**14**	**20**	**106**	
% Total	**1.89**	**0.94**	**8.49**	**0.0**	**13.21**	**41.51**	**0.94**	**0.94**	**13.21**	**18.87**		

* Double Degree (DD)

TABLE 13. Textual analysis of the syllabi of the evaluated degrees. University of almería.

Engineering Degree	Keywords evaluated											
	Smart Grids	Smart City	Smart Systems	Intelligent Networks	IoT	Sensors	Energy Internet	5G	Embedded System	AI	Total	% Total
Electrical	4		1		1	6					**12**	**41.38**
Computer Science					1					2	**3**	**10.34**
Industrial Electronic	1				2	4					**7**	**24.14**
DD* in Industrial Electronics & Industrial Automation	1				2	4					**7**	**24.14**
Total	**6**	**0**	**1**	**0**	**6**	**14**	**0**	**0**	**0**	**2**	**29**	
% Total	**20.69**	**0.0**	**3.45**	**0.0**	**20.69**	**48.27**	**0.0**	**0.0**	**0.0**	**6.90**		

* Double Degree (DD)

TABLE 14. Textual analysis of the syllabi of the evaluated degrees. University of pablo de olavide.

Engineering Degree	Keywords evaluated											
	Smart Grids	Smart City	Smart Systems	Intelligent Networks	IoT	Sensors	Energy Internet	5G	Embedded	AI	Total	% Total
Computer in Information Systems											**0**	**0.00**
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
% Total	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.00**	

28.34%, Telecommunications and Telematics Engineering with 16.15%, Health Engineering with 3.23%, and Aerospace Engineering with 1.62%. Figures 7 and 8 provide a clearer representation of these data.

Furthermore, Table 15 presents the values and percentages obtained in the textual analysis, revealing that the most frequent terms are Sensors (47.72%), Embedded Systems (20.41%), IoT (8.81%), AI (8.81%), Smart Grids (5.58%), Smart Systems (3.52%), 5G (2.06%), Energy Internet (1.76%), and Smart City (1.32%).

TABLE 15. Results by specialization areas.

Engineering Areas Evaluated	Smart Grids	Smart City	Smart Systems	Intelligent Networks	IoT	Sensors	Energy Internet	5G	Embedded System	AI	Total	% Total
Electrical & Electronic (EEE)	32	7	7	0	21	207	12	0	58	1	**345**	**50.66**
Computer Science (CS)	6	0	15	0	19	48	0	8	45	52	**193**	**28.34**
Telecommunication & Telematics (TTE)	0	2	2	0	20	40	0	6	36	4	**110**	**16.15**
Health Engineering (HE)						19				3	**22**	**3.23**
Aerospace Engineering (AE)						11					**11**	**1.62**
Total	**38**	**9**	**24**	**0**	**60**	**325**	**12**	**14**	**139**	**60**	**681**	
% Total	**5.58**	**1.32**	**3.52**	**0.0**	**8.81**	**47.72**	**1.76**	**2.06**	**20.41**	**8.81**		

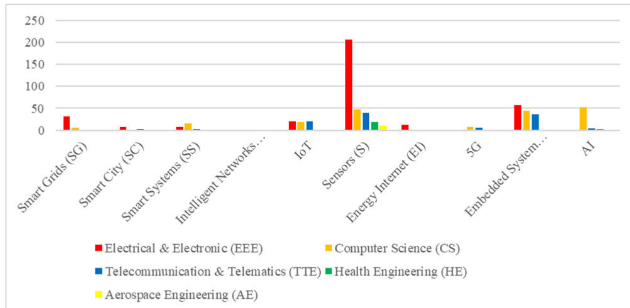

FIGURE 9. Comparison of engineering families and textual analysis.

Table 16 summarizes the data extracted from the textual analysis and compares them across different institutions and degree programs. Another analysis and comparison are conducted, this time focusing on institutions and the computed values from the textual analysis of intelligent systems. Figures 9 and 10 graphically depict the obtained data. It is worth noting that two universities stand out with higher percentages: Malaga, Cadiz, and Granada, followed by Seville, Jaen, Almeria, and Cordoba.

Table 16 shows a list of data that are subsequently summarized in Table 17. In addition, the figures and graphs 9, 10, 11 and 12 extracted from these data offer a clearer view of the percentages and ranking of each institution and each item evaluated.

It is clearly observed that the item Sensors is the word that appears most frequently in the subjects analyzed, with a large percentage over the others. The University of Malaga leads the ranking, but it should be noted that the number of subjects of this institution is higher than the rest.

V. DISCUSSION AND FUTURE TRENDS

The objective of this research was to evaluate the primary undergraduate degrees in technological areas at 9 Andalusian universities, comprising a total of 66 degrees and 2309 subjects/teaching guides. The focus of the evaluation was on conducting a textual analysis of 10 specific items/words

TABLE 16. Results obtained in the extraction of data in universities and degrees.

University	Engineering Degree	Smart Grids	Smart City	Smart Systems	Intelligent Networks	IoT	Sensors	Energy Internet	5G	Embedded System	AI	Total
Jaén (UJA)	Electrical	6		1				2				**9**
	Computer Science					6	5			1	6	**18**
	Industrial Electronic		1			1	2	3				**7**
	Telecommunication Technologies					1	1					**2**
	Telematics					10	5					**15**
	DD* Electrical and Mechanical	4										**4**
	DD* Industrial Electronic & Mechanical						5					**5**
	DD* Electrical & Industrial Electronics	1					2					**3**
	DD* Telecommunicat. Tech. & Telematic			1								**1**
Cordoba (UCO)	Electrical						6					**6**
	Computer Science			1			2			1	5	**9**
	Industrial Electronic					1	7			4		**12**
	DD* Energy, Mineral Resources & Electrical											**0**
Seville (US)	Electrical											**0**
	Computer Science						2					**2**
	Computer Science-Software			1								**1**
	Computer Science-Computer Technologies			1			1					**2**
	Industrial Electronic						7					**7**
	Aerospace						3					**3**
	Industrial Technologies		1				4					**5**
	Telecommunication Technologies		2				8					**10**
	Energy											**0**
	DD* Electronic, Robotics & Mechatronics						6			2		**8**
	DD* Electrical & Industrial Electronics						3					**3**
	Electrical											0
Huelva (UHU)	Computer Science						1					**1**
	Industrial Electronic			1			6			3	1	**11**
	Energy						17	1		6		**24**
	DD* Electrical & Energy	3					1			1		**5**
	DD* Industrial Electronic & Mechanical	3					2			1		**6**
	Electrical						17	1		9		**27**
Cádiz (UCA)	Computer Science	3					7			3		**13**
	Industrial Electroni			3		10	2			16	5	**36**
	Aerospace		3			1	12	2		7		**25**
	Industrial Technologies						8					**8**
	Radioelectronic						8	1		1		**10**
	DD* Electrical & Industrial Electronics						8					**8**
	DD* Industrial Electronic & Mechanical	2	1			1	8	1		2		**15**
	DD* Computer Science and Mathematics	2					2					**4**
	Electrical			3		1					13	**17**
Málaga (UMA)	Health						2					**2**
	Computer Science						19				3	**22**
	Software	3					4		4			**11**
	Computer			2			5			14		**21**
	Industrial Electronic	3					3		4	1		**11**
	Industrial Technologies						5			1		**6**
	Telecommunication Systems						38					**38**
	Electronic Systems						1		1	1	1	**4**
	Sound and Image					3	13			18		**34**
	Telecommunication Technologies						1		1		3	**5**
	Telematics					1	2		3	16		**22**
	DD* in Electrical & Mechanical					3	2			2		**7**
	DD* in Electrical & Industrial Electronics						1					**1**
	DD* Telecommunic. Technolog. & Mathem.						3			1		**4**
	DD* in Computer Science and Mathematics					1				14		**15**
	Computer Engineering										1	**1**
Granada (UGR)	Computer Engineering (Ceuta)			3		1	14			9	7	**34**
	Industrial Electronic						2					**2**
	Telecommunication Technologies	2	1	5		9	14	1		2	1	**35**
	DD*Computer Business Administration and Management			1		4	12		1	3		**21**
	DD* Computer Eng. and Mathematics						1				6	**7**
	Electrical						1				6	**7**
Almería (UAL)	Computer Science	4		1		1	6					**12**
	Industrial Electronic					1					2	**3**
	DD*Indust.Electronics & Indust.Automation	1				2	4					**7**
	Computer Eng. in Information Systems	1				2	4					**7**
UPO	Electrical											**0**
	Total	**38**	**9**	**24**	**0**	**60**	**325**	**12**	**14**	**139**	**60**	**681**
DD*: Double degree	**% Total**	**5.58**	**1.32**	**3.52**	**0,00**	**8.81**	**47.72**	**1.76**	**2.06**	**20.41**	**8.81**	

TABLE 17. DAta analysis by institutions.

University	Smart Grids	Smart City	Smart Systems	Intelligent Networks	IoT	Sensors	Energy Internet	5G	Embedded System	AI	Total	% Total
Jaén	11	1	2	0	18	20	5	0	1	6	**64**	**9,40**
Córdoba			1		1	15			5	5	**27**	**3,96**
Sevilla	0	3	2	0	0	34	0	0	2	0	**41**	**6,02**
Huelva	6		1			44	2		20	1	**74**	**10,87**
Cádiz	7	4	6		13	55	4		29	18	**136**	**19,97**
Málaga	6		2		8	99		13	68	8	**204**	**29,96**
Granada	2	1	9		14	44	1	1	14	20	**106**	**15,57**
Almería	6		1		6	14				2	**29**	**4,26**
P. Olavide											**0**	**0,00**
Total	**38**	**9**	**24**	**0**	**60**	**325**	**12**	**14**	**139**	**60**		
% Total	**5.58**	**1.32**	**3.52**	**0.0**	**8.81**	**47.72**	**1.76**	**2.06**	**20.41**	**8.81**		

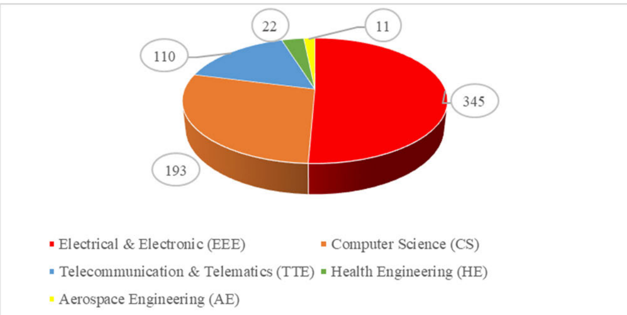

FIGURE 10. Data quantification in engineering families.

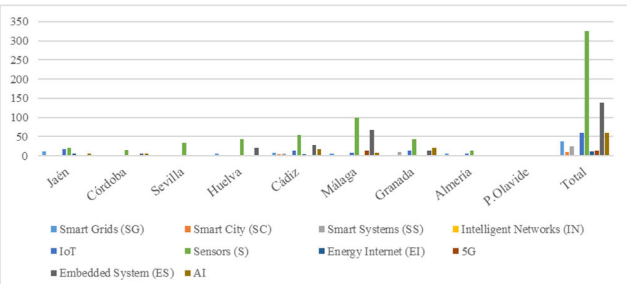

FIGURE 11. Data by universities and textual analysis.

related to intelligent systems. The purpose was to extract data regarding the presence and interest in content related to Smart Grids (SG), Smart City (SC), Smart Systems (SS), Intelligent Networks (IN), IoT Sensors (S), Energy Internet (EI), 5G, Embedded Systems (ES), and AI technologies. The selection of these textual items is based on the studies and analyses conducted in sections III and IV, which incorporate insights from Gartner reports on educational strategies for 2023 and beyond in the higher education sector. [35], [36].

Figures 9 and 10 depict the relationship and alignment percentages between the extracted data and the titles and subjects of the evaluated university institutions. Within each teaching program or subject, there are specific items, words, and texts related to intelligent systems, which provide us with a comprehensive understanding of the subjects being taught

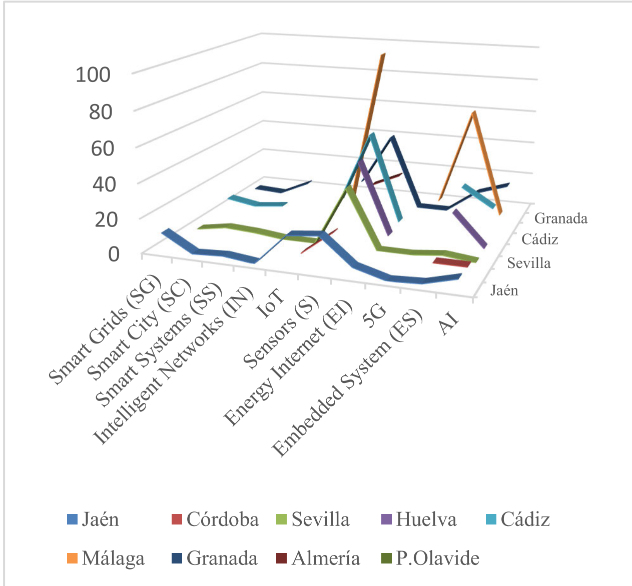

FIGURE 12. Graph of data Universities and texts.

and the knowledge acquired by the students regarding these topics. These figures serve to illustrate the overall representation of intelligent systems within the curriculum.

In our data search, we were unable to obtain a comprehensive and precise list of all the subjects taught. To achieve a more detailed analysis, including paragraphs and specific texts, a more complex search would be necessary. However, we conducted an analysis of 10 items or texts related to intelligent systems in 66 titles from 9 Spanish university institutions. Through this analysis, we were able to identify the main titles and subtitles of the contents taught, although not all the details of each subject. Therefore, it is important to note that we cannot analyze all the subjects in their entirety.

In the context of the Spanish university framework, particularly in the region of Andalusia which is the focus of our analysis, the contents of teaching guides are modified based on the European Higher Education Area (EHEA) and the Protocol for the evaluation of university degrees, in accordance with the updated regulations as of March 2022 [62]. It is worth mentioning that the process of modifying, adapting, or changing the contents of teaching guides to incorporate or enhance technological innovations involves a complex procedure, governed by legal and regulatory criteria that can sometimes be tedious and inflexible.

Despite this, we have overcome these limitations and offer resilient content that address the societal challenges and meet the needs of companies and the industrial environment, we will be able to establish more relevant and suitable educational criteria for training in intelligent systems.

University education in the fields of engineering and technology, focusing on areas such as electricity, electronics, computer science, and telecommunications, plays a crucial role in addressing advancements in intelligent systems, sensors, IoT, Smart Grids, and more. To ensure effective progress, it is essential to adapt the curricula in higher education to be more agile, flexible, and resilient, catering to industrial, social, economic, and other pertinent needs.

The research conducted in this study, which involved analyzing keywords, items, and concepts in undergraduate engineering subjects, provides an initial overview of how these degrees are structured, particularly in the field of intelligent systems. Engineering, in all its disciplines, holds immense importance in society. Gaining a quantitative understanding of the current state of the subjects taught in university programs is a valuable approach to comprehending how engineering specializations are organized within academic institutions.

It is crucial for universities, their spheres of influence, and the higher education landscape as a whole to prioritize top-notch education that aligns with societal requirements and the latest technological trends. Students must stay abreast of the most innovative areas. Engineering curricula, subjects, and teaching guides should incorporate topics such as Smart Grids, Smart City, Smart Systems, Intelligent Networks, IoT, sensors, Energy Internet, 5G/6G, Embedded Systems, and AI. It is imperative to establish a continuous and updated correspondence between industry, society, and the training content provided to engineering students in intelligent systems. This will enable them to contribute and collaborate effectively in shaping the future of progress and environmental transformation, encompassing economic, social, and business dimensions.

To enhance the training plans and contents in intelligent systems engineering, the following points are proposed:

1) Establish a collaborative team comprising faculty and university management that can swiftly and effectively implement content changes in response to technological, social, and business requirements on a quarterly basis.
2) Foster university-industry-society collaboration to address the demands of intelligent systems engineering and adapt the subjects to the needs of the student body.
3) Provide continuous training for teaching staff through engineering teams from the industrial and business sectors, fostering synergy between academia and the professional world.
4) Plan and resolve proposals, training initiatives, and outcomes within a maximum timeframe of 6 months, with at least 2 meetings per academic year.
5) Streamline administrative and regulatory processes that hinder efficient resolution of content solutions and curriculum adaptation, eliminating tedious protocols and complex administrative systems.

Furthermore, it is crucial to ensure continuous improvement and adaptation of intelligent systems terminology in the teaching guides of technological engineering degrees across all disciplines. This will facilitate the alignment of educational content with the latest advancements and industry practices.

VI. CONCLUSION

This research has focused on investigating both quantitative and qualitative parameters to gather information about the structure of subjects, teaching guides, and university degrees related to intelligent systems. A total of 2309 subjects from 66 official engineering degrees across 9 Andalusian universities were analyzed. The disciplines examined encompass various areas, including engineering, electrical engineering, electronics, computer science, industrial engineering, telecommunications, and related fields. The results of the analysis have revealed strong correspondence in terms of words such as Sensors, IoT, Embedded Systems, AI, Smart Grids, and Smart City. The field of Electrical Engineering, Electronics, and related disciplines exhibited the highest correlation, followed by Computer Engineering and related areas.

These findings will serve as a basis for strengthening and revising the content within the evaluated disciplines, specifically within the engineering subjects. The aim is to ensure that graduates possess essential specialization in the areas demanded by the industrial, business, and social sectors in this decade.

The research hypotheses and questions have been analyzed and answered. It has been identified that, based on the analysis of the 9 evaluated institutions and their teaching guides through textual analysis and indicators, there is still work to be done in terms of academic management. It is necessary to plan teaching and educational strategies that promote learning and content related to intelligent systems and applications. This is crucial to meet the demands of the engineering industry and business market that require this type of training.

Furthermore, the discussion and recommendations address the possibility of changes and improvements within the higher education system in the evaluated institutions. Proposed plans and developments have been outlined to achieve these improvements.

In terms of macro and micro changes in the educational system that can facilitate the implementation strategies of Smart Cities and Territories in a globalized world, based on the 2030/2050 Agenda and the Sustainable Development Goals (SDGs), proposals and developments have been put forward. These primarily focus on enhancing training in the field of intelligent systems, fostering multidisciplinary approaches within engineering branches in universities. The areas that require improvement and enhancement in terms of curriculum and subject content include training in Sensors, IoT, Smart Grids, Smart Cities, AI, and technological adaptation to address climate change across all engineering domains.

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