ESCALATE

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State of the Art Review (WP2)

Higher education institutions/Universities Responses to Digitalization (IO1)

Country Report

SPAIN

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List of Abbreviations

AI	Artificial intelligence
ESCALATE	Coordinated Higher Institutions Responses to Digitalization, Erasmus+ KA2 - Cooperation for innovation and the exchange of good practices, KA203 - Strategic Partnerships for higher education
EU	European Union
ICT	Information and Communication Technologies
IO	Intellectual Output
IT	Information Technology
INE	Instituto Nacional de Estadística (Spanish national institute of statistics)
IvieLab	Valencian Institute for Economic Research
MU	University of Mondragon
R&D	Research and Development
R&D&i	Research and Development and Innovation
RIS3	Research and Innovation Strategies for Smart Specialisation
STEAM	Science, Technology, Engineering, Arts and Mathematics
STEM	Science, Technology, Engineering and Mathematics
UAH	University of Alcala de Henares
UPV / EHU	University of the Basque Country
VET	Vocational Education and Training
WP	Work Package

1. Introduction

Spanish economy presents certain delay in its Digital Transformation when compared with its European peers, mainly due to the lack of a clear digital strategy, the digital talent gap, the operating complexity of companies, the limited investment in innovation and the sometimes-rigid regulation. (Digital Economic Opportunity in Spain 2017, Accenture)[1].

Analyzing all the digitalization indicators as a whole, according to Spain Digital Nation 2019[2], Spain is still located on the border between second-tier economies and the group of most advanced economies, although still far from most of the main digital European leaders and the main European countries, except Italy.

In the Digital Economy and Society Index (DESI) of 2019[3], Spain ranks 11th out of 28 EU Member States. Spain performs particularly well in connectivity, thanks to the wide availability of fast and ultrafast fixed and mobile broadband networks and to the increasing take-up. This connectivity places Spain in first place in Europe, in terms of fiber optic coverage and users.

With regard to human capital, Spain scores below the EU average. Around one fifth of people in Spain are not yet online and close to half of them still lack basic digital skills. Despite growing demand on the labour market, the supply of ICT specialists is still below the EU average. Spain is doing best in the area of digital public services, having implemented its e-government strategy in good time.

Regarding the digital transformation of the industry, according to the Digital Society in Spain report by Fundación Telefónica[4], Spain exceeds the European average, although it is far from being the leader. The challenge is for SMEs and the Self-Employed, who must undertake an effort to digitalize their organisations. Two out of three Spanish companies are lagging behind in this process. The digital reinvention of Spain could have an impact that could reach an annual value equivalent to 1.8% of GDP until 2025.

To achieve this digitalization, training in digital skills for Spaniards is presented as an opportunity. In our country, just over half of people between 16 and 74 years old have basic digital skills, meaning 3.5 points below the European average. The challenge is to achieve digital skills, with a humanistic vision and where people are protected with an ethical framework and a new social contract.

More and more Spaniards trust Internet (43%) and logically this trust has taken an accelerated leap following the crisis of COVID-19. Digital entertainment was in 2019 the main growth lever of

the internet, where it highlighted the business of the video game and the rise of subscribers to pay television. Both are a reflection of an increasingly digital Spanish society.

COVID-19 has indeed dramatically accelerated the digitalization process for organisations because it has impacted on the most important element: people. The acceleration of the digital culture is what has allowed organisations agility in incorporating technology, digitalizing processes and establishing a more horizontal, collaborative digital culture and using mobility and virtualization as a base.

Before the COVID-19 there were many people who were reluctant to technology, but after 60 days of confinement, Spain may have accelerated its digitalization process the equivalent of five years, according to the interviewed experts for the purpose of this report.

Precisely the digitalization of the industry - also of small and medium-sized companies and the self-employed - and digital training are presented as key factors to revive the economy and generate employment in Spain after the crisis caused by the coronavirus.

2. Methodology

In the preparation of the report, different research techniques were used in order to analyse the context of the Spanish Digitalization Strategy and the Universities' responses. Desk research was conducted during May and June 2020 using internet based searches that brought up statistics and reports by entities such as the European Commission and other Spanish public organisations. Thorough desk research has been carried out in order to check all possible and relevant channels for information on digitalization and universities' initiatives and plans to become more digital. The research was performed through Google on a number of different dates: 5 May, 7 May, 8 May, 13 May, 5 June, 6 June, and 16 June 2020.The main search terms used in Google were:

- Digitalización educación España
- Desi index Spain
- Plan digitalización España
- Agenda digital España
- Digitalización España
- Digitalización país vasco
- Estrategia digitalización España
- Transformación digital universidades
- Digitalización universidades
- Madurez digital universidades
- Plan transformación digital universidad
- Programa competencias digitales
- Digital skills Spain
- Efectos digitalización España
- Ministerio transformación digital
- Impacto digitalización España

- Educación digitalización empleo
- Estrategia capacitación digital
- Alfabetización digital
- Estrategia digitalización educación

The results of the Internet-based searches were diverse, but mainly included official websites of the Spanish Government and Public Associations, as well as some key publications by well-known organisations and authors. The relevant results were then analysed in detail and narrowed down to the sources mentioned at the end of this report. The outdated reports were discarded as well as the information that did not explain their methodologies or indicate the references used. As a result we relied heavily on results using reports by the European Commission and Government webpages as well as publications by consultancy firms such as Accenture or PwC and sector specific reports by Fundación Telefónica, CRUE, Orkestra, CEOE, and Adigital.

Qualitative research has also been carried out through 6 telephone interviews with three experts from higher education institutions, the Public Employment Service, one private IT company, and the Spanish Association of universities. The experts were selected according to their availability and relevance of their inputs to this report.

The following questions were used to guide each of the interviews:

- Problems associated with digital transformation, what barriers do you encounter at university? (leadership, resources, internal structure, analogue procedures, digital training ...)
- Impact of digitalization on teachers and students
- How are digital skills taught within traditional university education?
- Do you develop new courses on digital topics in anticipation of new skills needs?
- Do these courses train people in digital skills or "something else"? In which case, in what? Are they optional or compulsory courses?
- Do you develop new support materials / itineraries for students in anticipation of the new skills of the future?
- Political framework - does it help? Is it a barrier? How should it change to promote digital transformation in universities?
- What other elements would help in the digital transformation?
- Do you have any good practice at the university? (Innovative and open source solutions for teachers and students; New training opportunities derived from digitalization; Sector response to the labor market; Innovations in skills, policy design and governance of the education system; The ethics of digitalization; Digital transformation plan / strategy)

3. The potential impact of digitalization

Digital transformation is generating a fierce debate among education providers, policy-makers, economists and industry leaders about its societal impact. As digitalization disrupts society ever more profoundly, concern is growing about how it is affecting issues such as jobs, wages, inequality, health, resource efficiency and security. Current estimates of global job losses due to digitalization range as high as 2 billion by 2030 (World Economic Forum). There is currently great uncertainty, with concerns also about its impact on wages and working conditions.

Spain presents risks of profound transformation of its jobs that are higher than those of the more advanced countries as a whole, in a context of high unemployment, and it is necessary to adequately adjust the skills and knowledge of citizens and employees to try to avoid market polarization and the tensions between territories (Spain Digital Nation 2019, Adigital[5]).

We need to know how digitalization affects the future of work and, according to many of the studies carried out, the focus should not be so much on the destruction or replacement of employment, but on the fact that this process is altering as well existing tasks with new demands, new functions, which demand new skills to which we must respond. And also in the fact that, beyond the replacement of jobs or tasks, there is a wider division between work complemented by digitalization - much more qualified, more productive and with better wages - and other work not subject to digitalization- but which faces precarious conditions in its development. Therefore, the new situation could generate a greater labour and salary inequality that will affect people depending on whether or not they are qualified and adapted to the digital revolution.

This era of disruption radically impacts on people's lives, in the ways of working and producing, and in the displacement of some traditional business models to completely new ones. A digital transition entailing challenges and uncertainties, but also with very positive effects and, in turn, great opportunities. The current COVID-19 crisis has forced us overnight to rethink the way of living, studying, working and enjoying, and adequate infrastructures in Spain have made adaptation possible and have allowed many essential activities to continue.

3.1. Industry 4.0.

In Spain, the focus of digitalization has been closely linked to the so-called Industry 4.0 or "fourth industrial revolution". This has been understood as the application on an industrial scale of automated systems (such as robots) with the focus placed specially on production processes.

The productive sector now counts with companies and industrial plants whose main support is the information in large quantities from the objects connected to the networks, which is stored and analyzed in order to optimize processes, improve manufacturing times and minimize production costs. Industry 4.0 intensively combines the Internet of Things with artificial intelligence, big data, cloud and edge computing, in addition to other technologies, such as blockchain.

In a period of four years, according to the Digital Society in Spain report by Fundación Telefónica[6], Spanish industrial companies expect that, as a result of digitalization, they will increase their income by around 11% and reduce costs by almost a fifth. However, SMEs still have a long way to go digital. For example, although 23% of large and medium-sized companies make regular use of cloud computing, this figure falls to 9% in the case of micro-enterprises. The use of big data analysis in the productive sector is even more anecdotal: just over a tenth of SMEs and large companies, and a very small 2% of micro businesses with less than 10 employees, who represent around 95 % of the business fabric of our country.

In summary, it is estimated, according to a study by PwC (Industry 4.0 Global Digital Operations Study 2018)[7], that 2 out of 3 Spanish companies are lagging behind in the digitalization process, and only 20% of their income comes from digital products and services. Accelerating this digitalization for SMEs and the Self-Employed can contribute, after COVID-19, to making the economy rebound and contribute to creating employment in one of the hardest hit sectors, together with tourism and services. The digital reinvention of Spain could have an impact that could reach an annual value equivalent to 1.8% of GDP until 2025.

3.2. Digital skills

A high degree of skills mismatches in companies' workforces limit their capacity to innovate and capitalise from innovation. Increasing the number of Spanish ICT specialists, narrowing the gender gap and re-skilling the labour force are of great importance, if Spain is to tap into the full potential of the Digital Economy.

A key requirement to take advantage of the full potential of digital services and products is to have adequate digital training. Now more than ever, training in digital skills is presented as an opportunity in the aftermath of this COVID-19 crisis. As previously mentioned, the DESI indicator in the human capital dimension, reflects that Spain falls to position 17 in the ranking, 3.5 points less than the European average. It is a fact that in our country just over half of people between 16 and 74 years old have basic digital skills. The proportion of ICT specialists represents a lower percentage of the workforce compared to the EU average (2.9 % compared to 3.7 % in the EU).

ICT graduates in Spain account for 3.9 % of the total. Female ICT specialists account for a mere 1 % of total female employment. Despite these low levels, the trend seems positive and users with advanced digital capabilities would have gone from 32% of the population in 2017 to 36.1% in 2019. Users with basic digital capabilities also increased (from 28% to 32 %), mainly due to the incorporation of new internet users. (Digital Society in Spain, Fundación Telefónica[8]).

Lack of digital skills is one of the main causes limiting the use of different digital services. It is estimated that 14.5% of the Spanish population does not buy on the internet due to lack of skills or knowledge, nor does it make general use of electronic administration due to the same lack of skills or knowledge. In a society in which the digitalization of all daily activities grows unstoppably, the lack of digital training may become a factor of social exclusion, at the level of academic training itself. This situation is exacerbated if people's employability increasingly depends on their level of digital training. Promoting STEM and STEAM vocations is a complex and urgent task, since the latest available data from the Ministry of Education, Culture and Sports show that the number of students enrolled in technical careers such as Engineering and Architecture has decreased by 28% in the last years. (Digital Society in Spain, Fundación Telefónica[9]).

But in addition, this capacity building in digital skills should not only be technical, but should also be transferred to humanistic disciplines and foster a creative attitude. This integration of knowledge and skills will be essential to face the jobs of the future, according to the experts. It is the driver that integrates science and technology with the humanist vision, and that allows developing a truly comprehensive understanding of the world. The greatest guarantee for a future marked by automation and robotization is the development of what differentiates us from machines: creativity, critical thinking, social skills, emotional thinking, collaborative work and the ability to inspire. According to Burning Glass Technologies, while 42% of all jobs are at risk for automation, for hybrid jobs - those that require both types of skills - only 12% are. (Digital Society in Spain, Fundación Telefónica[10]).

Moreover, the postcovid professional must be able to adapt to rapid technological advances and have the necessary skills to accompany companies in their digital transformation processes in a globalized, technical and volatile scenario.

3.3. Artificial intelligence

Artificial Intelligence has become the most disruptive technology which will transform all sectors of society. Its applications range from online shopping to disease diagnosis and treatment services.

Undoubtedly, artificial intelligence is the digital technology that is going to impact most on the way in which citizens, companies, Public Administrations, non-governmental organisations, educational institutions and any other related entity. More and more tasks and functions are performed by machines. AI applications range from recommending online purchase of products and services to improving disease diagnosis and treatment.

There is no economic sector or social sphere that will escape the influence of AI. MMC Ventures has identified 1,600 startups directly related to AI in Europe, this is 12 times the figure in 2013. Predictions suggest that ten years from now, most companies will have incorporated intelligent systems into their business processes. This exponential growth carries with it a challenge: machines must work for the common good and we must ensure that they do not harm any group or person.

In February 2020, the European Commission published its White Paper on Artificial Intelligence stating that, given the great impact that this technology can have on our society and the need to build trust, it is vital that it be grounded with our fundamental values and rights, such as human dignity and the protection of privacy.

3.4. Connected world

We are in a digital society in which citizens have acquired new habits and have much higher expectations regarding the use and access to services at all times, from anywhere and in a simple, intuitive and personalized way. Higher education is not oblivious to this reality, and the so-called digital transformation has become a strategic priority for the vast majority of universities on the national and international scene. Moreover, students are digital natives who do not understand non-technology based services and demand instant solutions to their needs.

All aspects of our lives have a direct relationship with technology and networks: how we interact, work or have fun. If Artificial Intelligence was the most revolutionary digital technology, digital leisure was the leading sector in the growth of internet use, a sector that has probably increased during the confinement of COVID-19 along with teleworking or remote training, among others. In 2019, access to digital entertainment (music and multimedia) were at the forefront of activities carried out over the internet. Moreover, the near future brings us 5G technology with faster, much more secure, much simpler, lower latency and, of course, much smarter networks.

In a stage of crisis like that of COVID-19, the need for connectivity has multiplied exponentially. Hundreds of thousands of Spanish employees have maintained activity in their companies from their homes and thanks to this, there has not been a drop in productivity.

The health crisis caused by the coronavirus has forced Spain and much of the world to adapt to teleworking, an option that some companies in the country already offered but that have now become a reality where possible, including public institutions.

During the weeks of confinement due to the coronavirus crisis, teleworking became the only way to maintain the productive activities, a necessary option that has been novel for many workers in Spain. In fact, in 2019, only 4.8% of employed people used this formula, working from home normally or more than half of the days, while during the weeks of pandemic restrictions, the percentage has increased to 34% of the total, according to a study carried out by IvieLab, of the Valencian Institute for Economic Research, based on surveys and data from the INE.

3.5. Social inclusion

One of the challenges presented by this digital revolution is social inclusion, we must ensure that it is a digitalization for all, and that no one is left behind in this process of change or is directly or indirectly harmed by technology. The transformation process has a direct impact on the economy, on democracy and on the effective application of rights. For this reason, social and fiscal policies must also be adapted to the digital society to accompany people and mitigate the impact of automation on the labour market and on tax contributions.

The COVID-19 crisis will open new social gaps, the biggest challenge we must face is managing this digital transition successfully, without leaving anyone behind. The benefits of digitalization should not reach only a few, and we must ensure that everyone participates in a connected world.

Therefore, a new paradigm of policies and regulation based on accountability, transparency and self-regulation is needed, together with an approach more adapted to the digital environment of public policies and market supervision. Companies will have to adopt an ethical approach to the use of data and new technologies, such as artificial intelligence or algorithms, and take responsibility for the impact they have on society.

4. Current policy and educational/universities responses

Digitalization is transforming the skills needed by Europe's working population to successfully engage in the world of work in a globalized modern economy. In this context, higher education institutions play a key role in providing the digital skills required by the labour market in the globalized modern economy. Consequently, national education systems must swiftly and appropriately respond to the challenges digitalization poses.

4.1. Policy at National Level

4.1.1. Digitalization Strategy

The Government's strategy to develop the digital economy and society in our country is called the Spanish Digital Agenda[11] and it dates back to 2013. This strategy was configured as the umbrella for all the Government's actions in the field of Telecommunications and the Information Society. The Agenda was jointly led by the Ministry of Energy, Tourism and Digital Agenda and by the Ministry of Finance and Public Function.

The Agenda set the roadmap for Information and Communication Technologies (ICT) and Electronic Administration for meeting the objectives of the Digital Agenda for Europe in 2015 and 2020, and incorporated specific objectives for the development of the economy and the digital society in Spain.

Initially, the Digital Agenda for Spain contained 106 lines of action structured around six major objectives:

- Encourage the deployment of networks and services to guarantee digital connectivity.
- Develop the digital economy for the growth, competitiveness and internationalization of Spanish companies.
- Improve electronic administration and digital public services.
- Strengthen trust in the digital environment.
- Promote R&D&i in future industries.
- Promote digital inclusion and literacy and the training of new ICT professionals.

In January 2020, the Spanish Government reinforced the area of digital transformation with two new Secretaries of State under the Ministry of Economic Affairs and Digital Transformation[12]. The Secretary of State for Digitalization and Artificial Intelligence aims to promote the digital transformation of our society, in order to achieve a prosperous, safe, reliable, inclusive growth

that respects the rights of citizens. The Secretary of State for Telecommunications and Digital Infrastructures has the objective of promoting connectivity and the deployment of digital infrastructures to place Spain at the forefront of technological transformation.

The Government is currently working on the 'Spain Start-up Nation' strategy as an overarching strategy to embed innovation and digitalization in all aspects of the economy and society. This strategy will include the following elements: 1) a new plan for the deployment of digital infrastructure; 2) investment in enabling digital technologies; 3) programs to promote skills and talent, and 4) a national Artificial Intelligence strategy.

4.1.2. Connected Industry 4.0 Strategy

Aware of the importance and significance of digital transformation for the Spanish industry, since 2015, the General Secretariat for Industry and SMEs develops the content of its Connected Industry 4.0 Strategy[13] which responds to a triple objective:

- Increase industrial added value and qualified employment in the industrial sector.
- Favour the future industrial model for Spanish industry, in order to enhance the future industrial sectors of the Spanish economy and increase its growth potential, while developing the local offer of digital solutions.
- Develop differential competitive levers to favour the Spanish industry and boost its exports.

4.1.3. National Strategy for Artificial Intelligence

The Inter-Ministry Artificial Intelligence Working Group, coordinated by the Ministry of Science and Innovation, is actively working on the elaboration of the National Artificial Intelligence Strategy[14].

The National Artificial Intelligence Strategy aims to align national policies aimed at promoting the development and use of AI in Spain, increasing investment, reinforcing excellence in AI technologies and applications, and strengthening collaboration between the public sector and private, so that there is a significant impact on society and the Spanish economy.

This strategy aims to be a meeting point between the demands of all stakeholders, reconciling the concerns of the scientific community, industry, civil society and the most vulnerable communities, but above all it seeks to understand and prevent the implications of the rapid introduction of Artificial Intelligence in basic social areas.

4.1.4. Educational Strategy

The digitalization of the economy will not be possible without the digitalization of education, which not only has to be prepared to capture the changes in the labour market, but also to produce them.

The Spanish Government (through the Ministry of Employment) has set up a training plan in digital and technological skills. This plan focuses on 12 areas considered to be priorities in 23 sectors of the economy: 1) broadband communications; 2) cybersecurity; 3) management and maintenance of 3D printers; 4) artificial intelligence; 5) robotics; 6) drones; 7) automotive with electric motor or autonomous driving; 8) cloud computing; 9) Internet of things; 10) advanced analytics; 11) cognitive computing; and 12) location services.

The government announced in 2019 the implementation of a Digitalization Strategy in Education and VET[15] (Vocational Education and Training) which includes actions aimed at developing the digital competence of teachers, students and the educational centres.

The Plan will also provide a significant boost for training in science, mathematics, engineering and technology (STEM), and will also seek to emphasize the approach of women to STEM.

The Plan also includes 80 new VET offers associated with smart manufacturing, digital maintenance, Artificial Intelligence, Big Data, virtual reality, cloud computing, autonomous vehicles, drones, machine learning, 5G or video game design, among other subjects.

4.1.5. COVID-19 response

The COVID-19 health emergency has revealed that the Spanish educational system needs an impulse to deepen digitalization. The closure of educational centers to deal with the pandemic meant that many vulnerable students were unable to continue their learning process because they did not have the appropriate devices, connectivity or tools to do so.

The health emergency situation has not only affected students. During these months, the teaching staff has had to make an extraordinary effort to adapt to a distance learning scenario that they had no room to plan, and that requires specific skills and resources.

To respond to this reality, the Government launched in June 2020 the Educate in Digital Programme (Educa en Digital) [16] to promote the technological transformation of the Educational System in Spain. There are three major educational gaps that this programme aims to close: access to technology, quality of use of these tools, and training to develop and use them.

Educate in Digital is the first step to guarantee the correct protection of citizens in the digital sphere, helping to create a reliable environment that offers the same rights and responsibilities that operate in the physical sphere.

To address the teaching staff's needs, the Ministry of Education and Vocational Training, through the National Institute of Educational Technologies and Teacher Training (INTEF), has multiplied the supply of materials and tools for digital education, as well as that of teacher training courses for adapt teachers' skills to education in a digital environment.

4.2. Policy at Regional Level

The Basque Country is one of the 17 autonomous communities in Spain. If we take a look at this region, in 2019, it reached a DESI index of 63.61%, according to the "Digital Economy and Society in the Basque Country study" by Orkestra[17], which places it in fifth place in the ranking that groups the EU28 countries. In human capital, the Basque Country occupies a notable eighth position but that translates into disparate results regarding the type of skills analysed. Thus, in the field of skills that go beyond those of the Internet use, the Basque Country shows intermediate levels, while in the field of ICT skills there is some advantage.

The Digital Agenda for the Basque Country 2020[18] is the strategic plan that the Basque Government has designed for the proper promotion of the Information and Knowledge Society in the Basque Country and for which it has articulated a series of driving measures and support that were to be deployed during the 2016-2020 period.

The Basque Country also has a Research and Innovation Strategy for Smart Specialisation (RIS3)[19] in place which has identified Energy and Advanced Manufacturing as strategic areas. The three essential enabling technologies of the Basque RIS3 strategy are: biosciences, nanosciences and advanced manufacturing.

Advanced Manufacturing affects several production sectors in the Basque Country, it is key in the industrial tradition of the region and has significant technological capabilities linked to manufacturing. Progress in technologies such as nanotechnology, advanced manufacturing and ICT could be transferred to the most representative industrial sectors of the Basque economy: metals, machine tools, transportation, environment and advanced services, mainly.

The Strategy "Basque Industry 4.0"[20] is a move towards the incorporation of intelligent systems into production plants, the improved use of emerging capabilities and technologies in new products and processes, the integration of advanced materials into higher added-value solutions

and improved processes, and the efficiency and sustainability of resources and integration of high added-value services.

The Basque Digital Innovation Hub[21] is a connected network of advanced manufacturing assets and services Infrastructure for training, research, testing and validation available for companies.

The aim of this initiative is to provide industrial enterprises, especially SMEs, with the technological capabilities needed to meet the challenges of industry 4.0. The network will be used for the development of R&D projects, scaling of industrial projects, exhibition of cutting-edge technologies and also as a resource for training and acceleration of startups.

Regarding education, there is a University System Plan (2019-2022)[22] in place, which is the framework of reference for the development and transformation of the Basque society through higher education, excellence research and the transfer of knowledge. It is a plan that seeks to strengthen the Basque University System, through a university and research policy, relying on specialized strategies and plans that are developed based on five axes: excellence research, university-company relations, training and innovative methodologies, internationalization and the university community.

4.3. Educational/ university responses

Spain has a long history of university education, the university system dating back to the middle ages. Spain has both publicly and privately owned universities that are organized into schools that are separated into different departments, each of which offers the chance to enroll in a specific area of study (e.g. Business, Humanities, Engineering). The education system in Spain is regulated by the Ministry of Education and Spanish universities offer both official and non-official degrees. Since 2006, Spain has implemented structural changes in its university system in accord with the Bologna Process, which ensures comparability in standards with the European Higher Education Area.

There are some 1.5 million university students in Spain, a figure generally considered to be too high for a country with a population of 47 million. Currently, there are 76 universities of which 50 are public and 26 are private. They are distributed throughout the Spanish territory and the cities that concentrate the largest number of universities are Madrid, Barcelona and Valencia.

Higher education in Spain faces significant challenges according to the “Education and Training Monitor 2019 Spain”[23] by the European Commission. At 42.4%, Spain’s higher education attainment rate in 2018 is high, above the EU average of 40.7%. However, 21.5% of enrolled students drop out of university (12.1% of master’s students). Although employment rates of

recent graduates are improving (from 76.6% in 2017 to 77.9% in 2018) , they are still below the EU average (85.5%).

4.3.1. Current status of digitalization in universities

Digitalization is having a great impact on the way in which Spanish universities carry out their main functions: training, research and management.

Like most organisations, the Spanish higher education sector has been exploiting information technology in different ways for years. Although we have witnessed over the last few years a long list of interesting changes, such as the increased use of learning management systems, the increasingly widespread application of facilities and complex computer systems in many of the activities and disciplines of research activity, or the gradual incorporation of the electronic administration, the impact of information technologies, is still relatively limited. According to the interviewed experts, teaching and research activities often maintain their traditional approaches, even when using ICT tools.

An "Analysis of the use of ICT in Spanish Universities" developed by UNIVERSITIC (2017)[24], reveals that:

- 83% of classrooms in Spanish universities have multimedia projector and Internet connection
- On average, each university supports more than fifty thousand Wi-Fi connections daily
- More than half of universities have a dashboard extracted from the datawarehouse
- Spanish universities spend an average of 3.48% of their total budget on IT
- Half of the universities have defined a procedure to prioritize IT projects
- The main concern of universities at the moment is the security of information and a comprehensive approach to information security is necessary
- 78% of universities are immersed in the digital transformation of learning
- 46.67% of universities analyze and incorporate innovative IT (that is not yet widespread)

The COVID-19 crisis had caused a disruptive and acceleration effect on the digitalization process of universities. During the coronavirus crisis, the universities have shown that far from being immobile, they have been able to face the challenge of the pandemic and to maintain training activity, continuing to develop the students' academic skills and, also, values such as empathy, resilience and sacrifice and teamwork capacity. According to the interviewed experts, there has

not yet been a change in the educational model, but rather a better adaptation of methodologies to better use the functionalities of online teaching.

4.3.2. Provision of digital skills

According to the interviewed experts, if our graduates have to compete more and more in a globalized market, it is essential that they have knowledge and skills related to the impact of ICT in their area of knowledge. We can no longer rely on what is studied during the career will serve for the exercise of the profession throughout life. And although it is true that basic training will necessarily have to be given, it is increasingly important that graduates acquire two types of skills. On the one hand, transversal skills, and on the other hand, the ability to learn to learn, precisely to be able to operate in that rapidly changing world.

Indeed, if society and therefore the productive fabric and jobs of the future are going to be different, we must prepare students for it. This involves two things. On the one hand, the need to update the study plans to include ICT-related knowledge and skills in the corresponding field of study. On the other hand, given the exponential nature of knowledge, it will be necessary to assess to what extent the emphasis is placed on focusing on knowledge or the ability of students to be able to acquire new knowledge.

According to the experts, key skills for the future include the ability to carry out critical analysis, diffuse thinking, to work in changing and unpredictable environments ... That is, what a machine cannot do, at least not yet. And this type of training must be integrated throughout the educational field, but especially in universities, where we train for life and to function in this environment as citizens and especially as professionals. If the University does not adapt to this new environment by offering answers, the university will no longer fulfil an essential function. Each University must properly interpret the changes (challenges-opportunities but also threats) that it has to face in this new scenario, otherwise another will offer society what society needs.

The great challenge, in this sense, is to have the capacity to train our young people and provide them with skills so that they can adapt to changes with ease, assume and integrate them in their work, having technology in their favour and not against them.

If we want to have technology in our favour, experts say that we have to know what new technologies do and understand how they work. We have to rethink education and adapt it so that, regarding the area of knowledge in question, our students know how to handle the universe of data and have knowledge of how machines or artificial intelligence work.

The fate of the University is not only to train in technical capacities, but to teach how to learn; and it is not to train but to transform. The key is to train citizens who have the capacity to adapt to a constantly changing world, who know how to assimilate these changes, reinvent themselves in their professions, and this not only involves acquiring knowledge but also exercising the social and emotional skills necessary for them to be successful.

4.3.3. New market demands

According to the experts and to the report by CRUE, Digital Transformation at the University[25], there is a new generation of students, academics and managers with new expectations regarding the use of ICT. In addition, there are other external factors that drive change. Social pressure is one of them: the institutions and entities considered as advanced, and the universities must be included by their very nature in this group, today they are inexorably associated with the use of new technologies. Globalization is another one of these factors: the new communication technologies and the almost general availability of mobile devices with high capacities and functionalities allow teaching and research work to be carried out with less time and location dependencies. The visible signs of change in Spanish universities are more than evident. And most importantly, the willingness of university institutions not only to incorporate this new digital paradigm but to assume part of the social leadership in its widespread use is unquestionable.

In addition, based on the University of Murcia's Digital Strategy[26], the expansion of digitalized learning environments and micro-courses will continue, in response to the need for continuous updating and the acquisition of specific knowledge, through new methods and personalized teaching models. The accreditation of knowledge will tend to become more flexible and evolve towards the ecosystem of digital badges, due to its transparency, durability and applicability to recognitions of a different nature.

Finally, the generalization of automation, artificial intelligence and technology will boost high value-added jobs, eliminating those more linked to repetitive tasks. The collaboration and cooperation of small work teams, but with great flexibility, will be predominant in contexts where workloads and information exchange will be highly variable.

On the one hand, there will be a predominance of temporary jobs and self-employment, with a greater focus on individual responsibility, professional development and interdisciplinary knowledge. On the other hand, students will prioritize employability when selecting their studies, and the demand for the updating of skills of graduates will continue to grow exponentially, in a commitment to learning and the acquisition of skills throughout life. As a consequence, higher

education organisations will compete openly to attract the best students and maintain a relevant position.

4.3.4. Management

Regarding management, Spanish universities are increasingly turning to data collection and analysis as a key element in guiding their actions toward improving their results and efficiency. The experts indicate that some initiatives in this area have to do with the use of artificial intelligence and data analytics for the early detection of students at risk of dropping out, personalized recommendation systems for students on complementary courses to improve their skills, dashboards that allow the management of teams, projections of the evolution of the university in terms of the demand for degrees or tools that analyze the performance of students automatically both in the tasks performed and in their participation in class.

5. Critical points and Gaps in Policy Response

Within the European Union, the European Commission's Digital Economy Society Index for 2018 shows that EU countries face deep digital development gap and therefore „it should invest more in digital and also complete the Digital Single Market as soon as possible to boost Europe's digital performance". Even more, the same disparity is seen on digital skills, „while Nordic countries and the U.K. have populations with notably advanced digital skills, almost half of all Europeans still lack basic technical competences", according to the index.

5.1. Changing role of universities

Technological changes and the digital economy demand new job profiles that Spanish Universities are not always providing.

This great challenge is exacerbated by difficulties in innovating and adapting to changes with agility and in short time cycles. According to the interviewed experts, Spanish universities lack the speed that changes demand. By the time they agree on a change in a degree, send the change to the accreditation agencies, and verify the process, they may have to start all over again[27].

Furthermore, many technology companies (specially the largest ones) when recruiting, currently do not require a specific degree, but value the person's skills and capacities. The experts say, "So what is the point of having a degree? How must the role of universities evolve?"

According to the experts, teaching innovation is a reality in most Spanish universities, but it is voluntary. Many universities are already changing the teaching model and moving from a university where we teach to a university where we learn, which is not the same. We are starting to distinguish between a teaching course, traditional in universities, and a teaching that provides students with the ability to learn to learn and, especially, to learn to unlearn because, whether we want it or not, learning is a requirement that becomes permanent throughout our lives.

The Spanish education system, however, is still far from the lifelong learning model based on the concept of 'learning by doing'. In many universities, the educational models continue to use the same parameters as they did 40 years ago, when it is necessary to rethink an educational model where students can pause and redirect their itinerary over time.

In the competitive context of higher education, universities begin to strive to include innovation, identification and generation of new opportunities for value creation. For example, the certification model until a few years ago was not questioned, and today it is on the agenda of numerous institutions as a way to generate value for both its graduates and the business sector. This value proposition derives from the fact that currently university degrees are being questioned as the only tangible evidence of the higher education process, ideally its purpose is to report the value or level of skills that a person has acquired in order to enter the labour market. However, beyond trust issues, it is not clear how an employer can secure the skills that person has learned solely on the basis of a degree. For this reason, some universities are evolving towards models of digital badging, which can certify the skills and competencies learned and that place their graduates in a good position in the competition for job offers.

5.2. Lack of digital strategy

University leaders are beginning to understand the potential of information technologies to contribute to the transformation of the University, but it is essential to acknowledge that investments in technology, by themselves, are not enough to achieve the desired objectives and that there is an important background of cultural change, of organisational processes and resources that it is necessary to promote and lead in order to realize all that potential.

Today there are still many Spanish institutions that do not have a clear strategy regarding governance and the extraction of value from their data.

University leaders often expect the Information Technology (IT) area or department to provide added value, however, they do not provide them with sufficient resources (human and material) to tackle projects. They do not always understand what digital transformation means and, therefore, the cross-cutting role of IT within the university is key to facilitate the success of the transformation.

5.3. Poor digital skills

Do teachers have the necessary skills to lead this digitalization? Teachers and researchers at university often lack the required digital skills. The most technologically advanced departments are the ones leading the change but it usually depends on the efforts of individual figures, not on a university strategy. Many teachers often hold resistance to change and insecurity in their digital capacities.

The lack of digital skills is aggravated with age. The average age of the staff according to the European Commission's "Education and training Monitor in Spain"[28] in higher education, in 2017, 44% of teachers were over 50 and only 3.6% under 30. It is clear that over the next decade, a substantive renewal of the workforce will be needed.

In the IT department, the age is a handicap too when it comes to being updated in knowledge. The average age is over 45 years and since 2008 there has hardly been any generational change.

5.4. Resistance to change

Most organisations, including universities, face the challenge of managing change. It is human nature of people to try and keep their methods and customs constant. University staff generally finds it convenient to continue doing something as they have always been doing. They think changes will affect them negatively and therefore they resist.

As mentioned in the report "The digitalization of Spanish Society" by CEOE[29], Spanish Universities often base their systems and processes on historical solutions and that are sometimes difficult to adapt to the new digital environment. The fact that administrative services were designed, in

some cases, decades ago with non-optimized procedures, does not help in the transit to the digital university.

5.5. Low cooperation between academia and business

Academia and business cooperation remains weak in Spain. As mentioned in the Education and Training Monitor 2019 by the European Commission 2019[30], higher education institutions tend to cooperate with large and medium-size companies located in their region. Cooperation is particularly low in aspects such as curriculum co-design, co-delivery and student entrepreneurship. Business perceive a lack of business knowledge within universities, low public financial support, and the high level of bureaucracy in universities as barriers to cooperation. National and regional administrations are seeking to foster university-business cooperation.

Today there are many entities, companies and institutions that are part of an ecosystem and universities are making great efforts to find their place among this multitude of actors. For example, institutions appear that are partnering with companies to offer greater value to their students in certain niches, participating in platforms, universities that collaborate closely with each other in order to face threats that come from other sectors, etc.

Cooperation and collaboration become key elements of training processes in technological environments. Although the learning process continues to retain an important component of individuality, the real challenge lies in knowing how to create non-face-to-face collective spaces that allow groups of teachers and students to work together. We should make use of collaborative work tools to develop concepts such as learning networks or to tend towards what has been called distributed intelligence.

6. Good practice identified locally and nationally

6.1. Crue Spanish Universities

Crue Spanish Universities[31], established in 1994, is a non-profit association composed by the 76 Spanish universities: 50 public and 26 private. Crue represents universities in conversations with the central government and plays a key role in all the regulatory developments that affect higher education in Spain. Likewise, it promotes initiatives of different kinds in order to foster relations with the productive and social fabric, institutional relations, both national and international, and works to enhance the value of the Spanish University.

The Sectorial Commission for Information and Communication Technologies (ICT) of Crue was created in 2003 with the birth of a working group concerned about the role that these technologies were already playing in the universities. The objective of this ICT Commission is to advise Spanish Universities in the field of information and communication technologies to improve the quality, effectiveness and efficiency of Spanish universities. The ICT Commission studies the needs and applications of these technologies in management, teaching and research, proposing joint actions and projects and promoting cooperation between universities.

The ICT Commission is made up of Working Groups, one of them being FOLTE (OnLine Training and Educational Technologies Working Group), with three main objectives:

- Facilitate the sustainable development of ICT support services for teaching in Spanish universities, promoting interoperability, inter-institutional collaboration and the sharing of procedures and good practices.
- Understand the status of implementation of Teaching Support Technologies in Spanish universities, to maintain an updated information map of it.
- Evaluate the new emerging Educational Technologies and make open proposals for their application in educational environments, facilitating the transfer of the necessary knowledge to universities that allows the improvement of the quality of the Spanish educational system.

The working group is composed by 87 members from 51 universities, with a steering group of 12 members.

As a result of the need to provide momentum towards the digital transformation of the Spanish university system, the Crue-ICT 2020 Master Plan was born, which proposes 19 actions structured in 6 strategic axes that are intended to be developed in projects in the years 2019-2020. The plan

counts with contributions from all working groups and consensus among the members of the ICT Commission.

The first axis plans the need to update the reference models in IT governance and management, also providing the results of the continuous prospective in technology related to the sector and the possible adoption of international reference frameworks such as the "Enterprise Architecture". Given its current impact and its cross-cutting nature, an action aimed at improving university cybersecurity is also included in this area.

The following three axes refer to actions structured around teaching, research and university management. The ICT Commission considers that this plan will help to develop the teaching-learning process through the adoption of educational technologies, to adopt the Open Science paradigm and to fully deploy the concept of "electronic administration". Not being oblivious to the need to interact with external agents, the ICT Commission proposes the development of alliances with strategic, local and entrepreneurial entities.

The fifth axis raises the need to promote the so-called "data culture" in the university environment, identifying adoption models and advancing in the dimensions of interoperability and open access required in the current legal framework.

Crue's reports and publications around the use of ICT in universities and the Conferences organized by this association as well as the network of contacts that it provides, are all of great support for Spanish universities in their transformation processes, according to the interviewed experts. This highlights the need of organisations such as Crue, to give universities the opportunity to learn from each other through collaboration and exchange of good practices, facilitating the digitalization.

6.2. FutureLan

In order to make informed decisions, universities have to count on reliable labour market information and future projections. FutureLan[32] is a future- oriented labour market observatory promoted by Lanbide[33], Basque Employment Service, and developed by Prospektiker[34].

The observatory is a key instrument for obtaining early information on the demand of workers and the potential future mismatches regarding qualified staff in the labour market of the Basque Country, with a focus on occupations, economic sectors and qualification levels. It is a decision tool for workers, students, higher education institutions, training centers, families and policy makers.

The observatory is built based on an econometric model which takes into account the historic data about the evolution of employment by sectors and by occupations, the macroecomomic forecast of future evolution (based general macroeconomic environment), the different weight and behaviour of our sectors, occupations and university fields in the Basque territory and demographic conditions and activity rates of the Basque population. The econometric model has been developed by CEPREDE[35], a well-known Economic Prediction Center of the Autonomous University of Madrid.

FutureLan contains two types of information:

- Quantitative information with projections of the demand for employment by economic sectors, occupations and university fields, as well as projections of the supply of workers by occupation and university field, including the scenarios resulting from adjustment / mismatch between supply and demand.
- Qualitative information on occupational trends and demand of skills in the different occupations.

With regard to employment projections, the information covers two periods: from 2006 to 2019, with data from the labour Market Census on the real evolution of employment in the different economic sectors and occupations and from 2020 to 2030 with estimated data on the expected evolution of employment describing:

- The demand for expansion (or contraction) which is the demand coming from projections of economic growth and expected evolution of employment in sectors, occupations and university areas.
- The demand for replacement which is the demand coming from the needs of replacement because of the retirement of the people who currently work in the labour market of the region.

Net employment opportunities are the total employment opportunities resulting from the sum of the demand for expansion and the demand for replacement.

All these data can be visualized by sector, occupation and qualification level (university or VET area). There are 37 sectors, 62 occupations (at ISCO 2 digit level) and 21 university fields and in each one it is described the historic evolution (from 2006 until 2019) and the future evolution. Indeed, the system delivers data and projections around the offer and demand by qualification levels and breaks down the information in 21 university areas of knowledge: Teaching and education; Arts; Languages, literature and humanities; Social and behavioral sciences; Journalism; Business and administration; Law; Biology, biochemistry and the environment;

Chemical, physical, geological and mathematical sciences; Information and communication technologies (ICT), Mechanics, electronics and other technical training; Manufacturing industry and production; Construction; Agriculture, livestock, fishing and forestry; Health; Social services; Personal skills and services; Health and safety services; Security services; Transport services and General training.

All data is provided by gender and you can see the relation of a given occupation with the main sectors of employment and educational area.

The scenarios to 2030 are built based on the projected offer and demand, showing the gaps regarding shortages and surpluses of professionals for the next 10 years.

The website also includes qualitative information on trends that will affect occupations and their potential impact on future skills demand. By selecting the occupation of interest in the link "trends and skills" it is possible to access information on the following aspects:

- The future prospects foreseen in Europe for this occupation.
- The sectors that will be most affected by this evolution.
- Trends and changes in skills, distributed in organisational trends, technological trends and economic trends.

For the trend analysis, we used different sources such as information of a prospective nature collected from multiple sources and different agents: universities, companies, technological centers, sectoral specialists and also from the international institutions of work and education such as OECD and Cedefop or O*NET.

6.3. Kolaborategia

Kolaborategia[36] is a laboratory on education in the digital society created in the Faculty of Humanities and Education Sciences of the University of Mondragon (MU)[37] in the 2016-2017 academic year. It helps educational centers to take steps in their digital transformation, preparing society and students for the digital society of the future.

Kolaborategia means in Basque “collaboration” and “laboratory” and it is a space that brings together discussion, collaboration, master thesis, and all the work of the past years around digitalization. A lot had been done but it was not organized, and thanks to Kolaborategia and its multidisciplinary team of 12, they have been able to collect all the knowledge and to provide training to teachers and students and assist all faculties in the education processes.

They do research as well, on the role of digitalization in the transformation of education and society in general. Investigating and experimenting, creating the future and opening spaces to new opportunities, collaborating with the main actors of education and society. The objective is to investigate the changes that occur in the transformation of education and society in general, focusing on those changes from the research perspective. The laboratory of education and communication of the digital society is based on the identification of future trends, on the acceleration of novel processes (research), and on the joint work of international groups.

They have different projects in hand, for example the use of applications or the blue bots in early childhood education, the development of the digital portfolio from early childhood education to high school, the use of learning analytics to personalize the learning process, or the development of the robotics curriculum.

They identify 3 spheres of influence (university, school and society) and 3 opportunities for influence (radical advice and training, experimentation and research).

Kolaborategia's projects in the university include:

- ePortfolio: They create a portfolio of digital learning for 3 years where students have to acquire and demonstrate digital skills. They are testing its use in two ways, the first to analyze what value it has for professionalization and the second for the evaluation of students, that is, to know if the student has been evaluated based on their choices, and not only based on the activities proposed by the teaching staff
- DigCompEdu: An experience carried out in the Faculty of Humanities and Educational Sciences, to analyze how to work with our teachers of the future and what reflections should be promoted.

  As teaching processes adapt to the demands of the digital age, educators require an ever-expanding set of digital skills and strategies. The DigCompEdu framework aims to capture these specific digital skills for the educator. Kolaborategia first assesses the level of digitalization of the teacher, then they guide him/ her into the learning process, depending on their level. The process consists of 10 sessions.
- Online escape room: An online escape room for students, to analyze the study process of the students, to know their motivation to study, and to analyze whether an experience of this type motivates them to continue with deep learning.
- Learning Analytics: Create a personalized evaluation process for students. Define the indicators necessary to design a dashboard for students in online courses taking into account the perspective of teachers. The conclusions drawn from this study highlight the importance of training teachers and students in the pedagogical use of data visualization.

- Computational thinking & Scratch (allows the development of mental skills by learning programming without having deep knowledge of the code): How to do computational thinking and Scratch in students in early childhood and primary education.
- Analysis of the digital skills of the students of three Bachelor's degrees of the University of Mondragon: This research analyzes how students use ICT in the Bachelor's degrees of the Faculty of Humanities and Educational Sciences of the University of Mondragon. Information has been collected through a questionnaire and a focus group.

In addition to these types of projects, they organize conferences once a month with different experts in various topics related to education and technology, and for the transfer of this knowledge they create videos and leaflets. Every 15 days they create a newsletter that addresses different current issues such as digital education and technologies or women and technologies for example. They also hold webinars on all kinds of topics related to education, such as the use of mobile phones in pedagogy or rethinking education after the health crisis caused by COVID-19. On the other hand, they also carry out investigations such as the one started in September 2019 to investigate the relationship of teenagers with social networks and to propose appropriate actions.

Kolaborategia also analyses the current online training material in order to build specific training on how to improve these materials.

Kolaborategia covers as well the transfer of knowledge and it is addressed by:

- Internal training in digital topics within the University for teachers, students and other types of workers
- External training for other schools: they offer advice from the innovation center and they carry out joint projects that are enriching for both parties, since it is a learning opportunity for both. Besides, they do research and work with IT companies in developing different projects, right now one about algorithms to personalize the learning itinerary of students.

Among the training carried out by Kolaborategia aimed at teachers we find different video tutorials of between 30 and 60 minutes. Examples include: how to make video tutorials for their students, how to manage a platform (MOODLE), how to conduct online courses or various tools offered by Google, such as Meet, how to conduct live videoconferences with their students, etc. They also provide training for online evaluation.

6.4. eCampus

eCampus[38] is the department of the University of the Basque Country (UPV / EHU)[39] that is responsible for managing and developing all aspects related to online learning and teaching, both in regulated training and in continuous training. The department is composed by a staff of seven multidisciplinary workers.

The UPV / EHU educational model incorporates ICTs as a basic element for the teaching and learning process. The purpose of eCampus is therefore to respond to the needs emerging from the use of information and communication technologies in teaching and learning strategies.

The services offered by eCampus for official undergraduate and postgraduate teaching and long life learning include:

- Virtual classrooms
- Creation of Digital Content: eCampus offers support to teachers in the creation of digital content through free and paid software, which will help to generate educational content autonomously.
- Promotion of the use of eCampus resources to support non-classroom teaching
  - Assistance to teachers for the use of learning platforms to transfer knowledge from the UPV / EHU to society, through traditional online courses and massive and open online courses (MOOC)
  - Assistance to teachers for the use of all kinds of channels and audio-visual resources
- Promotion of the dissemination of free knowledge, through the open publication of university materials
  - Open Course Ware
  - Virtual Repositories for University Academic Content
- Creation of online courses:
  - Promote the adaptation to the online modality of the current training offer, promoting the implementation of innovative initiatives in the field of online teaching.
  - Support the design and implementation of complementary training programmes and continuous training, both blended and non-classroom.
  - Promote the visibility of the UPV / EHU as an online, national and international training agent, through the creation and delivery of open online courses.

In addition, eCampus offers multimedia recording services that allows its use by the different agents of the University in the dissemination of their activities.

On the other hand, eCampus in collaboration with other universities of the shared virtual campus offers training to teachers in topics related to new technologies. eCampus, in short, aims to always be attentive to the incorporation of new strategies and technological developments to offer them to the educational community.

7. Recommendations for action

7.1. Recommendations for Higher Education

The most important challenge in the digital transformation process of universities is the transformation of the organisation itself. In this sense, a profound change is required both in its leadership and in its culture.

The digital transformation strategy should be accompanied by a good design of the teaching and learning processes. To reformulate university training, so as to resolve the current gap between the demand from companies and the supply of professionals from the Spanish educational system, it is necessary to flexibilize and connect the system. This way, we would give a training response in an agile way to the needs identified by the productive sectors in the technological field.

The table below summarises the main recommendations provided by the interviewed experts:

Recommendation	Description
Digitalization Plan	The adoption of a Digitalization strategy is much more than the incorporation and regular use of the Internet and digital media. Digital transformation requires an institutional plan to face it, so universities must design, arrange, and execute a digitalization plan that will allow the organisation to evolve to the so-called digital transformation. This plan should be specific to each university, establishing a set of actions that will lead it, either to an evolved model of the current one, or to a totally disruptive model.
Re-design of the teaching and learning process	The "Digital transformation and global innovation in University 4.0" paper by Ana M. López[40] mentions the following initiatives: - Teaching platforms and educational technologies (virtual laboratories, simulators, artificial intelligence) - International exchange of teaching materials - Greater connectivity between subjects - Flexible curriculum and personalized training

Recommendation	Description
	- Lifelong learning training - Proactive learning methods: case and project based, flipped classroom, blended learning - More participatory evaluation procedures - Teaching with focus on skills and abilities for employability and not only for employment
Flexible education model	Ideas to flexibilize the University model as mentioned in the report "The digitalization of Spanish Society" by CEOE [41] include: - To bet on dual training in university training, taking as reference successful models in Europe such as the German one. - To carry out a follow-up, study and permanent analysis of the demand for professional qualifications and their evolution in the different productive sectors. - In order to provide an adequate response to the demands of the productive fabric, it is necessary to count with a more flexible and streamlined procedure of the Catalog of professional qualifications of the National Institute of Qualifications (INCUAL). - To prepare a catalogue of university degrees according to the needs of the Digital Society and to define the transversal (generic) skills in relation to the groups of professional profiles, both for undergraduate and master degrees, which concern the Digital Economy sector. - To increase collaboration agreements with companies.
Cooperation between academia and business	The 2019 European Semester country-specific recommendation to Spain[42] included the recommendation to "Increase cooperation between education and businesses with a view to improving the provision of labour market relevant skills and qualifications, in particular for information and communication technologies". Working groups could be established between university leaders and entities specialized in incorporating innovation into education, in order to agree on training objectives and content, regarding to both knowledge and skills. Moreover, when bringing universities and companies closer together, the training curriculum and teacher training evolve at the same speed as technology evolves. This would prevent the current gap from continuing to widen, given the rapid pace of technological evolution.
Training staff in digital skills	One of the priorities should be the training in digital skills of all the staff in university including the research and teaching staff, the administration staff and the management bodies. We must pay special attention to the training of the IT unit or service, which will be one of the fundamental actors. It is essential that teachers are trained in the use of new technologies applied to the classroom and education, knowing in-depth tools that allow managing the teaching-learning processes. Teachers should also be trained in new innovative teaching practices and ways to facilitate learning. And finally, the new technological disciplines (programming, robotics, etc.), awakening STEM vocations (Science, Technology, Engineering and Mathematics) bringing to the reality of the classroom the axiom: "learning by doing".

Recommendation	Description
Informed decision making	We need to go beyond the assessment of the past, it is necessary to train and empower our universities with predictive and prescriptive capabilities, and equip them with an advanced business analytics solution. According to the report by CRUE, Digital Transformation at the University[43], we must train the organisation to be able to know in real time what is happening, what will happen, and even what actions we must take to influence the direction in which the events must happen. This necessarily implies adopting a data governance model so that the university makes the decisions based on the analysis of the data. Data is a primary asset of the organisation, and must be properly standardized, classified, and protected.
Learning process monitoring	Having access to data about the learning process permanently will be the key to guarantee the correct development of the student's training process. This information will be extremely useful both for one and the other according to Mercè Gisbert as collected in her article "Digitalization of universities"[44]
Tools	Students want to learn differently, they consume information differently. There will be an impact on the training contents and the way in which they must be presented; we have to offer interactive content, made possible by the application of technology such as virtual reality or artificial intelligence. We must equip ourselves with the tools that allow us to collect and make the correlation of these interactions, not only of the information systems and / or own physical points, but also of the interactions of the students in external services or systems, such as social networks.
Financing	It is essential to allocate resources to cover the cost of new developments and the implementation of new IT infrastructures, as well as their financing during their entire life cycle. Therefore, rigorous strategies are needed to help develop financing models that are aligned with the achievement of the university's objectives and guarantee coherence and transparency.
Security Management and Risk Management	Privacy and legality issues such as security, privacy and fraud increasingly concern organisations. These and other risks need to be reasonably known, managed and mitigated. The University, which traditionally has moved in non-restrictive environments regarding the use of technological tools and resources, cannot be oblivious to these new circumstances. The fact that in the process of digital transformation the universities are going to collect an increasing volume of data, makes it necessary to create security plans and ethical and responsible use of data, guarantors of the use of this information and its exploitation oriented towards the development of personalized services that provide added value to users

7.2. Recommendations for Policy Makers

The system must respond to the challenges of digitalization from all areas, not only education and university. According to the interviewed experts, the authorities must also assume their role and not only support the digital transformation and the digitalization of the universities and reinforce the educational systems at previous levels, but also work to build new frameworks for relationships in a hybrid society (in constant interaction between the digital and real world), where technology is at the service of the majority, improving people's living standards, in a more fair and sustainable way.

Mercè Gisbert in her article "Digitalization of universities"[45] highlights that the involvement of all social, political and economic agents is absolutely necessary to achieve an educational system connected to the development of society and new models of learning and knowledge transfer.

Experts agree that there should be a dialogue between the private sector and the Public Administrations, together with other social and academic agents, to analyse and overcome the concerns that have arisen in recent years regarding the creation / destruction of employment, and the need for labour with new skills adapted to digitalization.

Finally, policy makers could establish a specific observatory of digital employment, due to its peculiarity and its importance, transversal to all the productive sectors.

8. Expert Interviews

Name of organisation	Type of organisation	Expert's position	Interview date	Mode of interview (telephone, mail, etc.)
Mondragon University	Higher education institution	Teacher and researcher at Mondragon University and Director of Kolaborategia	14/05/2020	Telephone
University of the Basque Country	Higher education institution	Director of eCampus	21/05/2020	Telephone
University of Alcalá de Henares	Higher education institution	Vice-Rector for Strategy and Planning	29/05/2020	Telephone
Lanbide	Public employment service	Director of the labour market observatory	15/06/2020	Telephone
LKS NEXT	IT Company	Director of IT Strategy	23/06/2020	Telephone
CRUE	Association of Universities	Executive secretary	25/06/2020	e-mail

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