

# STUDENT'S DIGITAL TRANSFORMATION DURING HIGHER EDUCATION: ENTRANCE AND EXIT DIGITAL PROFILE

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## Abstract

Digital technology has entered almost all areas of our daily lives to the point that we call our own society the Digital one. In the last 2 years with the impact of the COVID-19 pandemic, that has forced most of us to work from our homes, connecting online, this aspect of growing more digital has accelerated. This transition to remote work reminded us, once more, of the need to empower students with the required digital skills, or e-skills, to enter the labour market that “demands highly skilled people” [1], to perform lifelong learning, and to help answering the call of the European Commission's Digital Compass targets of developing digital competences until 2030. This paper is the first part of an ongoing research that aims to understand the Higher Education (HE) Students' Digital Profile when they enter HE, and then assess if their existing digital profile is correspondent to the labour market's ideal profile when they finish their studies. This research also and foremost aims to design a research model for Student's Digital Profile, providing us with the opportunity to assess this on a yearly basis, to the students that enter HE and the ones that are finishing their studies, helping Higher Education Institutions perceive if their studies' syllabus are adequate to empower students with the needed workforce digital competences each specific field of expertise requires. As this study is correspondent to the first part of this research, this paper will focus on the literature review and research methodology that will lead us to our first results.

Keywords: HE student Digital Profile, Higher Education, Digital Profile, e-skills, Digital Competencies, Digital skills.

## 1 INTRODUCTION

Research about students' digital competence is not new, trying to perceive if in fact the fact of being digital natives, as defined by Prensky [2], [3] has an impact on them being digital competent. However, various papers conclude that in fact this is not the case. This allows room for the distinction of being digital native and digital competent, as they are different things. Being born surrounded by digital technology does not automatically empower people with the competencies and skills required to master the more technical and complex digital tasks, such as computational thought and programming [4].

The use of digital tools is rooted in our society, however, it is mostly used to facilitate daily tasks, informal communication and leisure activity, as recent studies found [4] that students do have digital competencies but at a basic level. And even if this perception has only gained more definition in recent years, the goal is to empower students, and by extension all citizens to master higher level computational skills.

Bearing this in mind, and going further back, in 2013 The European Union published the Digital Competence Framework for Citizens (DigComp 2.0) as a reference model [1], aiming to help improve European Union Citizens' digital skills. Later, in 2017 the European Commission called on Member States, at the Gothenburg Summit, and together EU leaders outlined a vision for education and culture, encouraging EU Higher Education institutions to combine studies, among bottom-up networks of Universities, aiming to contribute to the international competitiveness of European Universities, by 2025.

Table 1. DigComp 2.0 Competence areas and competences

Competence area	Competences
1. Information and data literacy	1.1 Browsing, searching and filtering data, information and digital content 1.2 Evaluating data, information and digital content 1.3 Managing data, information and digital content
2. Communication and collaboration	2.1 Interacting through digital technologies 2.2 Sharing through digital technologies 2.3 Engaging in citizenship through digital technologies 2.4 Collaborating through digital technologies 2.5 Netiquette 2.6 Managing digital identity
3. Digital content creation	3.1 Developing digital content 3.2 Integrating and re-elaborating digital content 3.3 Copyright and licenses 3.4 Programming
4. Safety	4.1 Protecting devices 4.2 Protecting personal data and privacy 4.3 Protecting health and well-being 4.4 Protecting the environment
5. Problem solving	5.1 Solving technical problems 5.2 Identifying needs and technological responses 5.3 Creatively using digital technologies 5.4 Identifying digital competence gaps

A year later, in 2018, the European Commission published the European Skills Agenda for sustainable competitiveness, social fairness and resilience [5], considering that the addressed skills are Europe's key for success on the Green Deal, the new Digital Strategy and new Industrial and SME Strategies. Hence, the European Commission finds that digital skills will be essential to Europe's labour market, for our roles as involved citizens, having also a great impact in the success of reaching European countries green policies goals, of reducing greenhouse gas emission by 55% until 2030. As such, this specific commission's document defines the 3 key goals as necessary to reach a sustainable competitiveness as being: a) implement the Pact form Skills to businesses and social partners; b) develop Skills for jobs through a dynamic education and training provision to answer the market and societal needs; c) Empower People to acquire and improve their skills by developing innovative tools, creating new learning pathways.

Last year, in 2021, the European Council presented its goal to create an European Education Area and European Research Area, to help promote excellence in European HEI, inspiring the transformation of HE while promoting gender equality, inclusiveness and equity through an ambitious transnational cooperation between 280 HE Institutions in Europe [6], [7]. The purpose presented for this initiative is answering the previous "demand for highly skilled people" proposed by the European Commission in 2016 (DigiComp 2.2). According to the last press release by this same commission, the COVID-19 pandemic has accelerated HEI's digital transformation, but however, it needs deep technological and structural changes in order to be able to respond to Europe's big societal challenges for the development of cities and regions by the end of 2030.

All of these initiatives are therefore part of a European drive to improve people's digital competencies until 2030, empowering people with skills to work with cutting-edge technologies, setting more regulation on the use of digital data by companies and implementing the use of digital tools to improve democracy.

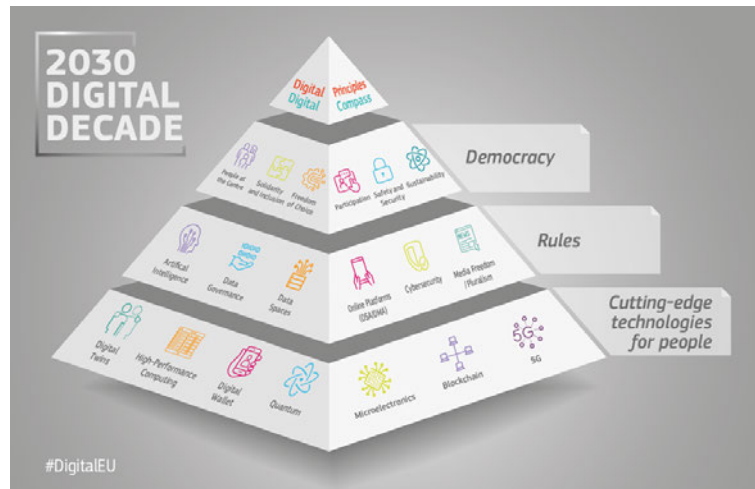


Figure 1. Digital Principles of the Digital Compass [8]

The Commission’s Staff working document to establish the 2030 Policy Programme defined as “Path to the Digital Decade” [9] proposes a set of goals to be reached over the next decade, i.e.:

- 1 “A digitally skilled population and highly skilled digital professionals;
- 2 Secure and sustainable digital infrastructures;
- 3 Digital transformation of businesses;
- 4 Digitalisation of public services.

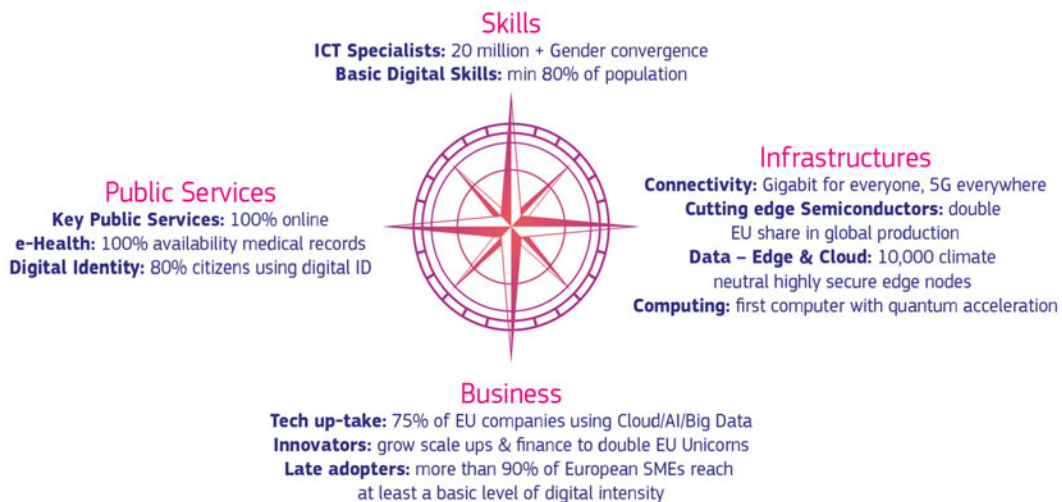


Figure 2. Digital Compass [8]

To ensure these goals are met, the progress is monitored yearly based on the Digital Economy and Society Index (DESI) that measures a country’s Human capital, Connectivity, Integration of Digital Technology and Digital public services. The Portuguese DESI report in 2021 places our country in 16<sup>th</sup> of the 27 EU Member States [10].

HEIs have a role in setting the rank of the Human Capital dimension, as this dimension measures the level of basic digital skills. In Portugal there is work to be done, as even though we have come a long way, we are still under EU average.

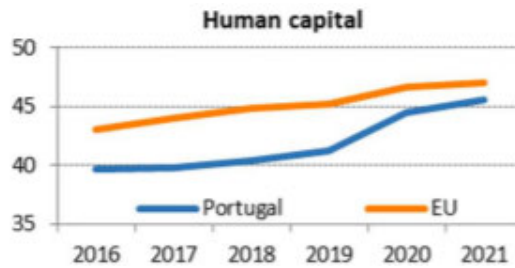


Figure 3. Human capital DESI indicator for Portugal in 2021 [10]

The latest 2021 Portuguese DESI report states that our country’s initiatives to improve this indicator includes the “digital literacy of schools, by increasing the digital literacy of 1,000 students in the third and secondary study cycles.” [10].

Having all this information in mind and trusting that basic ICT skills are offered as part of the secondary study cycles, HEIs study programs have focused on higher level digital and ICT skills. However, ITC subject is taught during basic school, and no evaluation is made of students’ ICT level when entering HE institutions, or even as they complete their studies. Not to mention that from 5th grade to 12th, seven years have passed, and part of the acquired knowledge may have been lost or most probably outdated by the time they enter HE. Aiming to ensure that their level of ICT and Digital skills are met to ensure their professional profile is as solid as possible according to the labour market needs, there is the need to verify what competencies they possess when they start college and when they exit.

As such, this study aims to understand HEI students’ ICT and Digital skills, when they enter and when they leave HEI, enabling us to portrait their transformation and growth, as well as their exit profile, and the verification that our students enter the labour market with all the skills needed.

## 2 LITERATURE REVIEW

### 2.1 Students’ profile at the end of basic education

In the 2017 the education department of the Portuguese Republic defined and published a referential to set a common matrix to all schools of basic learnings that students have to acquire when they reach the 9th grade. Based on Edgar Morin seven pillars [11] this document was created considering that citizens must aim autonomy and responsibility, error and illusion prevention, being able to read the context and set of a given situation, recognition of the link between diversity and the human condition, considering humanity as a community with a destiny, the capacity to accept the unexpected and the uncertainty as a mark of nowadays, to view education as the path to mutual comprehension among people of different cultures and backgrounds and being able to develop a human based ethics that follows the principles of an inclusive citizenship. As such the Portuguese Student’s profile document aims to “mobilise school and society for a better education” [12], and it proposes to do so with a conceptual framework (figure 4) based on OCDE 2016 Education and skills framework document that establishes that by 2030 the students’ profile has to be based on 3 dimensions: Knowledge, Competencies, and Attitudes.

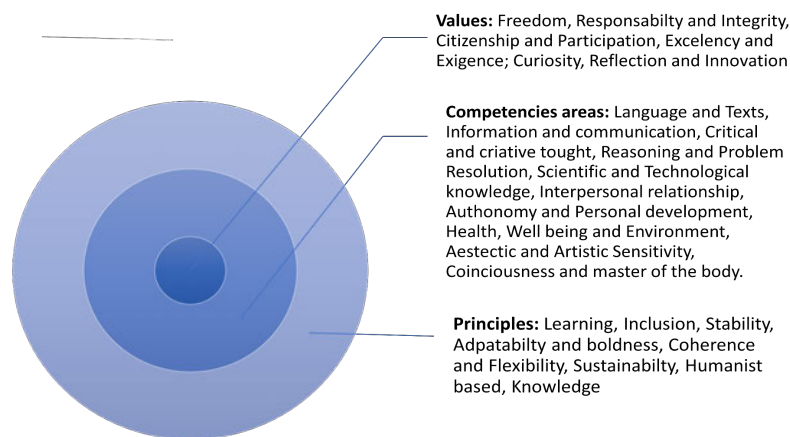


Figure 4. Conceptual framework of the students’ profile at the end of basic school

As such, ICT and Digital skills are then viewed as essential to be able to develop competencies in the areas of Language, Texts, Information, Communication, Critical and Creative Thought, Reasoning, Problem Resolution, Scientific and Technological knowledge. Being also helpful to work on all stated competencies areas.

## **2.2 ICT skills offered in the basic study cycles**

To understand what ICT skills are, it is essential to first define skills. According to the Merriam-Webster [13] a skill is the “ability to do something that comes from training, experience, or practice; the ability to use one’s knowledge effectively and readily in execution or performance; a learned power of doing something competently; a developed aptitude or ability”. The Cambridge Dictionary [14] defines skill as the “ability to do an activity or job well, especially because you have practised it; a particular ability that you develop through training and experience and that is useful in a job”. As for the Collins Dictionary [15] a skill is “a type of work or activity which requires special training and knowledge; the knowledge and ability that enables you to do something well.”

A skill is therefore perceived as the ability to do something well, and this ability must be acquired through training, experience and practice. It is something developed and learned.

In Portugal, since 2018, the Information and Communication Technologies (ICTs) subject is considered to the part of the Essential Learnings [16], to be taught during all basic school, from 1st to 9th grade and, according to the Essential Learning Framework document, 4 main skills are addressed:

- 1 Security, Responsibility and Respect in digital environments;
- 2 Investigate and Research;
- 3 Collaborate and Communicate;
- 4 Create and Innovate.

The pedagogic activities, level of difficulty and topics approach varies according to the several ministry official documents and legislation[16]–[22].

According to these established documentation by the end of 9th grade a student must be able to:

- 1 Have consciousness of the ICT and emerging technologies’ impact on society and daily activities, comprehend the need to use digital tools and internet safely, the need to adopt the rules of ergonomics to digital devices usage as well as the use of rules of creative commons and copyrights.
- 2 Have knowledge of how to plan and do research online, formulation the right questions to gather the needed information as well as to define the right keywords, the right tools, and platforms.
- 3 Mobilise the right strategies and tools for online communication and collaboration.
- 4 Know the digital tools and strategies to support creativity and computational thought, producing creative digital artefacts, as well as comprehend the concept of algorithm analysing them and elaborating them to find solutions to problems, using programming concepts to mobile devices, produce, test and validate application for mobile devices.

## **2.3 Digital competences required at the end of University studies**

Being digital competent implies the mastering of a set of skills, knowledge and attitudes that empowers the person with confidence, creativity, and critical capability to use technologies and systems, capacitating the person to become a confident digital citizen, with the capability to interact and collaborate digitally, produce digital artefacts, with confidence enough to handle data and computational thinking.

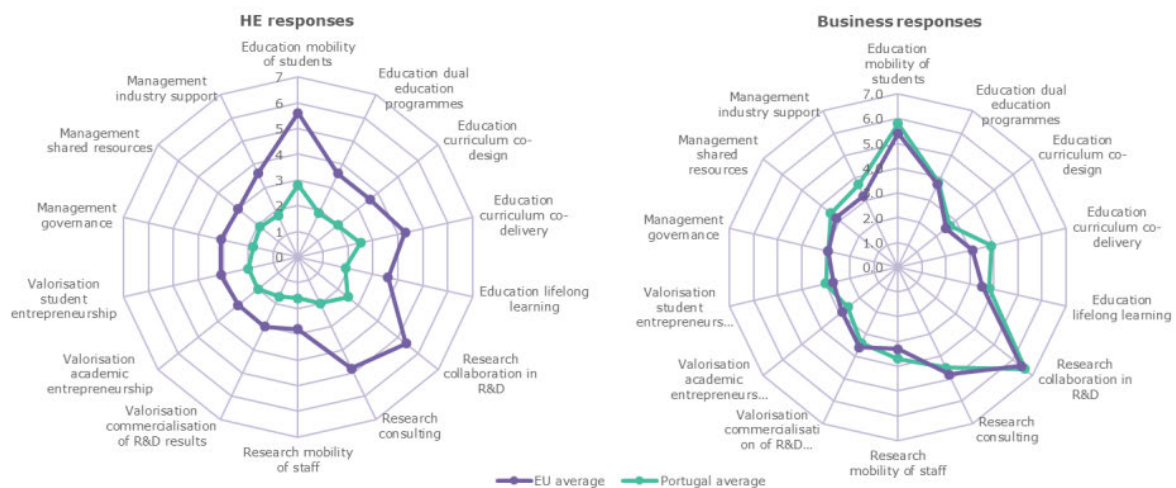
As such, even if basic and secondary education work to develop such said skills in students, HE has a crucial role in the acquisition of the specific abilities that students will have to master as future professionals in their fields of study. For authors such as Eisenderg [4], the integration of complex higher computation thinking or even complex fields specific digital abilities should be more developed in HE.

According to the Education and Training Monitor Portuguese report of 2019, by the European Commission [23], Portuguese tertiary education attainment is still very much under the European average despite a considerable increase. In 2009 the European average of tertiary educational attainment was 33.1% for native-born and 27.7% for foreign-born students. The Portuguese average for this same year was 21% for native-born and 22.6% for foreign-born students. By 2018 the numbers have risen in Europe, with 41,3% native-born students with tertiary educational attainment, and 37,8% for foreign-born students. In Portugal

the numbers have also risen, but only to the European levels of 2009, with 33,1% of native born students attaining tertiary education, and 36,8% for foreign-born students.

The same report states that in 2018 34.6% of EU companies find it difficult to fill in vacancies requiring ICT skills, with the proportion of ICT specialists in the total of the workforce being 2.2%, making this, according to the report, one of the lowest in the EU. The same research concludes that even with the number of ICT enrolled students growing 11%, it still only represents 2.6% of the total of students, not to mention the gender gap remains large, with only 17% female students. Thus the recommendation of the EU council for Portugal included to “increase the number of HE graduates, particularly in science and information technology.”[23].

This portraits the lack of commitment of HE institutions in focusing on digital competencies and ICT education. As the following figure 5 reads, Portuguese HE response to Digital and ICT challenge is very much under the European average, even with the Business response being very positive.



Source: DG EAC calculations, based on data from *State of University-Business Cooperation in Europe 2019*. Code: 0: Not at all; 1-4: Low; 5-7: Medium; 8-10: High.

Figure 5: State of cooperation from HE and Business viewpoints. In [23].

This leaves us to conclude that HE Institutions need to focus on improving their degree options to respond better to this challenge. Not only to reach the EU levels, but mainly and foremost to prepare students for the work market and for their roles as citizens.

## 2.4 Digital Competences required by the work market

According to Starčič et al. (2016), as cited by Sánchez-Caballé et al. [4] training students in the digital field has positive results on students careers, even if there is still the need to find out more about the up-to-dateness and appropriateness of today’s degrees curricula to in fact empower students with the needed skills that contemporary society demands.

The World Economic Forum Insight Report of 2018 concerning the Future of jobs [24] had as focus the better understanding of the potential of new technologies, in order to improve high-quality jobs and work quality and productivity, not only by analysing the possibility of augmenting existing jobs with technology but also to create new jobs, based on the new technologies, as the Fourth Industrial Revolution’s wave is due to reduce the number of workers to perform certain tasks, but will require new competencies to be able to perform new technology based tasks. Thus, the number of jobs based on the usage and work with new technology will increase, and HE will have to answer to the call.

This same report states that the wave of new technologies and trends will disrupt business models and will drive business growth, boosting the needs for specialist technology-based skills, where Analytical thinking, innovation, active learning and learning strategies, technology design and programming, critical thinking and analysis are portrayed as trending skills, once more with focus on ICT, as shown on the following figure.

Table 2. Skills demand comparison, in [24]

Today, 2018	Trending, 2022	Declining, 2022
Analytical thinking and innovation	Analytical thinking and innovation	Manual dexterity, endurance and precision
Complex problem-solving	Active learning and learning strategies	Memory, verbal, auditory and spatial abilities
Critical thinking and analysis	Creativity, originality and initiative	Management of financial, material resources
Active learning and learning strategies	Technology design and programming	Technology installation and maintenance
Creativity, originality and initiative	Critical thinking and analysis	Reading, writing, math and active listening
Attention to detail, trustworthiness	Complex problem-solving	Management of personnel
Emotional intelligence	Leadership and social influence	Quality control and safety awareness
Reasoning, problem-solving and ideation	Emotional intelligence	Coordination and time management
Leadership and social influence	Reasoning, problem-solving and ideation	Visual, auditory and speech abilities
Coordination and time management	Systems analysis and evaluation	Technology use, monitoring and control

Source: Future of Jobs Survey 2018, World Economic Forum.

### 3 METHODOLOGY

As this study's goal is to know the Portuguese HE Students' entrance and exit Digital Profile in order to understand if they have in fact the desired ICT and Digital skills, there is the need to first verify the skills they have when entering university, and then access the acquired skills. Thus, a questionnaire will be made available to 1st year students, when they enroll HE, 3 students of each degree will be randomly selected and interviewed. Last year students will also fill in a questionnaire and be interviewed. This implies that this study's approach will be mixed, and the procedures will be based on questionnaires. In the first moment the study will be a case study, as the study will first be applied in one HE Institution before being applied nationwide, allowing the testing of the data gathering tools and proposed framework.

Higher Education Institution: Higher School of Education of the Polytechnic Institute of Santarém.

Participants: A total of 360 questionnaires will be implemented and 33 interviews will be conducted.

Table 3. Implementation plan of the study's data gathering instruments.

Class/degree	Entrance /Exit	Questionnaire numbers	Questionnaire date	Interview numbers	Interview date
Environmental Education and Nature Turism	Entrance	30	October 2022	3	October 2022
Basic Education	Entrance	70	October 2022	3	October 2022
Social Education	Entrance	60	October 2022	3	October 2022
Multimedia Production for Education	Entrance	30	October 2022	3	October 2022
Entrance Subtotals		190		12	
Environmental Education and Nature Turism	Exit	30	June 2023	3	June 2023
Pre-School Education	Exit	15	June 2023	3	June 2023
Pre-School Education and Teaching in 1st cycle of Basic Education	Exit	15	June 2023	3	June 2023
Teaching in 1st cycle of Basic Education – Math and Science 2nd cycle	Exit	10	June 2023	3	June 2023
Teaching in 1st cycle of Basic Education – Portuguese, History and Geography 2nd cycle	Exit	10	June 2023	3	June 2023
Social Education	Exit	60	June 2023	3	June 2023
Multimedia Production for Education	Exit	30	June 2023	3	June 2023
Exit Subtotals		170		21	
Totals		360		33	

### 4 CONCLUSIONS AND FUTURE WORK

Digital technology has become part of the modern society and business has been evolving around it and with it, hence, it has become crucial to learn and master ICT and digital technology in order to be able to use it as a facilitator on the workplace, instead of an impossible constraint that conditions access to better work, quality of live and participatory citizenship.

Education has been integrating digital technology and ICT has essential competencies that need to be learnt by all students, adapting its usage to every area of knowledge, aiming to improve knowledge acquisition and empowering students to find better jobs with better working conditions and lifestyle. However, the Portuguese education system is yet to accompany the European average, and there is the need to comprehend students' entrance and exit profile on HE, to assure they master the needed skills for the work market and also to guarantee the adequacy of the degrees' curricula that are being offered. This will also set a path to create a better link between HE institutions and Businesses.

The next step in order to achieve the much-needed results, will be to finalise the questionnaires and interview scripts, by validating them, so it will be possible to implement them in the planned schedule. Data will then be analysed enabling us to present the first results by next year. As we aim to also develop a framework to help us replicate this study in other HE Institutions, data and results concerning that framework will also be published in the next year, as we hope that this study can contribute to perfect the Portuguese HE offer and empower our students with the best set of skills possible.

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