DESI INDEX IN HIGHER EDUCATION. A SOCIOLOGICAL REFLECTION FOR DIGITAL MEDIA INCLUSION

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ABSTRACT

In recent years, the Italian public University has experienced an acceleration of the digitalization process, also thanks to its response to the health emergency generated by COVID Sars 19 in 2020. Specifically, in recent years it has invested above all in technological-infrastructural equipment in order to guarantee educational and administrative continuity at a distance. This has contributed to strengthening the connectivity of universities, which is one of the indicators underlying the European DESI INDEX.

The use of technological devices as educational and communicative mediators has inevitably led to a technical and technological literacy of the teaching and administrative staff, enabling an implementation of the human capital of the DESI INDEX itself, albeit from an experiential perspective. This digitalization process, however, has not always ensured a consequent process of didactic integration of technology, i.e. a process of normalization of the same that would induce an updating of teaching and knowledge transmission methodologies, helping to implement the soft digital skills of educators and students themselves. This gap has left open a challenge of reflection and research precisely on didactic design and experimentation through the use of technologies in the perspective of digital education, as well as on the critical and safety component underlying the sharing of data and online information.

The abstract intends to propose a reflection on the implications of the application of digital education in universities as an innovative didactic methodology for enhancing the soft skills of teachers and students in the perspective of onlife-education.

INTRODUCTION

The impact of digital in the university is a complex, interdisciplinary topic, still little explored and deepened from a political-governmental and scientific point of view, but gradually becoming of great academic and public interest in recent years, especially in the post-pandemic period. The lack of empirical research in this field, both of a national and international nature, does not make it possible to concretely reconstruct a clear picture of the process of dissemination and integration of digital capital in the daily practices of lecturers, students, administrative staff, and the perceptions of the actors within universities, leaving open an unexplored field of investigation rich in stimuli for scholars in the academy and beyond. By virtue of what has just been stated, the essay intends to promote a scientific reflection, exclusively theoretical, deepening the meaning of initiating a process of digital transformation in the academic world according to a sociological perspective, considering some international theoretical contributions that have offered in recent years interesting hints to build new keys to interpret the phenomenon investigated and to acquire greater awareness on the role of digital in the educational

system of the University. The absence of a theoretical framework shared at an international level and promoted by the European Commission on the subject, has not facilitated the task of reconstructing the significance related to the use of digital in the university system, for this reason, within this essay we have decided to use the DESI INDEX (Digital Economy and Society Index) of the European Commission, as the main guiding tool to critically reason about the impact of digital within the Universities, focusing on 4 main areas human capital, connectivity, the integration of digital into everyday practices within organizations and e-government. Starting from this first reading framework, we proceeded to read and semantically analyze about 40 international scientific articles related to the topic of digital transformation in universities, written in the sociological field in the post covid period (2021-2023), from which we extrapolated the main reflections that emerged in the literature on the digital topic, reorganized in 4 semantic categories: human capital, connectivity, integration of digital in learning/teaching practices, integration of digital in administrative practices. The essay therefore begins with an initial sociological reflection on what it means to speak of digital transformation in universities from a macro-social and micro-social perspective to focus, in a second moment, on the DESI INDEX as the key to interpreting and analyzing the impact of digital technology according to the four main areas of which it is composed (human capital, connectivity, integration of digital in practices and e-government). For each of these areas, some relevant theoretical conceptual definitions were subsequently reported and summarized from the analysis of the scientific literature produced in the post-Covid period on the subject.

1. THEORICAL BACKGROUND

According to Jakoet-Salie and Ramalobe (2023), Higher education digitalization is a transformative process (Seres et al., 2018) that has a significant impact on all the activities of higher education (Crittenden et al., 2019; Rampelt et al., 2018). It includes technological and organizational changes brought about primarily by the advancement of digital technologies (Menendez et al., 2016). The term “digital transformation (DT)” refers to the changes that digital technology causes or influences in all aspects of human life (Stolterman and Fors, 2004). It has implications for the Sustainable Development Goals set out in The United States 2030 Agenda: governments, institutions and organizations should commit with the goal of reducing the digital divide and improving social and cultural inclusion.

Digital transformation has often defined as a journey (TechCentral.ie, 2018), in which technologies will require a constant evolution of working approaches, systems and processes throughout the system, to add value to users (Higher Education Authority (HEA), 2019). Hence, digitalization pervades all processes, locations, formats and goals of higher education teaching, learning, researchs and work. Finally, Westerman et al. (2014) define the DT of an organization as the use of digital technologies to improve its performance and scope.

In the sociological perspective, the DT of HEIs could be considered as the process of technological, cultural and organizational change induced in these institutions by the development of digital technologies (Almaraz et al.,2017). It is not a matter of technology, but how people use technologies, how institutions intend to invest in technological progress to improve the management of different activities, how these technologies are integrated into practices by changing methodologies of use and the previous ideas and assumptions (Diaz-Garcia et alii, 2022).

The incorporation of the possibilities of ICTs in Higher Education (HEI) is leading to the development of new strategic options using policies and plans according also to the new demands of the labor market.

Hence, in the macro social perspective, digitization process in the HEs system must take into account, at least, the following aspects:

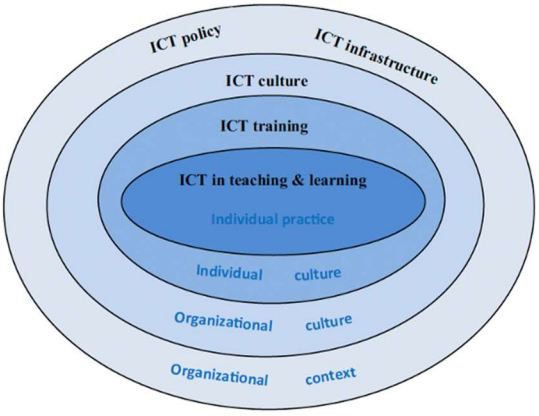
(a) strategically enabling DT development through an integrated and ecological perspective,

(b) moving away from basic forms of inquiry and incorporating multidisciplinary perspectives outside of educational sciences in order to advance theory and practice (Peters et alii, 2022).

In the first case (a), in Social Sciences the ecological approach assumes that technologies are not tools but environments within which relationships are built, interactions are established, symbols are shared and meanings are exchanged (Granata, 2015). According to this approach, digital media are part of wider relational systems, which are cultural, social, natural (De Biasi, 2007, p.13). Within such systems, the media take on roles and functions of support and management of educational, commercial, political, economic and cultural or entertainment activities. Media build relationships of mutual influence that contribute to the construction and sharing of symbols, perceptions of reality, ideologies, beliefs that modify people's way of thinking, acting and relating, as well as of constantly looking at and interpreting the surrounding reality. In order to summarise this ecological view of media, it is particularly effective to use the representation of this socio-cultural view of media proposed by some scholars, such as Tongeurs et al.(2008).

These scholars proposed a model of ICT integration in the form of concentric circles; it represents the complexity of the topic involving of integration of digital media in a sociocultural context, where it is possible to consider many characteristics that can influence the spread of digital technologies. Specifically, these scholars had to consider contextual features, cultural characteristics, teachers' structural characteristics, cultural characteristics, and ICT used in classrooms.

Fig.1 Conceptual model of ICT integration



Source: Yuting Zhang Donnie Adams, Kenny Cheah Soon Lee, 2022

In the figure 1, the ICT infrastructure dimension (Kundu et al., 2020; Mutisya, 2020) involves the construction of hardware, software, digital resources, and related services, as well as the arrangement of ICT funding within the institution by assessing physical, service and financial aspects. The technological investment is the basis for enabling access to digital equipment and resources and administrators play a critical role in providing guidance and services for ICT applications. Hence this dimension is connected to the ICT policy adopted in the higher education that may favor the investment in this field.

The institutional ICT culture is a critical component that predicts the level of ICT integration. It refers to values, knowledge, beliefs in digital culture that may orientate the digital perception of actors (researchers, professors, administrative staff and so on) and the socio-material relationships between institutional factors that dynamically interact with each other and that could be improved, fostered and changed during the process (Connell, 2019). They can influence the ICT integration in HE.The ICT

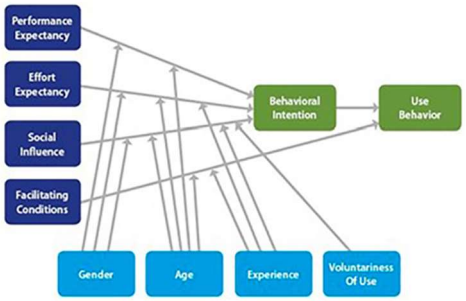
culture also influences the pedagogy and the digital course design, the idea of teaching and learning, the level of autonomy or innovation and collaboration principles at the basis of teaching, the teaching efficiency and the ICT-integrated curriculum (Blau & Shamir-Inbal, 2017).

ICT training is indispensable in ICT integration mentioned in the model (Tondeur et al., 2008) to improve technical digital skills and soft digital competences (Cortoni, Lo Presti, 2018) in the professional field. University teachers expected institution-based ICT training programs to facilitate the autonomy of teachers and their reflection on educational technology usage, to facilitate the implementation of technology in their educational activities. Finally, the ICT in the teaching dimension concerns the teaching practices of confidence, convenience, courses preparation and usage in curriculums, while ICT in the learning dimension refers to the learning practices of creation, exploration, communication and professional learning in the digital field.

In the second case (b), according to Kravchuk et alii (2022), the use of digital technologies in education is a complex system including interconnected structural-functional elements, namely: structure and subsystems, purpose, goals, challenges, principles, main tasks, functions, stakeholders (interest parties) or subjects, content and methods of educational activities, system dynamics, essence and features, factors and conditions, etc. For instance, technologies can optimize the organization of the educational process, speed up communication processes, increase the level of learning efficiency. They intervene to modify more aspects in the HE system, such as the streamlining of orientation, student and teacher recruitment, placement, tutoring, administrative support services from an e-government perspective. Finally, their practical use ensures the update of the competences of HEIs' participants: teachers, administrative staff and students. Hence, ICT integration in higher education must be explained by a framework to allow integration of individual and institutional characteristics from micro- to macro factors.

According to Esteve-Mon (2022), there are some models in the literature that connected to the responsibility for the success of technological implementations in HEIs. For example, UTAUT model is composed of four main constructs including: performance expectancy, effort expectancy, social influence and facilitating conditions. In this model, facilitation conditions refer to the facilitations provided by the institution for the faculty members to teach in online environment such as professional development and technical support etc. Also, effort expectancy refers to the expected efforts that faculty members need for using online teaching tools compared to the benefits received by that effort. Social influence is related to the peers or other faculty members' influence to use online teaching. Finally, performance expectancy refers to how using the new technology may enhance the performance of users (Aljanazrah A, Yerousis G, Hamed G and Khlaif ZN (2022). Some basic variables gender, experience, voluntary use, and age can influence ad orientate the functioning of the model.

Fig.2. Unified theory of acceptance and use of technology



Source: UTAUT; Venkatesh et al., 2003

2. DESI INDEX AND HES IN POST COVID PERIOD

The Digitization Index of Economy and Society (DESI INDEX) is the tool through which the European Commission since 2015 has started to monitor the digitization process of the 28 EU member states from 4 main areas: connectivity, human capital, the integration of digital technologies in the organizational context, the use of digital in public services (e-government).

Starting from this model, we use the same theorical structure to analyze the digitalization process in Higher Education. It is structured in four main dimensions:

1. **The investment in the technological infrastructure equipment** that is the basis to integrate the digital culture in the social context, such as the Higher Education (it could be connected whit connectivity area of DESI INDEX);
2. **The human capital** in higher education, that means the improvement of digital competences of teachers, students and administrative staff;
3. **The integration of digital tools in the daily activities** in these following fields: teaching and learning, research, support services, administration, and communication, as well as the need for students and faculty to acquire new (digital) skills for their future workplaces (Rampelt et al., 2018);
4. **Integration of technological means in the administrative procedures** to improve the quality of services in the higher education. The use of ICT is essential to many business processes of universities, including institutional communication, library management, HR management, teaching and student support, research and technology transfer support, project management and fundraising, financial support, IT support, legal support, logistics, strategic planning, and many others (Maltese, 2019).

In the following paragraphs we analyze each of these dimensions in HE, starting from studies and researches described into the recent scientific and intenrational literature in the post COVID period. These dimensions are at the basis of digital capital in the Higher Education (Ragnedda et al., 2018; Paino and Renzulli, 2012; Pitzalis, 2016; Cortoni, 2020). With this expression, we define the material and immaterial resources used in the specific social space, such as the HE system, to achieve specific educational goals. In the macro perspective, digital capital refers both to the endowment infrastructure and technology (DESI INDEX connectivity), as well as to the number of training and school digital experimentation, to implement the cultural capital of teachers and students on technology (digital literacy) and through technology (digital education). From a cultural point of view, the investment in projects of experimentation and training on digital literacy, or digital education, can contribute to increasing the digital skills of all school actors (teachers, researcher, students, staff and so on), hypothetically improve the efficient functioning of the school system, perceived externally as a factor of educational quality (DESI INDEX human capital). Still in the macro perspective, digital capital is doubly connected to financial capital, insofar as opportunities for economic investment, both institutional and public and private, can stimulate the purchase of technological equipment and educational experimentation.

Moving from a macro to a meso-social perspective, digital capital seems connected to the concept of educational innovation, from design to classroom experimentation to the teaching, learning and assessment of student learning, changing their relational dynamics (social capital) and cultural capital, as well as the sharing of digital skills in teaching activities, management and organizational activities (DESI INDEX Digital Technologies integration). Finally, from a micro-social point of view, digital capital is identified with a specific dimension of the cultural capital of each individual (digital competence), and with attitudes embedded in individual use (Ragnedda et al., 2018; Paino and Renzulli, 2012; Pitzalis, 2016; Magaudda in De Feo and Pitzalis, 2014).

2.1 TECHNOLOGICAL EQUIPMENT OF HES

Technologies are the initial and basic component of a first step, the “digitalization” of “HEIs,” when they tiptoe into the “digital economy” using “innovations” in the “management” of the “information” of the organization, which requires the acquisition of “digital competences” by their members (Díaz-García et alii, 2022).

The Digital Transformation of Education: Connecting Schools, Empowering Learners in 2020, the International Telecommunication Union (ITU), the United Nations Educational, Scientific and Cultural Organization (UNESCO), and the United Nations Children’s Fund (UNICEF) called for strengthening national infrastructure to ensure that Internet connectivity is more reliably and widely available (Unesco, 2022). In 2021, UNESCO published the Strategy on Technological Innovation in Education (2022–2025) to study emerging and future technological changes and their impacts on education and support member countries to develop remote learning platforms, learning tools, open educational resources, and effective learning methods, to enable equitable and inclusive quality education and promote lifelong learning opportunities for all.

According to the 2021 EDUCAUSE Horizon Report® | Teaching and Learning Edition, published by EDUCAUSE, the key technologies and practices that will have a significant impact on the future of teaching and learning in higher education are AI, Blended and Hybrid Course Models, Learning Analytics, Micro-credentialing, Open Educational Resources (OER), and Quality Online Learning.

The main digital resources and formats implemented in educational teaching in HE institutions during the COVID-19 pandemic have been LMS platforms of the institutions themselves: the videoconference—Zoom or Microsoft Teams; the creation and use of educational videos; the exchange of messages by the usual means (email) or through instant messaging applications—as WhatsApp Messenger—combined with the use of social networks, mainly used for communication or, alternatively, as an LMS platform (see fig.3).

In this sense, it can be noted that most of the applications or technological solutions used for the continuity of teaching are open educational resources (OER), that are available free of charge, or reusable educational resources (RER) that have been integrated into LMS platforms. (cfr. Rodríguez et alii, 2022).

Fig. 3 List of potential technologies implemented in HE during COVID period

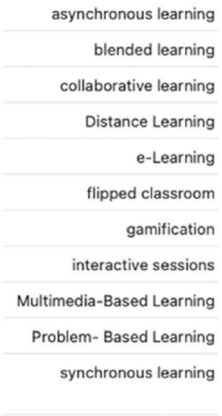
FORMAT	TYPE OF RESOURCES
SUPPORT	LMS Integration Content Lessons and courses Format/Language
TOOLS	Video conference Presentation Messenger service Response Storage Collaboration Support/Adaptation Social Networks
DIGITAL UNITS	Video Audio Text
SERVICES	Access to documents Identity Search Migration

Source: Rodríguez, M.L.; Pulido-Montes, C. 2022

According to Aljanazrah et alii (2022), online platforms such as learning destination sites (LDS) and learning management systems (LMS) are transforming learning experiences by allowing the learners to access and download courses, manage and track progress, take notes and actively participate in discussions with peers and co-learners (Bekova et al., 2021). Virtual communities of practice are empowering faculties to adapt to the evolving pedagogy and course work through resource sharing and curating engaging classroom experiences (Hodges et al., 2020). Digital curriculums are enabling curriculum-aligned, next-generation assessments that can provide automatic grading, support prompt feedback, track reasoning and understanding through strong analytics from different data sources (Ertmer, 1999).

The integration of these tools in education contribute to transform some didactic methodologies. The blended learning methodology involves the integration of resources within a methodological structure that is defined by educational moments marked by asynchrony and synchrony; such a methodology seeks to enhance performance, the integration of digital technologies and collaborative learning. This approach involves the application of a blended methodology, a process of developing pedagogical reflection, skills and resources (cfr.Rodríguez, et alii, 2022).

Fig. 4 List of methodologies developed during COVID period



Source: Rodríguez et alii, 2022

According to UNESCO (2022), after COVID period, HEIs need to transform their supportive services for the digital transformation of teaching and learning, following these main principles:

- **Change from single services to systematical services:** HEIs need to adopt the principle of systematization to provide well-connected and integrated supportive services by linking all elements of teaching support, strengthening the connectivity between all stakeholders and breaking the boundaries between scattered services, isolated links and separate departments.
- **Change from physical space to integrated space:** As teaching expands from traditional physical space to the integration of physical and digital spaces in the wake of the digital transformation, supportive services need to cater for teachers and students anytime and anywhere in the integrated teaching space.
- **Change from single-point services to whole-process services:** As digital teaching goes beyond traditional classrooms and breaks through the limitations of time, the teaching support team needs to provide whole-process services for activities before, during and after class.
- **Change from serving groups to serving individuals:** HEIs need to move away from traditional teaching services. Instead, they should provide supportive services that can meet the individual needs of teachers and students and develop personalized instructional design, curriculum management and learning evaluation by means of learning analytics and adaptive technologies.

Hence, HEIs need to build a technical environment that has to follow these indications:

- **Upgrade physical places of instruction in a digital way:** Physical places of instruction such as classrooms can respond interactively to various requirements of the digital teaching space once they are equipped with digital equipment to realize the data transfer between physical and digital space.
- **Build an internet-based teaching environment:** HEIs need to make an overall and coordinated plan to fill the gap between what the current campus network, digital facilities and equipment, learning management system software and digital teaching resources can offer and what teachers and students really need in the process of digital transformation.
- **Apply new-generation digital technologies:** new-generation digital technologies such as AI, learning analytics, IoT, social robots and blockchain will deeply integrate with higher education teaching.
- **Emphasize security and fairness:** The development of technology should be planned with ethics, fairness and justice as the core in advance instead of afterwards. To ensure data security and privacy protection, HEIs, teachers and students need to participate in the development process of technical systems, and actions should be taken to raise awareness, build institutional systems and enhance maintenance and management. Investment in network connection, digital equipment and organizational capacity of HEIs should ensure equal access to digital education for all learners.

2.2 HUMAN CAPITAL IN HES: DIGITAL LITERACY AND COMPETENCIES

The development of ICT skills has been identified as a critical element of students' future full and active civic participation (OECD, 2015). This expression refers to the knowledge, skills and confidence required to use available technology and devices to achieve objectives and results (PWC, 2018). Digital literacy entails the correct use of available data as well as the appropriate application of new technologies (Seiler and Fischer, 2021).

According to UNESCO (2022), Digital literacy is the ability to safely and appropriately acquire, manage, understand, integrate, communicate, evaluate and create information through digital technologies to promote employment, work and entrepreneurship, including the ability to apply digital technologies, information and data literacy, the ability to communicate and collaborate with digital technologies, the ability to create digital content, awareness of digital safety and digital ethics, continuous learning, problem solving, reflection and self-improvement through digital technologies, and digital expertise and competence. Among them, digital technology application ability, information and data literacy, digital expertise and competence are the essential components of digital literacy, serving (Law et alii, 2022) teachers act as technology facilitators for a shared ICT vision (Blau & Shamir-Inbal, 2017; Hero, 2020).

Morgan et alii (2022) introduce a framework of digital literacy that is structured in three main areas:

1. technical (operational literacy);
2. cognitive (Information literacy);
3. etiquette (legal, ethical and social literacy).

The technical skills refer to the operational literacy of individuals that are at the basis of access digital competencies. Second, are the cognitive abilities of searching, assessing, analyzing, evaluating, synthesizing and communicating digital information. This cognitive dimension focuses on the use of existing information and the creation and sharing of new information (critical digital competencies). Third, is etiquette which allows for appropriate and contextual online interaction and behavior. This involves ethical and legal literacy, as well as social aspects of communicating in personal and professional digital environments (awareness digital competencies).

Based on this framework, digital literacy can be described as the ability to access, analyze, evaluate and communicate digital information, using relevant digital tools in a manner which is legally, ethically and socially aware. 'Access' refers to not only having technical, but also beholding the operational understanding, knowledge and essential skills required to use it. 'Analyze' refers to one being able to navigate, determine bias and quality, summarize and assess information or data for interpretation and processing. 'Evaluate' refers to critically reviewing and determining significance, legitimacy and authenticity when encountering an infinite supply of online information. 'Communicate' refers to producing and sharing insights and formulating messages that fit the required medium. This includes operating and communicating in a safe, legally and ethically appropriate manner.

Conceptualizations of digital literacy have also emphasized the importance of social context, such as privacy and appropriate use of language (e.g., Ng, 2012a). Therefore, digital literacy is critical for higher education graduates' employability and citizenship. Graduates face various challenges associated with technological and digital change, such as: handling big data, cyber security and the proliferation of 'fake news'(Oliver & Jorre de St Jorre, 2018). These are digital soft skills (Cortoni, Lo Presti, 2018), connected to the awareness and critical thinking competences focus on commodification, datafication and personalization processes of platform society (van Dijck at alii, 2019).

The implementation of teachers' digital competences responds to the need to prepare students for a strongly digitized socio-cultural context and represents one aspect to be included in the educational mission of universities themselves, in order to prepare 'e-leaders' in different professional fields.

The Definition and Selection of Competencies Project - DeSeCo (OECD, 2005; Salganik et al., 1999) pointed out that competences are more than just knowledge and skills, as they include the ability to cope with complex demands by putting those skills into action in specific situations (the main areas of the project are three: 1. interactive usage of media tools, 2. working with others and working in society, 3. the use of psychological resources, abilities, and attitudes. In this context, digital competence is considered one of the key skills for accessing lifelong learning (Europea Union, 2006; Morselli, 2019). The changes resulting from the introduction at the beginning of the 21st century of the concept of competences as an educational goal (Rychen & Salganik, 2003) have led the university to assume pedagogical criteria of student-centered learning (Perez Rivero, 2022).

According to Peters et alii (2022), the digital competence of teachers (TDC) has defined as the set of skills, attitudes and knowledge required by educators to function productively, safely and ethically in diverse and digitally mediated environments (Esteve-Mon et al., 2020; Falloon, 2020). The definition of Digital Literacy is connected with the definition of Digital Competences.

Finally, according to the General Secretariat of the Council of the European Union, digital competence involves the confident, critical and responsible use of, and engagement with digital technologies for learning, at work, and for participation in society. It includes information and data literacy, communication and collaboration, media literacy, digital content creation (including programming), safety (including digital well-being and competences related to cybersecurity), intellectual property related questions, problem solving and critical thinking (European Union, 2018). In this definition all areas of the European Digital Competences for citizens (DIGCOMP 2013 and the followed upgrades) are mentioned.

Starting from the international literature in this field, in the last years, many theorical frameworks on digital competences are defined. In Europe, since 2013 the framework on digital competences for educatorsm the European framework for the DC of educators (DigCompEdu), is implementing, it aimed at guiding policy and implementing regional and national training programs (Redecker & Punie, 2017). This framework analyses and validates the digital competences included in 6 areas of professional life of educators: 1. Improving Professional engagement, 2. developing educational resources, 3. designing

and enacting teaching and learning activities, 4. assessment practices; 5 enhancing the soft skills, 6. digital skills of students (Esteve-Mon et al., 2020).

In the international literature, many other International frameworks of digital competences has been analized such as:

- *Technology, pedagogy, and content knowledge model* (TPACK), where content knowledge has to be combined with methodological knowledge of pedagogy and technological knowledge. In this sense, teacher competences in the HE have to be soft skill.
- *International Society for Technology in Education* (ISTE) Standards for Educators, that provides competencies for learning, teaching and leading in the digital age, giving a comprehensive roadmap for the effective use of technology in educational contexts such as the HEs.
- *The ICT Competency Framework for Teachers* (ICT-CFT) (UNESCO, 2018) that is a global standard to evaluate teachers' ICT competency and it is structured in six dimensions: (i) Understanding ICT in education policy; (ii) Curriculum and assessment; (iii) Pedagogy; (iv) Application of digital skills; (v) Organization and administration and (vi) Professional learning.
- *Spanish Common Framework of Digital Teacher Competence,* developed by the National Institute of Educational Technology and Teacher Training (INTEF, 2017), which is based on the digital competence model DigCompEdu developed by the EU.
- *The European e-Competence Framework for ICT Professionals* (e-CF ICT),
- *The Global Media and Information Literacy Assessment Framework* by UNESCO 2013 (Kuzminska et al., 2018).
- *The JISC Digital Capability Framework*, that is focused on four key areas and an overarching competency enveloping ICT proficiency for digital identity and wellbeing, as the core of digital literacy – 1. Information, data and media literacies, 2. Digital creation, problem solving and innovation; 3. Digital communication, collaboration and participation; 4. Digital learning and development (JISC, 2019).
- *Digital Teaching Professional Framework* (Education & Training Foundation, 2019),
- ISTE Standards for educators (ISTE, 2018), is a widely used standard worldwide to evaluate technology leadership, or function as guidance for related training, which explains the main necessary features of technology leaders in detail. It consists of five leading practices: (i) Equity and citizenship advocate; (ii) Visionary planner; (iii) Empowering leader; (iv) Systems designer; and (v) Connected learner.
- *Competence framework for Teaching and Learning with ICT* (van Loon et al., 2018).

2.2.1 THE FRAMEWORK OF DIGITAL COMPETENCES IN HES

The main and sub-dimensions of the frameworks were identified, existing similarities were merged where necessary, and the remaining digital competencies were mapped. The result was an overview of identified dimensions. This resulted in an initial draft of the HeDiCom framework, which included four main themes: Teachers' digital literacy, Teachers' Professional Identity; Teaching and Learning with Technology; Empowering students (Tondeur et alii, 2023).

This framework is structures in three areas: professional learning that includes all competences at the basis of the development of the educator profile. This area includes social competences (communication and collaboration), methodological competences (innovation in digital practices) and teacher's professional learning (key competences of teaching professionality). In the second dimension Digital literacy the author describes three main categories of digital competences of educators:

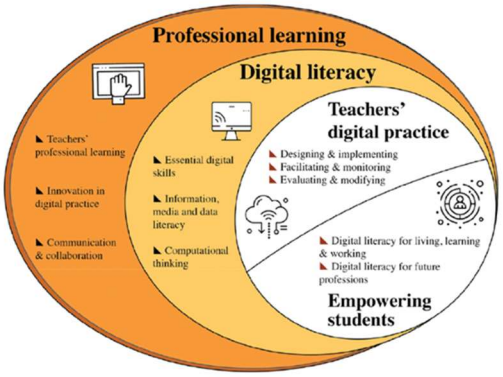
- *Essential digital skills* based on the improvement of technical and operational skills to use digital media;
- *Information, media and data literacy* that summarize different capabilities such as: searching for information, the organization of information, and the assessment of information (Almerich

et al., 2016). Carretero et al. (2017) for instance indicate that teachers must be able to analyze and compare both the information and the sources of digital content for reliability and credibility. They therefore need the necessary competencies to actively, creatively and critically use and understand data (López-Belmonte et al., 2019). They should be able to manage Big Data. This requires certain competencies in analytical treatment based on data mining, for the extraction of useful, valuable and meaningful information from large volumes of data (Huda et al., 2017).

- *Computational thinking* is only recently described as a relevant competence in Higher Education. It refers to break down a complex problem into steps and processes that can be solved using digital technologies and apply these solutions in their educational practice (Barendsen & Bruggink, 2019; Lyon &Magana, 2020; Wing, 2006).

The digital literacy competences are central for T*eachers' digital practice dimension, that includes designing, implementing didactic activities, facilitating the relationships in classroom* with students and with colleagues, monitoring, evaluating the effectiveness of the work and modifying it for future proposal. The digital literacy competences are also at the basis to implement digital competences of students for future professions and for living, learning and working (see figure 5).

Fig. 5 The HeDiCom framework



An other international framework of digital competences in HE is proposed by UNESCO in 2022. It is called Framework of teachers' digital competencies in Higher Education (UNESCO, 2022). It is structured in four main areas:

1. Digital awareness;
2. Digital literacy;
3. Digital capacity;
4. Digital research.

Each area is structured in three stages: acquisition that is the basic access stage, deepening that means intermedium stage and creation as the innovation stage (see figure 6).

In the first area, *Digital awareness*, teachers become aware of the importance of digital technology in teaching (acquisition stage); in the deepening stage, teachers acquire relevant knowledge and methods of ICT-based teaching, and start to practice innovative teaching. In the innovation stage, teachers develop ideas and methods to innovate and update teaching models.

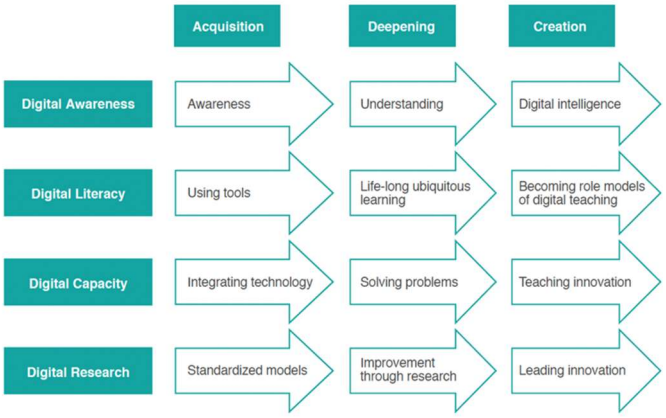
Digital literacy area is a prerequisite for helping learners to develop core competencies of the 21st century. In addition, teachers also need to have professional literacy to integrate digital technology into teaching activities. In the acquisition stage, teachers obtain a preliminary understanding of common digital technology tools for their work (such as office software, online teaching platforms, visualization

tools, popular social media apps, etc.). In the deepening stage, teachers use various open online courses, user-generated content from social media, etc. to carry out professional learning on smart devices and develop the habit of lifelong learning. In the innovation stage, teachers develop the ability to flexibly apply models of digital teaching.

Digital capacity area refers the ability to apply knowledge and skills in practical professional activities. In the acquisition stage, teachers could master one way of integrating technology into curriculum as part of the digital teaching. In the deepening stage, teachers diagnose problems in teaching, solve problems with the help of digital technology, to improve teaching continuously. In the innovation stage, teachers flexibly apply digital technology to innovate teaching models and help students to cultivate higher-order thinking skills, as well as the ability to explore, cooperate and autonomously construct their knowledge base.

Digital Research refers to use digital competences to improve the research processes. In the acquisition stage, teachers learn to conduct research based on standardized models, to diagnose problems in teaching and improve accordingly. In the deepening stage, teachers design teaching methods based on characteristics of courses and instructional conditions, in order to continuously improve teaching models and methodologies. In the innovation stage, teachers explore teaching patterns through research, deeply reflect on teaching, innovate teaching models and encourage other teachers to develop together through sharing and communication.

Figure 6. Framework of teachers' digital competencies in Higher Education



Source: UNESCO, 2022

In the HE context, teachers are leaders, they must take new responsibilities, prepare to accept, use and integrate technology in the university, and equip themselves with the newest technological knowledge and skills, as adapting to technology developments is indispensable for modern educators. Technology leadership refers to the combination of technological literacy, academic ability and management competencies to select, exercise and guide technology usage, which supports all education stakeholders to effectively deal with the exploration of technology-related tasks. Technology leaders are individuals who can empower followers to understand, select, assess, utilize and manage technology and innovation effectively (Daugherty et al., 2013). Previous studies have explored theories, conception and evaluation standards of educational technology leadership from various perspectives. Appropriate frameworks are needed to guide leaders to meet the demands of practice effective technology leadership (Zhang et alii, 2022).

Rogers [2000] argues about a paradigm in the integration of technology into higher education, due to the new requirements for the set of technological competences of teachers. According to the author, the key areas of technology integration are:

1. learning/teaching, (Planning and implementation of digital devices and other resources in the educational process in order to increase the efficiency of educational technologies. Proper management and streamlining of digital learning strategies.);
2. leadership (The application of digital technologies and services in order to enhance interaction with students, within and outside the learning process. The use of digital technologies for timely and focused leadership and assistance. Experimenting and developing new forms and formats of leadership and providing support.);
3. self-regulation of learning (The application of digital technology to support self-regulated learning, that is, to teach students to plan, monitor and reflect on their own learning, provide evidence of progress, share opinions and generate creative solutions);
4. coeducation and collaboration (Promoting and improving collaboration, cooperation and knowledge creation);
5. assessment and analysis of outcomes, formation of current and final assessment (Improving the diversity and suitability of assessment formats and approaches. Selection, critical analysis and interpretation of digital indicators of performance, efficiency and progress);
6. feedback and planning (The use of digital technology for targeted and timely feedback from students. Adapting learning strategy and providing targeted support based on indicators obtained by digital technologies. Enabling students and parents to understand digital technologies and use them to make decisions).
7. differentiation and personalization of learning (Meeting a variety of learning requirements, allowing different levels and speeds, and adhere to distinct learning paths and objectives);
8. accessibility and inclusion, (Ensuring the availability of educational resources and activities for all students, including those with special needs. Reflection on students' expectations, skills, uses and misconceptions, as well as contextual, physical or cognitive limitations on the use of digital technologies);
9. active engagement (The use of digital technologies to promote active and creative participation in the study of subjects. The use of digital technologies in pedagogical strategies promoting students' diverse skills, deep thinking and creative self-expression).

Starting from these features of teacher competencies in HE, the scolar describes a general list of specific teacher competences such as:

1. Knowledge and understanding of the subject area, professional activity.
2. Possession of critical thinking skills.
3. Possession of communication skills, ability to show empathy.
4. The ability to use information and communication technologies.
5. The ability of searching, processing and analyzing information from various sources.
6. The ability of personal and professional development.
7. The ability to generate new ideas, creativity.
8. The ability to apply best practices in professional activities.
9. The ability to motivate people and move towards a common goal.
10. The ability to act based on ethical considerations, motives.
11. The ability to show tolerance and respect towards cultural diversity.
12. The ability to conduct socially responsible and conscious actions (Kravchuk et alii), 2022.

This list of competence is comparable with the European framework of digital Competence of citizen (DigComp and following upgrades) that considers 5 main areas of digital competences: 1.Information and data literacy (connected with the Possession of critical thinking skills and The ability of searching, processing and analysing information from various sources); 2. Communication and cooperation (connect with the Possession of communication skills, ability to show empathy and The ability to use information and communication technologies); 3. The content creation (connected to The ability to generate new ideas, creativity; 4. Safety (connected with The ability to act on the basis of ethical considerations, motives; The ability to conduct socially responsible and conscious actions); 5. Problem solving (Knowledge and understanding of the subject area, professional activity; The ability to apply

best practices in professional activities; The ability to motivate people and move towards a common goal; The ability to show tolerance and respect towards cultural diversity.

2.3 INTEGRATION DIGITAL TECHNOGIES IN HE

According to Kravchuk and other scholars (2022), HEIs combine different approaches depending on the field of application of digital technologies in Higher Education. The Constructivism is the basic principle for the integration of technology in the context of the dynamism of scientific and technological progress, requiring teachers, administrators and students to constantly update their knowledge in the process of practice.

The components of constructivism are as follows: 1) the concept of lifelong learning, in order to update digital skills; 2) competence-based approach, involving the education of basic and special competences of teachers and students; 3) centralized approach to technical support of academic staff and students by creating standards, rules of procedures for the use of technologies; 4) systemic and structural-functional approaches for the integrated use of technology in various fields of higher education; 5) theory of student-centered learning based on the principle of student-centrism as the basis for the implementation of technologies, for instance, in the quality assurance system of HEIs for assessment of students' learning outcomes. (Englund at alii, 2017).

Within the framework of the constructivism concept, new approaches to teaching using technologies at HEIs are emerging. For example, **the Technological, Pedagogical, and Content Knowledge (TPACK)** framework is distinguished among approaches to the application of technologies by teachers in accordance with the strategies of teaching and the content of higher education (Dysart et alii, 2015). The gamified approach is also the innovative one, increasing students' motivation, productivity and performance through new principles, the possibility of adapting courses to students' interests [Kopcha et alli, 2016; Subhash et alii, 2018].

The digital transformation of higher education teaching and learning is not the application of digital technologies to education, but the integration of digital technologies and education, and that the aim is to improve the operations, strategic directions and values of HEIs and develop new education systems adaptive to the digital age. The digital transformation of higher education involves changes in institution's space, operations, strategic directions and values, as the digital age takes on different characteristics.

UNESCO (2022) defines four stages in applying digital technologies to education:

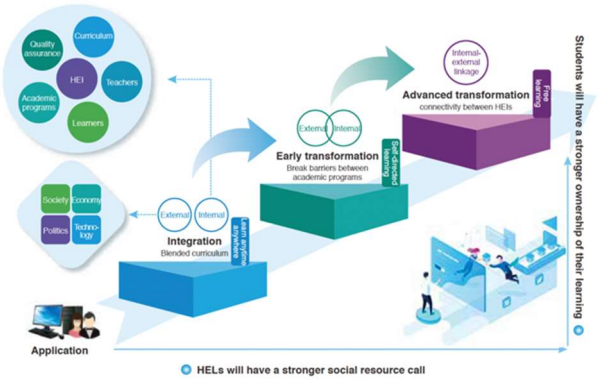
1. *building readiness stage*, focused on building infrastructure and developing teachers' digital competencies;
2. *applying stage*, focused on applying digital competences and tools in the daily activity to develop high-quality digital education resources and to improve learning management systems;
3. *infusing stage on innovative methods of teaching* based on the digital environment;
4. *transforming stage* focused on integrating emerging technologies to reshape education ecosystems.

It proposes a framework for the digital transformation of Higher education teaching and learning in three steps:

1. **integration**, where the curriculum development and delivery will not be limited by time or space. The core elements such as teaching objectives, contents, activities, assessments, and environment will be reshaped and reorganized by the integration of physical and virtual spaces. At this stage, students will enjoy more flexible learning by blending online and offline methods and HEIs will expand internet-based teaching.

2. **early transformation**, HEIs will gain access to external resources for curriculum development, such as those from other HEIs, relevant enterprises and social organizations. At this stage, HEIs will develop individualized curriculum designs with a flexible combination of course modules from different schools and academic programs to meet the diverse needs of students.
3. **advanced transformation**, digital technologies will completely break boundaries between HEIs, enabling connectivity between HEIs, between HEIs and society, and between HEIs and other stakeholders. By that time, sharing academic programs, curriculum, teachers, facilities, and services will become possible, and social resources will be fully utilized. As learners will have ownership over digital spaces, they can choose online courses and digital resources of other HEIs to meet their individualized needs.

Fig.7: Framework for the digital transformation of higher education teaching and learning

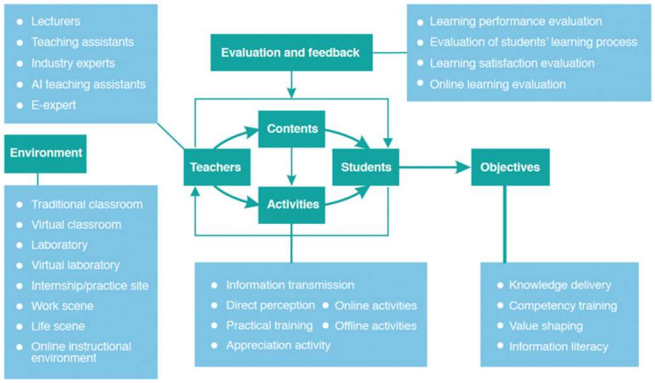


Source: UNESCO, 2022

In order to realize joint development and sharing of digital teaching resources across HEIs and academic programs, it is necessary to develop unified standards for developing shared resources to facilitate resource access and use; following the conditions of the Creative Commons (CC) licenses to protect the copyright of resource developers.

Second, establish a sound system for the management of shared resources. it means to develop relevant assessment and evaluation mechanisms to evaluate the quality of resource development and results of resource sharing and introducing a number of policy incentives based to encourage greater initiative, deliver higher-quality digital teaching resources, extend the life cycle of the sharing process, and promote the sustainable sharing of digital teaching resources. Third, adopt “customized” digital teaching resource sharing. Relying on digital teaching resource sharing platforms, students can have access to “personalized and customized” resources to meet their different needs (see figure 8).

Fig. 8: Key dimensions and their relationship in the digital transformation of teaching and learning



In this scheme, curriculum objectives refer to equipping students with the skills and abilities needed in the digital age and preparing them for the 21st century.

Curriculum contents is changing from fixed and structured knowledge to dynamic, open, unstructured and diverse contents. As big data, internet and other technologies advance, knowledge has been increasing and updating more quickly. Curriculum contents become more closely linked with social life and production, especially with the development of the latest science and technology and they are delivered by means of multimedia. Systematic, high-quality and dynamic digital open instruction resources have become an important source of curriculum contents.

Teaching activities are changing from face-to-face instruction limited to specific physical space to diversified instruction combining both the digital and physical spaces. Diversified electronic devices and technical systems such as smart phones, tablet, e-schoolbags, online instruction platforms and video conference systems provide strong support for carrying out various teaching activities.

Learning assessment and feedback change from static and summative assessment to dynamic, diverse, formative and big data-supported assessment and feedback. As new technologies such as mobile internet, cloud computing, big data, data mining, learning analytics and AI emerge, new methods for learning assessment keep springing up, making it possible to use big data generated in the teaching process to carry out multi-dimensional analysis, process evaluation and dynamic feedback.

Teachers will change from the role of one-way imparting knowledge to supporting students' autonomous, cooperative, and inquiry-based learning with technology. Students will change from passive receivers to autonomous learners supported by digital technology. Teaching environment: Changing from closed physical space in school to borderless and multi-channel connected physical and virtual spaces.

In this new hypothetical context new didactical methodologies have to be designed and experimented. Generally, this approach involves the application of a blended learning methodology. It is a process where all technological resources and others are integrated within a methodological structure that is defined by educational moments marked by asynchrony and synchrony.

After the COVID period, the new educational system, known as the hybrid model, has been defined by UNESCO as a 'learning approach that combines both remote and in-person learning in order to enhance the learner experience and ensure continuity' (UNESCO, 2020, p. 6). This model comprises different formats: flipped classrooms, live synchronous teaching through video conferencing, asynchronous activities to be carried out autonomously by students, and other remote features through technology platforms that professors use to provide instruction and feedback.

In this mixed format, educational institutions must make substantial technology investments in the classroom; in addition to the investment in technological resources, all universities have had to provide professors with training to cope with this new model by scheduling courses related to virtual teaching, content generation and new educational applications (De Obesso & Nu~nez-Canal, 2021).

According to Perez, Rivero et alii (2022), active methodologies such as flipped classrooms or the learning by doing approach have changed the role of educators. Instead of reinforcing the cognitive function, the educator becomes a facilitator and an active part of the teaching and learning process (Ladeveze & N!u~nez-Canal, 2018). Technology has contributed to this change in perspective and the new professors' role (Marcelo & Yot- Dominguez, 2019).

Some examples of international didactical methodologies already considered in HE, are described below:

- According to Arsenijević, J. et al. (2022), *The Community of inquiry model in online teaching* (Col) developed by Garrison, Anderson and Archer (1999), is based on three types of presence: social, teaching and cognitive presence. The teaching presence includes roles, activities, pedagogical forms and interventions of the teacher in order to establish interaction with students in the online learning process. According to this, Swan (2003) identified six best practices for teaching presence: establishing clear learning aims and instructions for students; using a wide range of presentations of course content; developing learning methods or exercises that enable students to be active and to be involved; providing students with feedback; being fexible in ways of achieving learning outcomes and providing students support and mentoring as much as possible. The second element of the Col model is Social Presence, which represents the extent to which students feel socially and emotionally connected to others and to the online environment in which they learn. The third element is Cognitive Presence, that includes the following phases: developing students' interest in the subject through the setting of a learning problem, researching and reflecting on problems and finding possible solutions, problem solving and its application (Garrison and Archer, 2003). These phases are organized by the teacher, but they can be also the result of the social interaction among students, because it is feasible in an atmosphere of proactivity, dialogue and reflection (Garrison, Anderson and Archer, 2001).
- According to Jakoet-Salie and Ramalobe (2023), *the Online Collaborative Learning* (OCL model), proposed by Linda Harasim (2017), is a well-known teaching approach in online education. It entails people cooperating, exchanging ideas and perspectives, establishing a shared understanding of specific themes and creating collaborative products (Magen- Nagar and Shonfeld, 2017). This theory emphasizes the Internet as a source of learning through encouraging cooperation and knowledge creation (Demuyakor, 2020). The OCL model is thought to aid in three stages of knowledge acquisition and building:
    1. Idea generating: This is a phase in which brainstorming will happen. Divergent concepts are brought together during this period.
    2. Idea organising: in this phase students compare, analyze and categorize the many concepts that have been created earlier, once again via debate and argument.
    3. Intellectual convergence: Intellectual synthesis and consensus occur during this stage. Assignments are written in the form of essays and collaborative pieces of work and students are encouraged to agree to disagree (Harasim, 2012).

CONCLUSION

Reflection and research on the impact of digital technology on the university is still an open and unexplored field of investigation that would require systematic government policy intervention at a European level, capable of providing guidelines for research and design of training interventions on and through digital technology in various spheres: from teaching to research, up to the third mission.

In this regard, an initial international mapping of what has been analyzed, studied and written by specialists in the field can certainly help to identify one or more theoretical frameworks on the subject, which can be adequately defined through reference dimensions, indicators and descriptors. Starting from such descriptors, it would be possible to circumscribe in a more conscious and targeted way the scholars' study and research interest on the different areas underlying the digitization process, such as the diffusion of digital skills in teachers and students, the degree of technological infrastructural endowment of universities, the type and level of integration of the same in daily professional practices, and the use of digital for the management of administrative practices.

After identifying the theoretical framework best suited to the characteristics of the educational context of the university system, shared at the European level, the second step that could be taken to work on the impact of digital technology at the university would concern the establishment of a research observatory capable of monitoring geographically and over time the digitization process in the various universities, enabling a longitudinal data comparison, but also on a geographical, national or international basis.

The third step, finally, could concern raising the awareness of political institutions on the issue of digital in universities, with a view to a governmental economic investment, on a European and national basis, able to work systematically on the implementation of digital and its culture in universities in terms of training of teaching and administrative staff on digital literacy, design and testing of management systems for teaching and administrative practice in universities, continuous technological updating and assistance, and on innovative teaching methodologies to be applied to universities in the perspective of the implementation of digital education within teaching and learning practices.

To achieve this goal, there is still a long way to go although there are local best practices on the use of digital in specific contexts and for equally specific objectives. Within this framework, the essay takes the form of a further small contribution of critical reflection on the issue of digital at universities, certainly not exhaustive in terms of theoretical reflection on the subject, which may however stimulate one to think about the complexity of the path to be taken in an interdisciplinary key and not to overlook the inevitable involvement of various stakeholders, directly or indirectly involved and interested in the implementation of digital policies and practices for the university.

REFERENCES

Aljanazrah, A., Yerousis, G., Hamed, G. and Khlaif, ZN. (2022). Digital transformation in times of crisis: Challenges, attitudes, opportunities and lessons learned from students' and faculty members' perspectives. Front. Educ. 7:1047035. doi: 10.3389/feduc.2022.1047035

Almerich, G., Orellana, N., Suárez-Rodríguez, J., & Díaz-García, I. (2016). Teachers' information and communication technology competences: A structural approach. Computers & Education, 100, 110–125.

https:// doi. org/ 10. 1016/j. compe du. 2016. 05. 002

Al-Samarraie, H., Teng, B. K., Alzahrani, A. I., & Alalwan, N. (2018). E-learning continuance satisfaction in higher education: A unified perspective from instructors and students. Studies in Higher Education, 43(11), 2003–2019. https://doi.org/10.1080/03075079.2017.1298088

Arsenijević, J. et al. (2022). The quality of online higher education teaching during the Covid-19 pandemic. International Journal of Cognitive Research in Science, Engineering and Education (IJCRSEE), 10(1), 47-55.

Barendsen, E., & Bruggink, M. (2019). Het volle potentieel van de computer leren benutten: Over informatica en computational thinking. https:// repos itory. ubn. ru. nl/ bitst ream/ handle/ 2066/ 213908/ 213908. pdf

Blau, I., & Shamir-Inbal, T. (2017). Digital competences and long-term ICT integration in school

culture: The perspective of elementary school leaders. Education and Information Technologies, 22(3), 769–787. https:// doi. org/ 10. 1007/ s10639- 015- 9456-7

Cabero-Almenara, J., Guillén-Gámez, F. D., Ruiz-Palmero, J., & Palacios-Rodríguez, A. (2021). Digital competence of higher education professor according to DigCompEdu. Statistical research methods with ANOVA between fields of knowledge in different age ranges. Education and Information Technologies, 26, 4691–4708. https://doi.org/10.1007/s10639-021-10476-5

Cabero-Almenara, J., Guti.rrez-Castillo, J.-J., Palacios-Rodr.guez, A., & Barroso-Osuna, J. (2020). Development of the teacher digital competence validation of DigCompEdu check-in questionnaire in the university context of Andalusia (Spain). Sustainability, 12(15), 6094. https:// doi. org/ 10. 3390/ su121 56094

Carretero, S., Vuorikari, R., & Punie, Y. (2017). DigComp 2.1: The Digital Competence Framework for Citizens with eight proficiency levels and examples of use. Publications Office of the European Union.https:// doi. org/ 10. 2760/ 38842

Cortoni i., (2020). Le competenze digitali nella scuola. Un'indagine dell'Osservatorio Mediamonitor Minori della Sapienza di Roma, Carocci, Roma

Cortoni I., Lo Presti V., (2018). Digital Literacy e capitale sociale, FrancoAngeli, Milano

Crittenden, WF., Biel, IK. and Lovely, WA.(2019). Embracing digitalization: student learning and new technologies., Journal of Marketing Education 41(1), 5–14.

Daugherty, J.L., Mentzer, N. J., Lybrook, D.O. & Little-Wiles, J., (2013). Philosophical perspectives on technology leadership. In Technology integration and foundations for effective leadership (pp. 42–56). Hershey, PA: Information Science Reference. dot:10.4018/978-1-4666-2656-0.ch003.

Davis, F. (1989) Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. MIS Quarterly, 13, 319-340.

De Biasi, R., (2007). Gregory Bateson. Antropologia, comunicazione, ecologia. Raffaello Cortina Editore, Milano

De Feo A., Pitzalis M. (a cura di) (2014). Produzione, riproduzione e distinzione. Studiare il mondo sociale con (e dopo) Bourdieu. CUEC, Napoli

De Obesso, M., & Nu~nez-Canal, M. (2021). El modelo educativo h!ıbrido: una respuesta necesaria de la ense~nanza universitaria a partir del COVID. COVID-2019 IMPERATIVO PARA EL CAMBIO. Ed. Tirant Lo Blanch.

Demuyakor, J. (2020). Coronavirus (COVID-19) and online learning in higher institutions of education: a survey of the perceptions of Ghanaian international students in China. Online Journal of Communication and Media Technologies 10(3), e202018.

Díaz-García, V., Montero-Navarro, A., Rodríguez-Sánchez, J-L. and Gallego-Losada, R. (2022). Digitalization and digital transformation in higher education: A bibliometric analysis, Front. Psychol. 13:1081595. doi: 10.3389/fpsyg.2022.1081595

Dysart, S., & Weckerle, C. (2015. Professional development in higher education: A model for meaningful technology integration. Journal of information technology education: Innovations in practice, 14(1), 255-265.

Education and Training Foundation (2019). Taking learning to the next level: Digital Teaching Professional Framework. Full reference guide. The Education & Training Foundation. www.et-foundation.co.uk/supporting/edtech-support/digital-skills-competency-framework/

Englund, C., Olofsson, A. D., & Price, L. (2017. Teaching with technology in higher education: understanding conceptual change and development in practice. Higher Education Research & Development, 36(1), 73-87. doi:10.1080/07294360.2016.1171300

Esteve-Mon, F. M., Llopis-Nebot, M. A., & Adell-Segura, J. (2020). Digital teaching competence of university teachers: A systematic review of the literature. Revista Iberoamericana de Tecnologias del Aprendizaje, 15(4), 399–406. https://doi.org/10.1109/RITA.2020.3033225

Esteve- Mon, F. M., Postigo- Fuentes, A. Y., & Castañeda, L. (2022). A strategic approach of the crucial elements for the implementation of digital tools and processes in higher education. Higher Education Quarterly, 00, 1–16. https://doi.org/10.1111/hequ.12411

European Union (2018). Council Recommendation of 22 May 2018 on key competences for lifelong learning. Official Journal of the European Union, (pp. 1–13). Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018H0604(01)&rid=7.

European union (2006). Recommendation of the European Parliament and of the council of 18 december 2006 on key competences for lifelong learning (cf. https://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:394:0010:0018:en:PDF)

Falloon, G. (2020). From digital literacy to digital competence: The teacher digital competency (TDC) framework. Educational Technology Research and Development, 68, 2449–2472. https://doi.org/10.1007/s11423-020-09767-4

Fishbein, M., & Ajzen, I. (1975). Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research. Reading, MA: Addison-Wesley.

Garrison, D.R., Anderson, T., & Archer, W. (1999). Critical inquiry in a text-based environment: Computer conferencing in higher education. The Internet and Higher Education, 2(2-3), 87-105. http://doi.org/10.1016/S1096-7516(00)00016-6

Garrison, D.R., Anderson, T., & Archer, W. (2001). Critical Thinking, Cognitive presence, and Computer conferencing in Distance Education. American Journal of distance Education, 15(1): 7-13. https://doi.org/10.1080/08923640109527071

Garrison, D.R. & Archer, W. (2003). A community of Inquiry Framework for Online Learning. In M. Moore (Ed.), Handbook of distance education. Erlbaum.

Ghomi, M., & Redecker, C. (2019). Digital competence of educators (DigCompedu): Development and evaluation of a self-assessment instrument for teachers' digital competence. In H. C. Lane, S. Zvacek, & J. Uhomoibhi (Eds.), Proceedings of the 11th International Conference on Computer Supported Education (vol. 1, pp. 541–548). SCITEPRESS. https://www.scitepress.org/PublicationsDetail.aspx?ID=1ClTvMhd8n4=&t=1

Granata (2015). Higher Education Authority (HEA) (2019). Digital transformation and empowering technologies in higher education. Future Focus Forum. Available at: https://hea.ie/assets/uploads/2017/04/190212_FutureFocus_Digital-Transformation_Discussion-Paper.pdf.

Harasim, L. (2017). Learning Theory and Online Technologies. New York: Routledge.

Jakoet-Salie A. andRamalobe K. (2023). The digitalization of learning and teaching practices in higher education institutions during the Covid-19 pandemic. Teaching Public Administration, vol.41 (I) pp.59-71, sage. DOI: 10.1177/01447394221092275

Hero, JL., (2020). Exploring the principal's technology leadership: Its influence on teachers' technological proficiency. International Journal of Academic Pedagogical Research, 4(6), 4–10.

Huda, M., Maseleno, A., Shahrill, M., Jasmi, K. A., Mustari, I., & Basiron, B. (2017). Exploring adaptive teaching competencies in Big Data era. International Journal of Emerging Technologies in Learning, 12, 68–83. https:// doi. org/ 10. 3991/ ijet. v12i03. 6434

Kopcha, T. J., Ding, L., Neumann, K. L., & Choi, I. Teaching technology integration to k-12 educators: A 'Gamified'approach. TechTrends, 60(1), 62-69. (2016).

Kundu, A., & Dey, K. N. (2020). An empirical study on the correlation between teacher efficacy and ICT infrastructure. The International Journal of Information and Learning Technology, 37(4), 213–238.

Kuzminska, O., Mazorchuk, M., Morze, N., Pavlenko, V., Prokhorov, A. (2018). Digital competency of the students and teachers in Ukraine: Measurement, analysis, development prospects. In: Proc. 14th international conference ICTERI. Proceedings, 2104, vol II: Workshops. CEUR workshop. Kyiv Ukraine, May 14–17, 2018, p 366–379.

JISC. (2019). JISC teacher profile (higher education). https:// repos itory. jisc. ac. uk/ 7283/1/ BDCP-HET- Profile- 110319. pdf

INTEF. (2017). Common Digital Competence Framework for Teachers – September 2017. Ministry of Education, Culture and Sport.

ISTE. (2018). ISTE Standards for Education Leaders. Retrieved from https:// www. iste. org/ stand ards/ foreducation- leade rs. Accessed 20 Oct 2021.

Ladeveze, L. N., & N!u~nez-Canal, M. (2018). Papel del profesor motivado en la educaci!on

emprendedora en Espa~na. Revista Empresa y Humanismo, XXI(1), 7–40. https://doi.org/10.

15581/015.XXI.1.7-40

Law, N., Woo, D., De, l. T. J. and Wong, K. 2018. A global framework of reference on digital literacy skills for indicator 4.4.2. Paris, UNESCO. Available at: http://uis.unesco.org/sites/default/files/documents/ip51-global-framework-reference-digital-literacy-skills-2018-en.pdf (Accessed 4 April 2022.)

López-Belmonte, J., Pozo-Sánchez, S., Fuentes-Cabrera, A., & Trujillo-Torres, J. M. (2019). Analytical competences of teachers in big data in the era of digitalized learning. Education Sciences, 9, 177. https:// doi. org/ 10. 3390/ educs ci903 0177

Lyon, J. A., & Magana, J. A. (2020). Computational thinking in higher education: A review of the literature.

Computer Applications. Engineering Education, 28, 1174–1189. https:// doi. org/ 10. 1002/ cae. 22295

Magen-Nagar, N. and Shonfeld, M. (2017). The impact of an online collaborative learning program on students' attitude towards technology. Interactive Learning Environments, 26(1), 1–17.

Maltese, V. (2019). Digital transformation challenges for universities: ensuring information consistency across digital services. Cataloging and Classification Quarterly 56(1), 1–15.

Mandinach, E.B.; Gummer, E.S. (2013). A systemic view of implementing data literacy in educator preparation. Educ. Res., 42, 30–37.

Marcelo, C., & Yot-Dom!ınguez, C. (2019). From chalk to keyboard in higher education classrooms: changes and coherence when integrating technological knowledge into pedagogical content knowledge. Journal of Further and Higher Education, 43(7), 975–988. https://doi.org/10.1080/0309877X.2018.1429584

Menendez, FA, Maz-Machado, A. and Lopez-Esteban, C. (2016). University strategy and digital transformation in higher education institutions. A documentary analysis. International Journal of Advanced Research, 4(10), 2284–2296.

Morgan, A., Sibson, R. & Jackson, D. (2022). Digital demand and digital deficit: conceptualizing digital literacy and gauging proficiency among higher education students, Journal of Higher Education Policy and Management, 44:3, 258-275, DOI: 10.1080/1360080X.2022.2030275

Morselli, D. (2019). The change laboratory for teacher training in entrepreneurship education: A new skills agenda for Europe. 144. Springer Nature. https://doi.org/10.1007/978-3-030-02571-7

Mutisya, S. M. (2020). Integration of information communication technology in teaching: The underpinning factors among Kenya's primary school teachers. Journal of Learning for Development, 7(2), 174–189.

Ng, W. (2012b). Can we teach digital natives digital literacy? Computers & Education, 59(3), 1065–1078. doi:10.1016/j.compedu.2012.04.016

Kravchuk, O., Tsyselska O., Buriak B., Nataliia Miatenko N., Volodymyr Mironov V. (2022). Application of Digital Technologies in University Education: Conceptual and Analytical Approach. IJCSNS International Journal of Computer Science and Network Security, VOL.22 No.1, January 2022. https://doi.org/10.22937/IJCSNS.2022.22.1.62

OECD (2015). Students, Computers and Learning: Making the Connection. PISA: OECD Publishing. Available at: http://dx.doi.org/10.1787/9789264239555-en.

Oliver, B., & Jorre de St Jorre, T. (2018). Graduate attributes for 2020 and beyond: Recommendations for Australian higher education providers. Higher Education Research & Development, 37(4), 821–836. doi:10.1080/07294360.2018.1446415

Oliver, E. (2014).Theological education with the help of technology. HTS: Theological Studies, 70(1),1–7.

OECD. (2005). The definition and selection of key Competencies. Paris.

Paino, M., Renzulli, L. A. (2012). Digital Dimension of cultural Capital: The (In)visible advantages for students who exhibit computer skills. Sociology of Education. 86, pp. 124-138

Pérez-Rivero, C. A., de la Mercedes de Obesso, M. & Núñez-Canal, M. (2022). Digital competence among university professors: analysis of the impact of the COVID crisis. Economic Research-Ekonomska Istraživanja, DOI: 10.1080/1331677X.2022.215585

Peters, M., Elasri-Ejjaberi, A., Martínez-Argüelles, M. J., & Fàbregues, S. (2022). Teacher digital competence development in higher education: Overview of systematic reviews. Australasian Journal of Educational Technology, 38(3), 122-139. https://doi.org/10.14742/ajet.7543

Pitzalis, M. (2016). Innovare a scuola: insegnanti, studenti e tecnologie digitali. Il Mulino, Bologna

PWC (2018). The 2018 Digital University: Staying Relevant in the Digital Age. Available at: http://www.pwc.co.uk/publicsector (Accessed 10 October 2021).

Ragnedda, M. (2018). Conceptualizing digital capital. Telematics and Informatics 35(8). pp. 2366–2375

Rampelt, F., Birnkammerer, H., R¨owert, R., et al. (2018). Opening up higher education in the digital age. On the potential to unite the social dimension and the digitalisation of higher education in Europe. Internationalisation of Higher Education–Developments in the European Higher Education Area and Worldwide (3), 27–42.

Redecker, C., & Punie, Y. (2017). European framework for the digital competence of educators: DigCompEdu (JRC107466). Publications Office of the European Union. http://publications.jrc.ec.europa.eu/repository/handle/JRC107466

Rychen, D. S., & Salganik, L. H. (2003). Key competencies for a successful life and a well-functioning society. OECD definition and selection of competencies final report, https://doi.org/

10.1080/2159676X.2012.712997

Rodríguez, M.L.; Pulido-Montes, C. (2022). Use of Digital Resources in Higher Education during COVID-19: A Literature Review. Educ. Sci., 12, 612. https://doi.org/10.3390/educsci12090612

Rogers, E.M. (2003). Diffusion of innovations. New York: Free Press

Rogers, D. L., (2000). A paradigm shift: Technology integration for higher education in the new millennium. AACE Review (formerly AACE Journal), 1(13), 19-33.

Salganik, L., Rychen, D., Moser, V., & Konstant, J. W. (1999). Projects on competencies in the OECD context: Analysis of theoretical and conceptual foundations. Swiss Federal Statistical Office

Seiler, M. and Fischer, JMF. (2021). Digital learning in schools: What does it take beyond digital technology? Teaching and Teacher Education 103.

Seres, L., Pavlicevic Vand Tumbas, P., (2018). Digital transformation of higher education: competing on analytics. In: Proceedings of INTED2018 conference 5th-7th March, Subotica: Serbia

Stolterman, E. and Fors, AC. (2004). Information technology and the good life. In: Kaplan B, Truex DP,

Wastell, D. et al. (eds) Information Systems Research: Relevant Theory and Informed Practice. London: Kluwer Academic Publishers, 687–692.

Stolze, A., Sailer, K. and Gillig, H. (2018). Entrepreneurial mindset as a driver for digital transformation–a novel educational approach from university-industry interactions. In: International Conference on Innovation and Entrepreneurship. Academic Conferences International Limited.

Subhash, S., & Cudney, E. A. (2018). Gamified learning in higher education: A systematic review of the literature. Computers in human behavior, 87, 192-206.

Swan, K. (2003). Learning effectiveness: what the research tell us. In: J. Bourne & J. C. Moore (Eds.), Elements of Quality Online education: Practice and Direction (pp.13-45). The Sloan consortium

TechCentral.ie (2018) Digital Transformation: A Necessary Disruption. Available at: https://www.techcentral.ie/digital-transformation-necessary-disruption/ (Accessed 10 October 2021).

Tondeur, V. K., Braak, V., & Valcke, M. (2008a). ICT integration in the classroom: Challenging the potential of a school policy. Computers & Education, 51(1), 212–223. https:// doi. org/ 10. 1016/j.compedu. 2007. 05. 003

Tondeur J.,· Sarah Howard, S.,· Manon Van Zanten, M., · Gorissen P.,·Van der Neut, I., · Uerz D., · Marijke Kral, M., (2023). The HeDiCom framework: Higher Education teachers' digital competencies for the future Education Tech Research Dev (2023) 71:33–53 https://doi.org/10.1007/s11423-023-10193-5

UNESCO. (2022). Digital Transformation of Higher Education Teaching and Learning, International Center for Higher Education Innovation under the auspices of UNESCO Institute of Education, Tsinghua University

UNESCO. (2020). COVID-19 response - hybrid learning: hybrid learning as a key element in ensuring continued learning. ED/PLS/2020/04/Rev.2. 64 p. https://unesdoc.unesco.org/search/344e98e4-5ddf-45eb-857c-20b811e2d8d4

UNESCO. (2018). UNESCO ICT competency framework for teachers. United Nations Educational, Scientific and Cultural Organization.

Van Dijck, J., Poell, T., de Waal, M. (2018). The Platform Society: Public Values in a Connective World. Oxford University Press: Oxford (tr. it., Boccia Artieri G., Marinelli A. (a cura di) (2019), Platform Society. Valori pubblici e società connessa. Guerini, Milano)

van Loon, A.-M., Coetsier, N., & Kral, M. (2018). Competentieset leren en lesgeven met ict. iXperium. www.ixperium.nl/onderzoeken-en-ontwikkelen/publicaties/competentieset-leren-en-lesgeven-met-ict/

Venkatesh, V., Thong, J. Y.L.; and Xu, X. (2012). Consumer Acceptance and Use of Information Technology: Extending the Unified Theory of acceptance and Use of Technology. MIS Quarterly, (36: 1) pp.157-178

Zhang, Y., · Adams D.,· Cheah Soon Lee, K. (2022). The relationship between technology leadership and teacher ICT competency in higher education. Education and Information Technologies 27:10285–10307, doi: https://doi.org/10.1007/s10639-022-11037-0

Zhang, Y., Adams, D., Cheah Soon Lee, K., (2022). Assessing academic staff's ICT integration in higher education: instrument development and validation. Journal computer Education, Springer, doi: https://doi.org/10.1007/s40692-022-00248-6

Wing, J. M. (2006). Computational thinking. Communications of the ACM, 49, 33–35. https:// doi. org/ 10.1145/ 11181 78. 11182 15